Marriage, Divorce and Savings: Don't Let An Economist Choose Your Spouse

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ABSTRACT

This paper considers the implications of marital uncertainty on aggregate household savings behavior. To this end, an infinite horizon model with perpetual youth that features uncertainty over marriage quality is developed. Similarly to Cubeddu and Ríos-Rull (1997), I test how much of the savings rate decline from the 1960s to the 1980s can be explained by the changing United States demographic composition, specifically the rise in divorce rates and the fall in marriage rates. It is assumed that these demographic changes are driven primarily by the shrinking gender wage gap and the relaxation of divorce laws.

Contrary to a model with exogenous marital risk, the results suggest that the choice of marriage and divorce has a non-negligible effect on savings behavior, where the changing demographics combined with the shrinking wage gap can account for roughly 45 percent of the higher savings rate in the 1960s.

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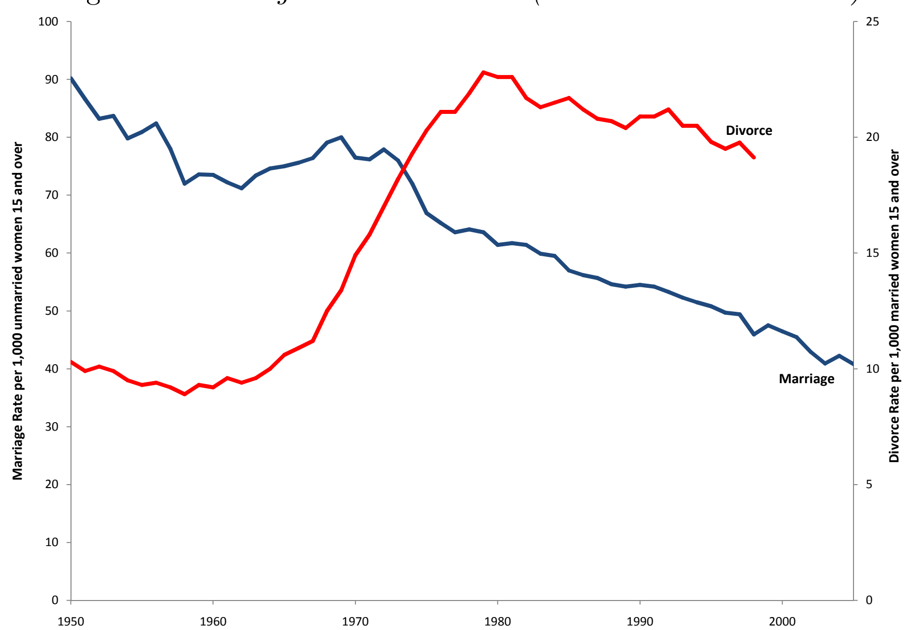
1. Demographics and Savings Pattern: Facts and Theories

"...when it comes to building wealth or avoiding poverty, a stable marriage may be your most important asset." - Waite and Gallagher (pg. 123, 2000)

The national savings rate has dropped drastically from eight percent in mid-century to two percent in 1980 (see Bosworth et al., 1991). Moreover, according to estimates by Cubeddu and Ríos-Rull (1997) from the Consumer Expenditure Surveys (CES) (1960-1961, 1972-1973 and 1984-1990) the household savings rate out of disposable income fell from 8.95 to 4.17 percent between the 1960s and the 1980s. During this same time period the composition of households underwent dramatic changes. While there were fewer married households in the 1980s, there where also considerably more divorces (see figure 1).

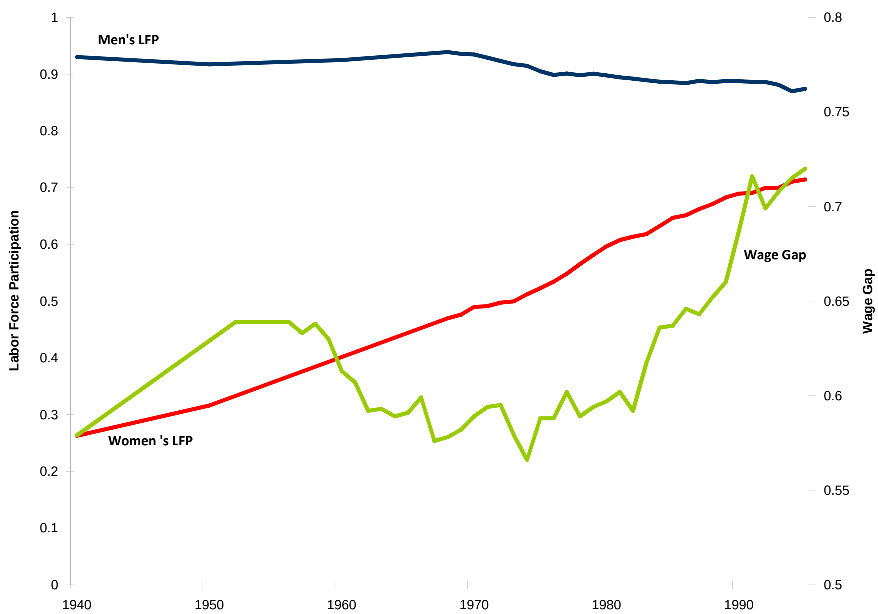
Figure 1: *Marriage & Divorce Rates (National Vital Statistics)*



Specifically, the divorce rate per 1,000 married women doubled from the 1960s to the 1980s, rising from 10 to 20 percent, and the marriage rate experienced a linear continuous downward trend. Part of this sharp rise in divorce rates can be attributed to the relaxation of divorce laws in the

1970s (see Friedberg, 1998; Wolfers, 2006). Most states introduced unilateral divorce during this time period, which allowed spouses to petition for a divorce without the consent of their partner. Moreover, since the mid-1970s the wage gap and employment difference between men and women has started to close (see figure 2), potentially contributing to some of the fall in marriage rates.

Figure 2: *Gender Wage Gap (Census & CPS)*



In this study I present microeconomic evidence supporting significant differences in household savings behavior by martial status and marital "bliss," and develop a partial equilibrium model to determine the impact of the liberalization of divorce laws and rising female wages on the aggregate savings rate.

In analyzing the effects of demographic changes on household savings rates the focus has historically centered on the aging population (see for example Auerbach et al., 1989; Auerbach and Kotlikoff, 1992). Generally, these results show the aging population, *ceteris paribus*, unable to explain the sharp drop in saving rates.[1] However the importance of household formation and dissolution on savings and wealth accumulation has been pointed out by Quadrini and Ríos-Rull (1997).

