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GENDER, MARRIAGE, AND LIFE EXPECTANCY

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ABSTRACT

Wages and life expectancy, as well as labor market outcomes, savings, and consumption, differ by gender and marital status. In this paper we compare the aggregate implications of two dynamic structural models. The first model is a standard, quantitative, life-cycle economy, in which people are only heterogenous by age and realized earnings shocks, and is calibrated using data on men, as typically done. The second model is one in which people are also heterogeneous by gender, marital status, wages, and life expectancy, and is calibrated using data for married and single men and women. We show that the standard life-cycle economy misses important aspects of aggregate savings, labor supply, earnings, and consumption. In contrast, the model with richer heterogeneity by gender, marital status, wage, and life expectancy matches the observed data well. We also show that the effects of changing life expectancy and the gender wage gap depend on marital status and gender, and that it is essential to not only model couples, but also the labor supply response of both men and women in a couple.

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1 Introduction

Wages and life expectancy, as well as labor market outcomes, savings, and consumption, differ by gender and marital status. In this paper we compare the aggregate implications of two dynamic structural models. The first model is a standard, quantitative, life-cycle economy, in which people are only heterogenous by age and realized earnings shocks, and is calibrated using data on men, as typically done. The second model is one in which people are also heterogeneous by gender, marital status, wages, and life expectancy, and is calibrated using data for married and single men and women.

We show that the standard life-cycle economy misses important aspects of aggregate savings, labor supply, earnings, and consumption. In contrast, the model with richer and more empirically relevant heterogeneity by gender, marital status, wage, and life expectancy matches the observed data well. We also show that the effects of changing life expectancy and the gender wage gap depend on marital status and gender, and that it is essential to not only model couples, but also the labor supply response of both men and women in a couple at a point in time and over time. Because marriage and female labor supply patterns have been changing a lot over the last seventy years, we take our model to data from the Panel Study and Income Dynamics (PSID) and the Health and Retirement Survey (HRS) for the 1941-1945 cohort.

Our paper thus provides multiple contributions. First, it documents the differences in participation, hours worked, and earnings, by gender and marital status. For instance, in terms of labor market participation, married men display on average the highest participation rate, over 98%, until they turn 40, and only slowly decreasing participation until age 50, while single men participation starts dropping fast after age 40. Single women's participation looks like a shifted down version of that of married men's by about 10 percentage points. Married women have a much lower participation, which is hump-shaped over the life cycle at peaks at 50% around age 45. In addition, women not only have a participation rate lower than men on average, but also display lower average hours, even conditional on participation.

Second, it shows that women and married people make up for a large fraction of workers, hours, and earnings in the aggregate economy. The fraction of workers who are women increases from 37% at age 25 to 48% at age 65. The fraction of hours worked by women as a fraction of total hours rises from 28% at age 25 to 43% at age 65, while the fraction of earnings earned by women raises from 23% at age 25 to 27% at age 65. Married people earn over 88% of total earnings and contribute over 86% of the hours worked during the whole life cycle of this cohort.

Third, besides considering a standard life cycle model, it constructs a structural and dynamic model that explicitly models single and married men and women and calibrates it to both PSID and HRS data, and shows that its aggregate implications are consistent with the data and very different from those of the standard representative agent life cycle model, that is calibrated for men. More specifically, the economy with only men drastically overestimates participation by about 10 percentage points over the life cycle of this cohort, overestimates average hours by one-third of actual aggregate hours in this cohort, and overestimates average earnings by age. In contrast, the marriage economy does a much better job of fitting aggregate behavior by age (and thus across ages as well).

Fourth, it shows that the interaction of modelling single and married men and women, with their observed differences in life expectancy and wages is important. In fact, the observed differences between wages and life expectancy for men and women are important determinants of savings and labor supply over the life cycle and affect married and single men and women differently. Thus, it is important to model the observation that many people are married and that both wages and life expectancy are different for men and women, even if one is only interested in aggregate outcomes rather than in these subgroups more specifically.

2 Related literature

Several papers build on the life cycle model with one-person and one-gender households and model two-people households, in which household members face different labor market opportunities. This richer framework is then used to analyze various questions.

One branch of this literature assumes that men work full time and focuses on the labor participation decisions of married women. Attanasio et al. (2008) build a model in which a unitary family makes consumption, saving, and female participation decisions and show that in the U.S. the observed increase in female labor participation by cohort is largely explained by the reduction of child care costs and by the increase in women's wages. Attanasio et al. (2005) use a similar framework to examine the insurance role of female labor supply when permanent labor earnings risk increases and find that additional uncertainty increases female participation rates and especially so when the ability to borrow (and hence to smooth consumption) is limited. Eckstein and Lifshitz (2011) compare the patterns of married and unmarried female labor supply during the last 50 years and attribute 60% of the observed increase in married women employment over this period to rising educational achievements and rising women's wages compared to men's. The latter paper, in addition to assuming exogenous married men's labor supply, does not allow households to save.