[1] For a short survey on studies related to savings behavior and wealth inequality see DeNardi (2002).

They suggest that in order to obtain results more closely matching the main features of the U.S. wealth distribution, especially in the lower quintiles, models should incorporate the potential risks associated with marital status. They argue that since changes in marital status are uninsurable and not directly reflected in individuals' earnings data, theses shocks could be important factors when characterizing household wealth in the bottom quintiles, especially for young to middle-aged individuals.

Most closely related to this study is the research conducted by Cubbedu and Ríos-Rull, in their paper "Families as Shocks," a simple model where agents face uninsurable shocks to marital status over the life cycle is developed. The main goal is to point out the importance of including marital status differences in macroeconomic models. This study simulates various exogenous marital shock processes and subsequently determines optimal savings patterns. The authors find that uninsurable martial risk is "just as important" as uninsurable earnings uncertainty in determining savings patterns and the wealth distribution over the life cycle, thus, concluding that neglecting marital status in macroeconomic models can have a significant impact. However, the study neglects the importance of an endogenous marriage process, allowing agents no autonomy in choosing whom to marry, and at what point in time to divorce or marry. Guner and Knowles (2004) are, to my knowledge, the first to develop a model of savings and *endogenous* marriage decisions. The authors develop an overlapping generation model that relates the wealth of older households to their earlier decisions about work, marriage and divorce. Agents make decisions over savings and marriage in a three period set-up. The authors find that wealth differences across marital states are mainly a result of, (1) differences in savings rates, and (2) high income people are more likely to have stable marriages.

While I model marriage and divorce in a similar way, by using the richer marriage match quality evolution from Greenwood and Guner (2004), the focus of this study is the simultaneous effects of the closing wage gap and changes in divorce laws on the aggregate savings rate. Therefore, this paper tests the question first postulated by Cubeddu and Ríos-Rull, who study whether the rise in divorce rates and illegitimacy from the 1960s to late 1980s can explain the drop in aggregate savings rate. While the authors concluded divorce and illegitimacy have only a minor impact on aggregated savings, the study neglects the potential importance of endogenizing the marriage process, and modeling divorce uncertainty with an exogenous shock process.

Why do people save? Most current wealth inequality and savings models use one of the following mechanisms to explain households' savings behavior (listed in no particular order):

- Precautionary savings. Individuals save due to uncertainty over labor earnings and the inability to insure against adverse events (incomplete markets). However, savings due to precautionary reasons found in recent studies are too small to explain U.S. savings patterns. Aiyagari (1994) finds precautionary savings to add around three percent to average savings.
- Retirement funds. Franco Modigliani developed the "life-cycle" model. Individuals save during their peak years of earnings in order to maintain consumption levels during retirement. However, the life-cycle principal in its most simple form does poorly in predicting savings patterns. Kotlikoff and Summers (1981) show that as much as 80 percent of current U.S. wealth is inherited and therefore conclude that the life-cycle component of aggregate U.S. savings is very small.
- Bequests. The dynastic model developed by Becker (1974) and Barro (1974) assumes wealth is accumulated for bequest purposes; i.e. individuals care about the welfare of their offspring and, therefore, save. However, the basic dynastic model does poorly in predicting wealth concentration. Aiyagari (1994) can only produce four percent of total wealth for the top one percent of the population compared to a 28 percent of total wealth in U.S. data.

Contrary to the above three theories, households' savings decisions in this study are driven by marital uncertainty. Marital uncertainty is the uncertainty over marriage match quality and the uncertainty of meeting a potential spouse. Why could it help explain the fall in aggregate savings? The model specified in this study plays on the following interactions of household structure and savings:

1. Married households have, on average, more disposable income than single households, through dual-earners and economies of scales, allowing them to save a greater fraction of their income;

2. Divorce has a negative impact on household finances, as some wealth is lost in the separation process and spouses lose the economies of scale in maintaining their home;

3. Rational households prepare for the probability of a divorce by changing their consumption and savings behavior to minimize the impact of a negative event such as a divorce. However, high earning members of a household that foresee/expect a divorce are less likely to save due to divorce costs and potential asset redistribution, spousal support, etc., while, low earning members or households where both spouses have similar earnings, save more as economies of scales are lost upon divorce; and

4. Single agents might save in order to differentiate themselves from potential competition in the marriage market. A lower marriage rate and higher divorce rate will likely dissipate this effect, as the benefits of a marriage decrease.

Therefore, an economy with a high fraction of married households and low divorce rate, should, in general, have a higher aggregate savings rate. An increase in marital uncertainty and a decrease in the number of married households can greatly affect the aggregate savings rate.

The model developed in this paper builds on the framework of Aiyagari (1994), Guner and Knowles (2004), and Cubeddu and Ríos-Rull (1997). While this study expands directly on the work done by Guner and Knowles, it contrasts Cubeddu and Ríos-Rull by internalizing marriage decisions. I will depart from previous studies that include marriage decisions by following Aiyagari's infinite horizon model.[2] The infinite horizon model is preferable as it simplifies the calibration by decreasing the number of parameters to be specified and matched over the life-cycle, therefore, reducing the computational burden. In order to focus solely on the effects of marriage and divorce on savings, I abstract from productivity shocks following Cubeddu and Ríos-Rull. However, instead of studying a finite horizon model with evolving wage profiles over the life-cycle, households will not be saving for life-cycle purposes in this paper, i.e., agents will *only* save due to marital uncertainty.

It should be stressed that this paper only focuses on the effects of households' marriage and divorce decisions on savings patterns. This is certainly a restrictive set-up given the results of other

[2]An exception in this stream of literature is the study by Regalia and Ríos-Rull (1999) that uses an infinite horizon model to study the increase in single households from the seventies to the nineties, as well as Greenwood and Guner (2004) who study the effect of falling household goods' prices on female labor supply, marriage and divorce.

research in the area of wealth inequality and savings. In general, we expect earnings uncertainty, entrepreneurship, bequest motives, social security, fertility, etc. to have an important impact on savings and wealth inequality. However, the focus in this study is to isolate the effects of changing divorce laws and the shrinking wage gap on savings behavior. I quantify how much aggregate savings is generated in a standard model such as Aiyagari's infinite horizon model of precautionary savings with endogenous martial uncertainty. The computational results indicate marriage and divorce risks to be an important factor in predicting aggregate savings. More specifically, endogenizing marriage and divorce can account for roughly 45 percent of the higher savings rate in the 1960s compared to the 1980s.

The remainder of this paper is organized as follows: section 2 provides U.S. facts on aggregate savings and marital distress on household savings behavior relevant to this study; section 3 develops a model where agents differ in gender, wages, marriage match quality and divorce laws change in the 1970s; section 4 provides details on the calibration; section 5 compares the resulting savings rates in the 1960s and 1980s, and section 6 concludes.

2. U.S. Savings Facts

Estimates for aggregate household savings rate vary across studies. However, a drastic fall in savings is undisputed. I use the Survey of Consumer Finances (SCF), as it is the only study with considerable household wealth information, to compute specific savings rates by the three demographic groups, married households, single men and single women. The SCF obtains detailed household wealth holdings data, unlike the CES, which collects household consumption expenditure and income over a year. Therefore, I estimate savings using the first difference of net worth across two years, rather than, estimating savings as the difference between income and consumption as in Cubeddu and Ríos-Rull (1997). The SCF reinterviewed household in 1963 from its 1962 survey, and again in 1986 from its 1983 survey allowing me to compare wealth differences between two consecutive survey years.[3] Bosworth et al. (1991) estimate aggregate savings using both these surveys and find comparable estimates with aggregate savings rate falling by 4.3 percent in the 1972/1973 to 1882/1985 CES surveys and 4.5 percent in the 1962/1963 to 1983/1986 SCF surveys. Since the model abstracts from many income sources in computing savings estimates I delete from the sample, (1) households headed by a person under the age of 25 or over the age of 64 in 1962 and 1983 to capture only the working population, (2) households with savings or borrowings greater than reported income plus capital gains and gifts, and (3) all households with wealth from own businesses exceeding ten percent of total wealth in the base year. These restrictions leave a sample of 1,077 and 1,459 households in the 1960s and 1980s, respectively. Savings are defined as the difference in net worth less own-home value appreciation between the two survey years.[4] In computing aggregate savings rate I use the standard specification of Bosworth et al. (1991), where the aggregate savings rate at time t is determined by the sum of all groups' weighted saving rates (here married households, single males, and single females),

$$S_t = \sum_j \alpha_{j,t} \frac{y_{j,t}}{Y_t} s_{j,t},$$

where $\alpha_{j,t}$ is the proportion of group j at time t and $\sum_j \alpha_{j,t} = 1$, $\frac{y_{j,t}}{Y_t}$ is the ratio of average income of group j to total average income Y_t at time t, and $s_{j,t}$ is the group's average savings rate. Aggregate savings fall from 17.18 percent in the 1960s to 9.37 percent in the 1980s. This drop in savings corresponds to a 47 percent drop from the 1960s to the 1980s, a number somewhat lower than the CES estimate by Cubeddu and Ríos-Rull (1997) of 53 percent. However, the estimate is in line with estimates by Bosworth et al. given my restricted sample. The authors obtain a slightly lower 1960s estimate of 14 percent mainly due to the omission of people above the age of 65 in this study. Table 1 summarizes the specific components of the aggregate savings formula for the three groups in the 1960s and 1980s.

[3]Note that in the 1960s the surveys were called the 1962 Survey of Financial Characteristics of Consumers and the 1963 Survey of Changes in Family Finances, but in this study will be simply referred to as SCF.

[4]Since net worth estimates in 1983 and 1986 are provided I use these measures and follow Projector (1968) in computing net worth and savings for the 1962/1963 survey.

Table 1: Contributions to Changing Aggregate Savings from the SCF

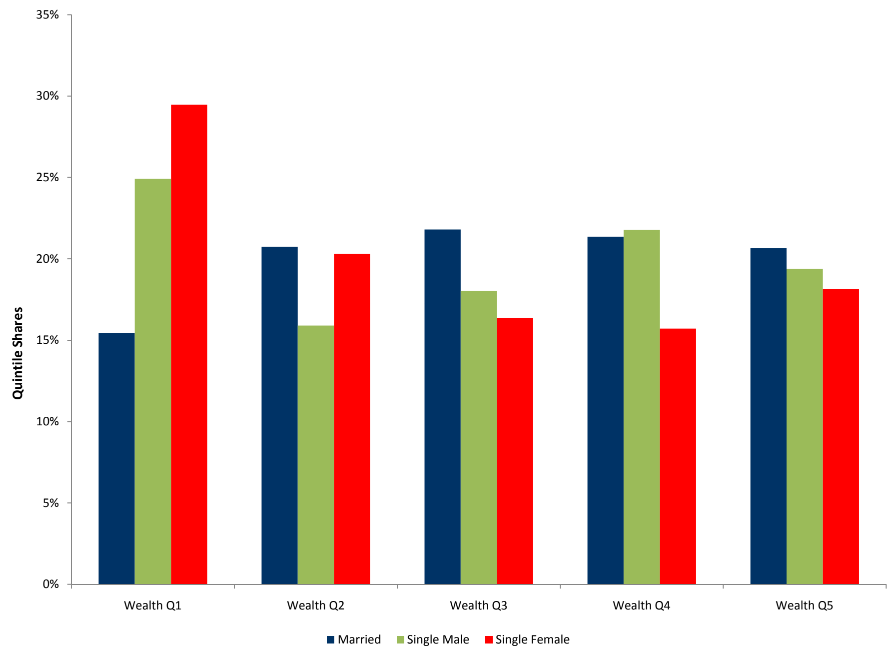
	Married		Single Men		Single Women	
	1960s	1980s	1960s	1980s	1960s	1980s
Fraction of Population α_j	77.68	64.58	7.05	12.69	15.27	22.74
Relative income share $\frac{y_{j,t}}{Y_t}$	1.12	1.15	0.71	0.86	0.52	0.65
Savings rate $s_{j,t}$	17.81	10.39	13.60	5.92	12.44	6.78