In contrast with these papers, we allow for savings and intensive and extensive labor supply decisions for both men and women and we also allow for heterogeneity in their life expectancy. We show in our data section that both male and female labor supply are important and that the life expectancy of men and women differs significantly. In addition, we do not seek to explain the differences among households born in different cohorts.

Another branch of the literature addresses the effects of changes in taxation and Social Security rules on female labor supply. Guner, Kaygusuz and Ventura (2012) quantify the aggregate effects of income tax reform in an overlapping-generations (OLG) model with married and single households with an extensive margin in labor supply. They find that gender-based taxes implying that women face lower and proportional income tax rates increase output and female labor participation, and that they improve welfare. However, they also find that the welfare gains would be even higher if the U.S. were to switch to a gender-neutral proportional tax. Kaygusuz (2012) documents that the Economic Recovery Tax Act of 1981 and the Tax Reform Act of 1986 drastically reduced the marginal tax rates on labor income of married women and study an economy in which married women decide whether to work or not. The paper finds that over 20% of the rise in married female labor force participation in 1990 is explained by the changes in the income tax structure, 60% is due to increased wages and 10% to changes in marital sorting. Nishiyama (2015) studies the aggregate effects of Social Security reform in a model with married and single households. He finds that removing spousal and Social Security survivor benefits would increase female labor participation, female hours worked, and aggregate output. Low et al. (2016) study how marriage, divorce, and female labor supply are affected by welfare programs that impose lifetime limits on benefit eligibility, such as the Temporary Assistance for Needy Families (TANF), which was introduced in the U.S. in 1996. Using a difference-in-difference approach, they first provide empirical evidence that the reform affected female employment, which increased after the reform, and the flow of marriages and divorces, which declined after the reform. To understand how welfare programs affect family formation, they build a dynamic model of saving, marriage, divorce, female labor market participation, and welfare participation. In their model, marriage and divorce are endogenous, and marriage is characterized by limited commitment. Blundell et al. (2016) also study how the U.K. tax and welfare system affects the career of women. Using a long panel data set and exploiting numerous reforms to the tax and welfare system as a source of exogenous variation, they show that reforms cause changes in both women's labor supply and educational choices. Estimating a dynamic life-cycle model of women's labor supply, human capital formation and savings on U.K. data, they find that tax credit system in the U.K. increases the labor supply of lone mothers, while reduces that of married mothers. Tax credits are overall welfare improving.

Compared to this set of papers, we allow for both intensive and extensive labor supply decisions for both men and women, we take our model to data by using the PSID and the HRS, and we also require the key outputs of the model to match the data. In addition, we allow for heterogeneity in life expectancy between men and women and compare the predictions of a standard life cycle economy with a richer life cycle economy that allows for both gender and marital status differences. Finally, we study the effects of changing life expectancy and wages for both married and single people.

Finally, another branch of the literature models the joint retirement behavior of couples (Blau (1998), Blau and Gilletskie (2006), van der Klaauwa and Wolpin (2008), and Casanova (2012)). Although we do allow for endogenous labor supply, we take the maximum retirement age to be exogenous and leave the question of joint benefit claiming for future work.

3 The model

Our model period is one year. We explicitly model the working and retirement stages of the life cycle. Let t be age $\in \{t_0, t_1, ..., t_r, ..., t_d\}$, with t_r being retirement time and t_d being the maximum possible lifespan. People start their economic life at the age of 20 and live up to the maximum age of 100. They retire at age 66 and from that time on, they face mortality risk.

During their **working stage**, people are alive for sure, face shocks to their wages, and are either single or married. Each household, whether single or married chooses how much to save for next period and how much to work, with married people choosing the labor supply of both partners. As in French (2005), we introduce a fixed time cost of working for each person, which implies that, consistently with the observed data, most people will not choose to work just a few hours.[1]

After **retirement**, the only control variable is savings and each person faces an exogenous probability of death, which depends on their gender and marital status.

We use the superscript i to denote gender, with $i = 1$ being a man and $i = 2$ being a woman. We use the superscript j to denote marital status, with $j = 1$ for singles and $j = 2$ for couples. Because of mortality risk after retirement, married people may lose their spouse that time. We allow survival probabilities and the fixed cost of working to differ by gender and marital status and, for married women, also by age, to incorporate the costs of raising children in a parsimonious way. We allow the earnings processes to depend on gender.

3.1 The government

The government taxes labor income using a proportional tax to finance old-age Social Security. Social security benefits are taken from the 1997 average payments for the groups that we study and thus depend on gender and marital status. We balance the Social Security budget for the cohort that we consider.