It is evident that most of the drop in savings is driven by a fall in the savings rate of each specific group, while the composition of the population, i.e., the fall in the fraction of married households, plays a smaller role. Aggregate savings in 1980 would have been one percentage point higher if the population structure of the 1960s prevailed until the 1980s, that is, the α_j stayed at the 1960s value. However, the drop in savings could be partially driven by the fear of greater divorce rates and the lower incentive for single agents to attract a possible spouse. Microeconomic studies provide some estimates on the effects of marital instability on savings. For example, Brenner et al. (1992) estimate that the introduction of unilateral-divorce laws throughout the United States would have lowered the savings rate by 1.3 percent after three years (their model has a two year lag structure) - according to the authors, a sizable fall in aggregate savings. Combined with a sharp rise in female labor force participation, the authors conclude that unilateral-divorce laws shifted the importance of financial and physical asset savings toward labor force participation and education as investments. Similarly, Finke and Pierce (2006), using the 1994 and 1999 Panel Study of Income Dynamics (PSID), study whether households that divorce within a five year time span save more or less in anticipation of their impending divorce. The authors investigate whether the standard precautionary savings theory, that is households save more when future income is increasingly uncertain, applies to the marital uncertainty for all types of wage earner. It seems to only apply for spouses with similar earnings, that is a "divorcing" household where each spouse contributes about 40 to 60 percent of total earnings, does save significant more than a non-divorcing household with 40-60 earners. However, divorcing households with one high wage spouse have significant lower wealth than non-divorcing households of the same type. More specifically, spouses that contributed 21 to 40 percent held $\$62,000$ compared to $\$99,000$ for non-divorcing households in wealth. Spouses that contributed 40 to 60 percent held almost $41,000 more in assets than non-divorcing households. The variance in 61 to 90 percent contributers was large and wealth holding comparisons inconclusive. Lastly, the highest contributers, that is 90 percent and above, held on average $28,000 less in wealth than comparable married households. Therefore, in households with unequal earnings contributions precautionary savings motives are replaced by the possible asset and income redistribution, e.g. through spousal and child support, upon divorce.

Given the changes in savings behavior over time by households, a driving force that could have affected the population structure, as well as the savings behavior, of the three groups must have existed. What caused this sharp rise in divorce rates and the steady fall in marriages is heavily debated. While some argue that the liberalization of divorce laws, with the introduction of no-fault unilateral divorce starting in the late 1960s, had a considerable impact on divorce rates. For example, Friedberg (1998) argues that divorce rates would have been six percent lower without unilateral divorce laws and the introduction of the law can account for 17 percent of the overall increase from 1968 to 1988. Others argue that the effect was less important, but nonetheless still significant. Wolfers (2006) finds a small and transitory rise in divorce for states that passed unilateral divorce laws, which fades within a decade. Moreover, the proportion of married households falls only by one to two percent within a decade in states that introduced unilateral divorce, and is only slightly higher in later years. Since changes in divorce laws seem to explain only part of the rising divorce and falling marriage rates, I postulate that the significant increase in female wages and labor force participation also contributed to the changing marital environment. In support of this theory Greenwood and Guner (2004) have argued that the rise in female employment is a substantial driving force in the falling marriage and increased divorce rates. Why female employment rose is another debate. Possible explanations are: (1) falling cost of household appliances (see Greenwood and Guner, 2004, and references therein); (2) the falling gender wage gap (see Jones et al., 2003); and (3) the rising returns to experience for women (see Olivetti, 2006). Since, it is impractical to add all these effects into a model, the closing wage gap (see figure 2) and the introduction of no-fault unilateral divorce laws in the 1970s are taken as the main driving forces in lowering marriage and increasing divorce rates. I choose these two since their effects on the rise in divorce rates are both sizable and well established. In summary, unilateral divorce and increased wages shifted bargaining power within a marriage by improving a spouses outside options. These two events and trends will lead to a fall in the proportion of married households and a rise in divorces.

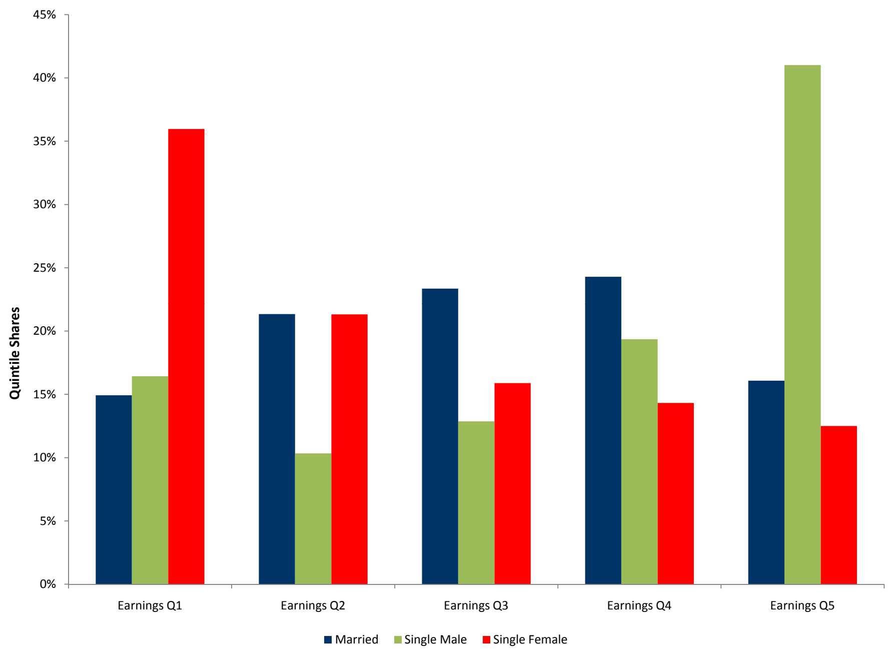
Díaz-Gimnez et al. (1997) and Budria Rodriguez et al. (2002) report the main facts on earnings, income and wealth inequality in the U.S. economy. For this purpose the authors use data from the 1992 and 1998 Survey of Consumer Finances (SCF), respectively. Both papers conclude that households of different marital status have very different earnings, income, and wealth profiles. Figures 3 and 4 picture the distribution of each demographic group by earnings and wealth quintiles.

Figure 3: *Distribution of Households by Wealth Quintiles*



Married households are evenly distributed between the quintiles, in both earnings and wealth, with a slightly greater concentration in the middle compared with the tails. In contrast, single women have a high concentration in the lowest wealth quintile and are more evenly distributed over the remaining quintiles, while their earnings distribution is highly skewed toward lower quintiles.

Figure 4: *Distribution of Households by Earnings Quintiles*



Similarly, there is a higher proportion of men in the lowest wealth quintile, but on average men do better than women, and men's earnings distribution is the reverse of women's, that is skewed toward the higher earnings quintiles. Moreover, Díaz-Gimnez et al. (1997) and Budria Rodriguez et al. (2002) find that married households have substantially higher earnings and income, while owning substantially more per capita wealth than single households.[5] Guner and Knowles (2004), when analyzing the Health and Retirement Survey (HRS), find that single men are wealthiest, while single women are poorest with $190,055 versus $65,425 average wealth. In addition, married couples hold on average $134,673 per capita wealth, while divorced agents hold $129,239 and $84,005 for men and women, respectively. It is evident that married households, even when accounting for the double income source, tend to be better off than single households. Moreover, Lupton and Smith (1999) find that divorced households have about 25 to 30 percent of the median net wealth of married households, which may be due to self-selection, i.e., households that divorce are poorer households.

[5]Results hold when adjusting for adult members in the household.

3. A Model of Marriage, Divorce and Savings

The model of precautionary savings by Aiyagari (1994) is modified to include precautionary savings due to marital uncertainty rather than labor uncertainty. Agents differ by gender, wealth holdings, ability, and marital status, which is determined endogenously through marriage and divorce decisions.[6] Moreover, the model is adjusted to include a perpetual youth feature to guarantee a steady fraction of single agents.

3.1. The Environment

Let the economy be populated by a large number of agents who differ by:

- Gender: $g \in \{f, m\}$, females and males, respectively;
- Marital status: $ms \in ms = \{s, p\}$, where s stands for single and p for married (partnered), respectively;
- Inherited (initial) wealth, which is randomly distributed; and
- By ability ϵ, which determines an agent's efficiency wage.

Agents derive utility from marriage, γ, and consumption, $c > 0$. Agents also face a probability of death, $0 < \delta < 1$, each period, and might, therefore, widow or leave accidental bequests. Lastly, agents cannot borrow. This is not important for the qualitative results of this paper, however, it eases the computational burden.[7]

3.2. Household Preferences

Spouses are restricted to consume the same amount, but only care about own consumption. Following Cubbedu and Ríos-Rull (1997) we take into account household size in consumption

[6] Results for a model with exogenous marriage uncertainty are also presented. In this scenario the marriage decision is substituted by a two-state Markov process with probability $\xi_{ij} = p(ms' = ms_j | ms = ms_i)$, where $i, j = s, p$ stands for single and "partnered" (married), respectively. Also, note that for simplicity, and without loss of generality, direct utility from the marriage is omitted in this case. The omission would only have an impact in welfare calculations, which are not computed in this paper.

[7] In quantitative terms, allowing for borrowing may lower equilibrium aggregate savings rates.

calculations such that \$1 of expenditure buys $\$\frac{1}{\eta_{ms}}$ of consumption for each agent. For single households $\eta_s = 1$, while in married households $2 > \eta_p > 1$. This feature captures the economies of scale, due to public goods consumption within the household unit. This implies that

$$u_{ms}(c) = u\left(\frac{c}{\eta_{ms}}\right) \quad \forall ms.$$

Married agents derive an additional utility from marriage, defined by match quality γ, which implies a one period utility for each spouse of:

$$u_p(c) + \gamma,$$

where γ is the utility/disutility from being married. Single agents draw a common γ upon meeting. Following Guner and Greenwood (2004) γ is normally distributed and herein denoted by $S(\gamma)$:

$$\gamma \sim \mathcal{N}(\mu_s, \sigma_s^2).$$

For married couples γ evolves according to the autoregressive process:

$$\gamma' = (1-\rho)\mu_m + \rho\gamma + \sigma_m\sqrt{1-\rho^2}\xi, \quad \xi \sim \mathcal{N}(0,1),$$

where γ' is the next period's utility, given the present marriage utility is γ. This implies that $\gamma'|\gamma$ is normally distributed, with the distribution denoted by $P(\gamma'|\gamma)$:

$$\gamma'|\gamma \sim \mathcal{N}((1-\rho)\mu_m + \rho\gamma, \sigma_m^2(1-\rho^2)).$$

3.3. Endowment and Factor Prices

This study only analyzes a partial equilibrium model, where wages and interest rates are set exogenously. As mentioned previously, agents supply labor inelastically and only differ by their innate ability. The wage, $w_{g,t}$, and set of ability, ϵ_g, which differs for men and women, are determined from the data (Current Population Survey 1962-1999, see the following section for further details on the calibration). Consequently, an agent receives each period earnings of $\epsilon_g w_{g,t}$. The gender wage gap is captured by the fact that $w_{m,t} > w_{f,t}$.

3.4. Timing

The timing of events through one year is as follows:

1. Agents begin the period as either married or single (includes divorcees) with asset level $a \in A$;
2. The marriage market opens:
   (a) If an agent is single, he/she goes to the marriage market. A meeting is guaranteed, they observe each others characteristics, i.e., asset holdings and the common match quality, γ. With this information as public knowledge agents decide on whether to accept the marriage. Marriage only ensues if both parties agree to the match.
   (b) If an agent is married, he/she decides on wether to remain married or divorce. In order to maintain the marriage both spouses must agree.[8] However, prior to the 1970s in accordance with more restrictive divorce laws, agents have to agree on divorcing. If agents divorce they remain single for the current period. In the event of a divorce assets are split, with some assets being destroyed due to seperation costs (defined in detail in the maximization problem).
3. Savings and consumption decisions: once all marriage and divorce decisions have taken place agents decide on savings and consumption.
4. Agents are born and die, and the marriage quality of married couples updates.
5. The period concludes.

From the above set-up it is evident that agents will differ in their marital status, earnings, asset holdings and gender. The next paragraphs outline the choices of each agent type.

[8] Utility is not transferable and, therefore, remaining married cannot be negotiated.

3.5. Marriage and Divorce Decision

All agents must decide whether to marry or divorce and how much to save. Let $V_{s,g}(a,\epsilon)$, be the value function of a single agent of gender g, who holds a amount of wealth and has innate ability ϵ. Similarly, let $V_{p,g}(\hat{a},\epsilon,\epsilon_{g*},\gamma)$ be the value function for a married agent of gender g, who is married to a spouse (subscript $g*$), with marriage match quality γ and assets $\hat{a}$. The marriage and divorce decisions are then as follows:

- A single agents would only like to marry the agent he/she meets for the set of match qualities:

$$\mathscr{G}_{s,g} = \{\gamma : V_{p,g}(\hat{a},\epsilon,\epsilon_{g*},\gamma) \geq V_{s,g}(a,\epsilon)\}$$

- A married agent would only like to remain married for the set of match qualities:

$$\mathscr{G}_{p,g} = \{\gamma : V_{p,g}(\hat{a},\epsilon,\epsilon_{g*},\gamma) \geq V_{s,g}(\alpha_g a,\epsilon)\},$$

  where α_g is the proportion of assets distributed to the spouse of sex g upon divorce.

Note that there is no guarantee that the agent will get/remain married if a match quality from the given sets is drawn, as the decision also depends on the spouse. However, to model the change in divorce laws to a no-fault unilateral divorce law, agents prior to the 1970s have to agree on divorcing, but after the late 1960s/early 1970s, each spouse can unilaterally decide on a divorce, therefore, increasing divorce risk after the 1970s.

3.6. Single Agent Problem

The single agent's problem is complicated by the fact that the agent has to be aware of the distribution of single agents in the economy. The fraction of single agents (normalized to one) of opposite sex with assets a_{g*} and ability ϵ_{g*} or state variable $x_{g*} = \{a_{g*},\epsilon_{g*}\}$ is denoted by $s_{g*}(a,\epsilon)$.

The single agent then maximizes the following dynamic programming problem:

$$\begin{aligned}
\max_{a'} \quad & u_s(c) + \beta\delta\Big\{ \sum_{x_{g*}} s_{g*}(a,\epsilon)\big[\int_{-\infty}^{\max(\overline{\gamma},\overline{\gamma}_{g*})} V_{s,g}(a',\epsilon)dS(\gamma') + \cdots \\
& \int_{\max(\overline{\gamma},\overline{\gamma}_{g*})}^{\infty} V_{p,g}(\hat{a}',\epsilon,\epsilon_{g*},\gamma')dS(\gamma')\big] \Big\} \\
& \text{s.t.} \\
& c = (1+r)a + w_g\epsilon - a',
\end{aligned} \tag{1}$$

where "primes" represent next period variables. Married assets are $\hat{a}' = a' + a'_{g*}$, as asset holdings of married couples after marriage are combined. The cut-off values for marriage, $\overline{\gamma}$ and $\overline{\gamma}_{g*}$, are determined by a γ that makes the inequality in the set $\mathscr{G}_{s,g}$ hold with equality. As both agents must agree on the marriage, the higher cut-off value ultimately determines the marriage choice.

3.7. Married Agent Problem

The married household must choose asset holdings for the next period in unison. This problem can be solved in various ways. The literature has traditionally focused on solving a weighted maximization problem, which leads to the Pareto optimal solution. A married agent solves the following problem:

$$\begin{aligned}
\max_{a'} \quad & u_p(c) + \beta(1-\delta)^2\Big\{ \int_{-\infty}^{\max(\overline{\gamma}_m,\overline{\gamma}_f)} \nu_m V_{s,m}(\alpha_m a',\epsilon) + \nu_f V_{s,f}(\alpha_f a',\epsilon)dP(\gamma'|\gamma) + \cdots \\
& \int_{\max(\overline{\gamma}_m,\overline{\gamma}_f)}^{\infty} \nu_m V_{p,m}(a',\epsilon_f,\epsilon_m,\gamma') + \nu_f V_{p,f}(a',\epsilon_f,\epsilon_m,\gamma')dP(\gamma'|\gamma) \Big\} + \cdots \\
& \beta(1-\delta)\delta\big\{\nu_m V_{s,m}(a',\epsilon) + \nu_f V_{s,f}(a',\epsilon)\big\} \\
& \text{s.t.} \\
& c = (1+r)a + w_g\epsilon + w_{g*}\epsilon_{g*} - a',
\end{aligned} \tag{2}$$

where ν_g is the weight on each spouse and $\nu_g + \nu_{g*} = 1$. If a couple divorces, agents, by assumption, remain single for the remainder of the period, while assets are split according to the proportions α_g (determined exogenously). Due to divorce costs $\alpha_g + \alpha_{g*} \leq 1$ is possible. The last term multiplied by $\beta(1-\delta)\delta$ belongs to the case of one spouse passing away and the other becoming single. Note that, $u_p(c)$ and γ are, by assumption, the same for both spouses. The above specification allows agents to decide on divorce unilaterally. In order to model the economy prior to the introduction of no-fault unilateral divorce laws, $\max(\overline{\gamma}_m, \overline{\gamma}_f)$ must be substituted with $\min(\overline{\gamma}_m, \overline{\gamma}_f)$. Once optimal asset holdings $\tilde{a}'$ are determined the value of being married is derived:

$$\begin{aligned} V_{p,g}(\hat{a}, \epsilon, \epsilon_{g*}, \gamma) \quad = \quad & u_p(c) + \gamma + \beta(1-\delta)^2 \bigg\{ \int_{-\infty}^{\max(\overline{\gamma}, \overline{\gamma}_{g*})} V_{s,g}(\alpha_g \tilde{a}, \epsilon) dP(\gamma'|\gamma) + \cdots \\ & \int_{\max(\overline{\gamma}, \overline{\gamma}_{g*})}^{\infty} V_{p,g}(\tilde{a}', \epsilon, \epsilon_{g*}, \gamma') \bigg\} + \beta(1-\delta)\delta V_{s,g}(\tilde{a}, \epsilon). \end{aligned} \tag{3}$$

Alternatively, agents could play a Nash bargaining game, where agents' threat points are the value of being single tomorrow $V_{s,g}(\alpha_g a', \epsilon)$. This feature could be very important, especially in marriages where one spouse stays at home and the other earns all labor income. However, this is computationally more costly and will be left for future research.

3.8. Partial Equilibrium

As this study only analyzes the partial equilibrium, the only equilibrium piece to analyze is the matching process of agents each period. However agents decisions are influenced by the aggregate state of the economy. More specifically, the distribution of single agents over wealth levels influences an agents decision over marriage, divorce and savings, as seen in the maximization problem of the single agent above. All these factors must be accounted for when analyzing the transition of the population from one period to the next. Let the population be represented by the following three distributions, $\{p(a, \epsilon_m, \epsilon_f, \gamma), s_f(a, \epsilon), s_m(a, \epsilon)\}$ of married and single agents, respectively. Note that

$$\sum_{a,\epsilon,\epsilon_{g*},\gamma} p(a, \epsilon, \epsilon_{g*}, \gamma) + \sum_{g=m,f} \sum_{a,\epsilon} s_g(a, \epsilon) = 1,$$

must hold at all times.

The distributions of married and single agents of gender g are updated in three consecutive steps. Agents first decide to marry and divorce, where previously married couples now have an "updated" γ; then agents chose savings for the next period; and lastly, some die with "new-born" individuals inheriting the accidental bequests of the deceased.

Suppose the distribution of married agents over marriage quality at the beginning of the period was $\mathscr{P}_{-1}(a, \epsilon, \epsilon_{g*}, \gamma_{-1})$ for each asset level and ability combination. This period's distribution after the marriage decision is then

$$\begin{aligned}\mathscr{P}(a, \epsilon_g, \epsilon_{g*}, \gamma) &= \int_{\infty}^{\gamma} \int_{\max\{\overline{\gamma}, \overline{\gamma}_{g*}\}}^{\infty} dP(\hat{\gamma}|\gamma_{-1}) d\mathscr{P}_{-1}(a, \epsilon_g, \epsilon_{g*}, \gamma_{-1}) + \cdots \\ & \quad 2s_{g,-1}(a, \epsilon) s_{g*,-1}(a, \epsilon) \int_{\max\{\overline{\gamma}, \overline{\gamma}_{g*}\}}^{\gamma} dS(\hat{\gamma}),\end{aligned}$$

where the first term summarizes households with asset holdings a that remain married and the second single agents that marry and remain with asset holdings $a = a_g + a_{g*}$.

The distribution of single agents is made up of the unmarried/unmatched portion of singles, plus all divorcees:

$$\begin{aligned}s_g(a, \epsilon) &= \sum_{a_{g*}, \epsilon_{g*}} \frac{s_{g,-1}(a, \epsilon) s_{g*,-1}(a, \epsilon)}{\sum_{a_{g*}, \epsilon_{g*}} s_{g*,-1}(a, \epsilon)} \int_{-\infty}^{\max\{\overline{\gamma}, \overline{\gamma}_{g*}\}} dS(\hat{\gamma}) + \cdots \\ & \quad p(a_p, \epsilon_g, \epsilon, \gamma_{-1}) \int_{-\infty}^{\max\{\overline{\gamma}, \overline{\gamma}_{g*}\}} dP(\hat{\gamma}|\gamma_{-1}),\end{aligned}$$

where the first terms is of "failed" encounters and the second terms are agents that divorce, where $a_g = \alpha_g a_p$. Updating the savings distribution with the policy function is straight forward. Married agents follow:

$$p(a'(a, \epsilon, \epsilon_{g*}, \gamma), \epsilon, \epsilon_{g*}, \gamma) = p(a, \epsilon, \epsilon_{g*}, \gamma),$$

and single agents follow:

$$s_g(a'(a, \epsilon), \epsilon) = s_g(a, \epsilon).$$

Lastly, couples survive with probability $(1 - \delta)^2$. The fraction $2(1 - \delta)\delta$ becomes widowed and to maintain a steady population the difference is "new-born" with the asset levels of the deceased.

4. Marriage Parameter Calibration

The single agents problem is complicated by the fact that the agent has to be aware of the distribution of single agents in the economy. In order to simplify this problem, I make the reasonable assumption that agents only know the asset level of each quintile of single agents of opposite sex, rather then knowing the full distribution of agents of opposite sex.

The model described above has a great number of parameters. In order to ease the computational burden, most parameters are taken from other related studies (see table 3 for specific parameter values). However, the parameters that determine marriage matches, the initial distribution and the evolution of marriage match quality are chosen by matching the marriage and divorce rates in the United States.[9] More specifically, I match the late 1980s (1984-1990) marriage rate of 58.10 percent per 1,000 married women and the divorce rate of 21.45 percent per 1,000 married women. The marriage (75.10 percent) and divorce (10.64 percent) rates for the 1960s are only calibrated in one scenario (see section 5).

When analyzing aggregate savings rates, all agents earn the normalized mean wage as computed from the data. Wages are normalized by the male mean wage of the distribution of each year. Table 2 lists all parameter values used in the simulations. Following Aiyagari and Guner and Greenwood (2004), the annual discount factor is set to 0.96. Furthermore, the utility function is CRRA of the form:

$$u(c) = \frac{c^{1-\sigma} - 1}{1 - \sigma}.$$

The relative risk aversion parameter σ is set to 1.5, most commonly used in the literature (see Auerbach and Kotlikoff(1987), Prescott(1986), Huggett(1996) and Cubeddu and Ríos-Rull(1997)). The economies of scale parameter η_p is taken from the Organization for Economic Co-operation and Development (OECD) household equivalence scale. The OECD assigns a value of 1 to the first household member, 0.7 to each additional adult and 0.5 to each child, implying $\eta_p = 1.7$ for this

[9]In the exogenous marriage model I use these rates to compute the Markov process for the exogenous marriage model. The resulting Markov transitions are

$$\begin{pmatrix} (s,s') & (s,p') \\ (p,s') & (p,p') \end{pmatrix} \equiv \begin{pmatrix} 0.9249 & 0.0751 \\ 0.01064 & 0.98936 \end{pmatrix}, \begin{pmatrix} 0.94184 & 0.05816 \\ 0.02145 & 0.97855 \end{pmatrix}$$

for the 1960s and late 1980s respectively.

study.[10] Assets are split as in Cubeddu and Ríos-Rull(1997), 40 percent of a couples' assets are destroyed in the event of a divorce and the remainder is split by $\alpha_f = 0.4$ and $\alpha_m = 0.2$. According to the authors, this unequal asset split accounts for child/ spousal support. Lastly, females and males have equal weights in the household decision problem, $\nu_f = \nu_m = \frac{1}{2}$.

Table 2: Selected Parameter Values

General Household	Discount factor (β)	0.96
Parameters	Relative risk aversion (σ)	1.5
	Household equivalence (η_p)	1.7
	Asset split for women (α_f)	0.4
	Asset split for men (α_m)	0.2
	Household weight ($\nu_f = \nu_m$)	0.5
Vital Statistics	Death probability (δ)	0.008
	Match quality single ($\mu_s; \sigma_s^2$)	-5.65; 7
	Match quality married ($\mu_p; \sigma_p^2$)	0.462; 0.75
	AR(1) coefficient (ρ)	0.9
Factor Prices	Interest rate (r)	0.04
	Male wage 1960s and 1980s($\overline{w}_{m,t}$)	1; 1
	Female wage 1960s and 1980s($\overline{w}_{f,t}$)	0.58; 0.77

5. Model Generated Aggregate Savings

As agents only face marriage uncertainties, all savings incentives are driven by the prospect of a better marriage and the prospect of divorce. Table 3 summarizes aggregate savings of the 1960s for various scenarios. The late 1980s serve as a base year, where the aggregate savings rate is normalized to one. As a reference the actual savings rate, as computed in section 2 is 90 percent higher in the 1960s.

All simulations use the parameters calibrated to the 1980s, unless otherwise specified. The cases differ as follows:

[10] The study abstracts from the issue of fertility, children and dependents.

1. Wages are adjusted to reflect the higher wage gap in the 1960s;
2. The introduction of the new divorce law is modeled;
3. Both points (1) and (2) are combined; and
4. Both points (1) and (2) are combined, but, in additon, the initial draw of the marriage quality is raised to match marriage rates in the 1960s.

The first three scenarios show a poor match for the marriage/divorce rate of the 1960s (75.10 per married women and 10.64 per unmarried women). Therefore, the fourth case calibrates the mean of the initial marriage draw (μ_s) to the 1960s marriage and divorce rate. The initial marriage draw is raised due to the fact that men receive a lower utility from marrying low wage women. As women have relative lower wages in the 1960s men are less likely to marry in the current model specification. Consequently, increasing the mean of the initial draw will result in a greater number of successful meetings.

Table 3: Results

	Savings	Marriage Rate	Divorce Rate
(1):	1.19	54.91	23.44
(2):	1.12	84.23	19.51
(3):	1.13	50.75	11.91
(4):	1.41	75.87	10.65

Table 3 highlights the importance of marriage and divorce on aggregate savings. Case (1) and (2) do poorly in matching marriage and divorce rates. As men gain less from being married to a low wage women, divorce slightly rises in (1), with the marriage rate being virtually unaffected. The rise in aggregate savings is primarily due to the increased savings of single females (on average 28 percent), and, to a lesser extent, by married households (14 percent). In contrast, the introduction of tighter divorce laws (2), leads to an increase in the marriage rate, with divorce rates remaining almost at the 1980s level. Agents feel a lower threat of divorce and are willing to marry with a lower match quality. The aggregate savings rate rises primarily due to married couples' behavior.

While married couples save on average 27 percent more with the lower divorce risk, singles save roughly 15 percent more.

Combining points (1) and (2) virtually matches the divorce rate in the 1960s, however it underestimates the actual marriage rate. As explained above, this is due to the simplified version of the model. In this case, as women earn lower wages, men obtain a lower utility from marriage, ergo men are less likely to marry in the 1960s, *ceteris paribus.* Increased savings are mainly driven by single women due to their lower wages, as well as the incentive structure of the marriage market that rewards savings with "attracting" a potential husband. While women save on average 30 percent, married households save 13 percent and single male households save five percent more than in the 1980s.

Scenario (4) adjusts for the decreased utility from marriage in the 1960s, by postulating that the initial mean marriage draw was higher in the 1960s. This implies that marriage has a benefit beyond combined wage income and economies of scale. We can think of this benefit being some sort of increased home production. The mean match quality is raised from $\mu_s = -5.65$ to $\mu_s = -4.05$. This calibrated version matches the actual fall in the aggregate savings rate remarkably well. Married couples and single females in the model save about 60 percent more in the 1960s than in the 1980s. These number come close to the observed changes between the 1960s and 1980s in the United States, where married households' save about 83 percent more and single women's save about 71 percent more in the 1960s (see table 2). While single male households in the model save roughly 40 percent more in the 1960s than in the 1980s, it fails to match the change observed in the data where single men save about 130 percent more in the 1960s.

While scenario (4) comes close to matching the fall in married and single women's savings rates, it cannot account for the tremendous fall in single males savings rate from the 1960s to the 1980s. However, the exogenous version of the model fails in all aspects. The model predicts a 28 percent higher savings rate in the 1960s. In this case single females save the greatest fraction of their income (54 percent), while married couples save about the same as males (35 percent). When keeping wages constant across the time periods, aggregates savings rise by about 14 percent, with all types of households saving roughly 27-30 percent more.

To summarize, endogenously modeled marriage incentives and divorce risks seem to have a sizable effect on aggregate savings. This is a result of the different incentives to save in the two versions. In the exogenous version, there is no incentive for single agents to save in order to attract a spouse. Moreover, in the endogenous version, married couples that have a better chance of remaining married save more, while in the exogenous version all couples face the same divorce probability. Hence, if divorce risk is low, married agents increase savings almost twofold in the endogenous version. It should be noted that the increasing savings rate across match quality is concave, rather than monotonically increasing. More specifically, households with extremely high match quality save slightly less than couples with average match quality, as increased savings can discourage divorce.

6. Conclusion

The purpose of this study is to assess the importance of marriage uncertainty when explaining household savings behavior. The results suggest marriage uncertainty to be a non-negligible factor in determining savings decisions within a household. Increased savings arise due to three reasons. (1) Assortive matching in the marriage market leads singles to save more money and attract better spouses. (2) Marriage allows agents to increase savings and consumption levels due to economies of scale in a household. (3) Savings incentives decrease considerably with increased divorce risk.

Additionally, the results presented clearly highlight the differences between the endogenous and exogenous model. Although the exogenous model allows economist to estimate more complex models due to less computational complexity, the resulting conclusions can potentially be misleading. For example, Cubbedu and Ríos-Rull (1997), in their paper "Marital Risk and Capital Accumulation," are unable to explain changes in household savings rates from the 1960s to the 1980s due to higher divorce and illegitimacy when marital changes are modeled through exogenous shocks. Although I find a sizable effect in both types of models, it is significantly greater in the endogenous version. Moreover, the reason behind the decreasing savings rate differ greatly between the two versions.

Nonetheless, the above model has some short comings that I hope to remedy in future research.

As can be seen in scenario (4) of the computational exercise, the benefits from marriage in the 1960s cannot be solely explained by wages and economies of scale. This follows from omitting all decisions on labor market participation and home production. It should not be surprising that labor market choices differ considerably between married and single people. A great portion of women, especially in the past, worked primarily as housewives. In the early 1960s about 50 percent of married women were out of the labor force, but only 25 percent were so by the late 1980s. This certainly allowed men to profit from marriage in a way not captured in this model.

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