3.2 Single men and women

Consider single people of working age. They have preferences given by

$$v(c_t, l_t) = \frac{(c_t^{\omega} l_t^{1-\omega})^{1-\gamma} - 1}{1-\gamma} \tag{1}$$

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

$$l_t = 1 - n_t - \phi_t^{i,1} I_{n_t}, \tag{2}$$

[1]This fixed time cost of working includes commuting time and time spent getting ready for work.

that is, total time endowment less n_t, hours worked on the labor market, less the fixed time cost of working. I_{n_t} is an indicator function which equals 1 when hours worked are positive and zero otherwise. The term $\phi_t^{i,1}$ represents the fixed time cost of working for singles of gender i at age t.

Let e_t^i be a deterministic age-efficiency profile, which is a function of the individuals' age and gender. Let ϵ_t^i be a persistent earnings shock that follows a Markov process. The product of e_t^i and ϵ_t^i determines an agent's units of effective labor per hour worked during the period.

$$\ln \epsilon_{t+1}^i = \rho^i \ln \epsilon_t^i + \upsilon_t^i, \;\; \upsilon_t^i \sim N(0, \sigma_\upsilon^2). \tag{3}$$

Let a_t be assets which earn interest rate r. The state variables for a single individual are age t, gender i, asset a_t^i, and the persistent earnings shock ϵ_t^i. From the first period of working age and until retirement, the recursive problem of the single person of gender i can thus be written as

$$W_t^{s,i}(a_t^i, \epsilon_t^i) = \max_{c_t, a_{t+1}, n_t} \left[v(c_t, 1 - n_t - \phi_t^{i,1} I_{n_t}) + \beta E_t W_{t+1}^{s,i}(a_{t+1}^i, \epsilon_{t+1}^i) \right] \tag{4}$$

$$Y_t = e_t^i \epsilon_t^i n_t \tag{5}$$

$$c_t + a_{t+1}^i = (1+r) a_t^i + (1 - \tau_{SS}) Y_t \tag{6}$$

$$a_t \geq 0, \quad n_t \geq 0, \quad \forall t \tag{7}$$

The expectation operator is taken with respect to the distribution of ϵ_{t+1}^i conditional on ϵ_t^i.

After retirement, single people face a positive probability of dying every period. The retired individual's recursive problem can be written as

$$R_t^{s,i}(a_t) = \max_{c_t, a_{t+1}} \left[v(c_t, 1) + \beta s_t^{s,i} R_{t+1}^{s,i}(a_{t+1}) \right] \tag{8}$$

$$c_t + a_{t+1} = (1+r) a_t + (1 - \tau_{SS}) Y_r^{i,j} \tag{9}$$

$$a_t \geq 0, \quad \forall t \tag{10}$$

The term s_t^i is the survival probability, which is a function of age and gender.

3.3 Married couples

Couples maximize their joint utility function and their utility from total consumption and from the leisure of each household member is given by[2]

$$w(c_t, l_t^1, l_t^2) = \frac{((\frac{c_t}{2})^{\omega}(l_t^1)^{1-\omega})^{1-\gamma} - 1}{1-\gamma} + \frac{((\frac{c_t}{2})^{\omega}(l_t^2)^{1-\omega})^{1-\gamma} - 1}{1-\gamma}, \tag{11}$$

During the working period each of the spouses is affected by a wage shock, which is realized and known at the beginning of each working period. As for singles, the superscript $i = 1$ refers to men, while the superscript $i = 2$ refers to women. Spouses differ in their earnings processes and initial wage shocks. The state variables for married couple are $a_t, \epsilon_t^1, \epsilon_t^2$.

The recursive problem for the married couple of working age can be written as

$$W_t^c(a_t, \epsilon_t^1, \epsilon_t^2) = \max_{c_t, a_{t+1}, n_t^1, n_t^2} \Big[w(c_t, 1-n_t^1-\phi_t^{1,2} I_{n_t^1}, 1-n_t^2-\phi_t^{2,2} I_{n_t^2}) + \beta E_t W_{t+1}^c(a_{t+1}, \epsilon_{t+1}^1, \epsilon_{t+1}^2) \Big] \tag{12}$$

$$Y_t^i = e_t^i \epsilon_t^i n_t^i \quad i = 1, 2 \tag{13}$$

$$c_t + a_{t+1} = (1+r)a_t + (1-\tau_{SS})(Y_t^1 + Y_t^2) \tag{14}$$

$$a_t \geq 0, \quad n_t^1, n_t^2 \geq 0, \quad \forall t \tag{15}$$

The expected value of the couple's value function is taken with respect to the conditional probabilities of the two ϵ_{t+1}^i given the current values of ϵ_t^i for each of the spouses (we assume independent draws).

During retirement, that is from age t_r onwards, each of the spouses is hit with a realization of the probability s_t^i. We assume that the death of the each spouse is independent from that of the other. The married couple's recursive problem during retirement can be written as

$$R_t^c(a_t) = \max_{c_t, a_{t+1}} \Big[w(c_t, 1, 1) + \beta s_t^{c,1} s_t^{c,2} R_{t+1}^c(a_{t+1}) + \beta s_t^{c,1}(1-s_t^{c,2}) R_{t+1}^{s,1}(a_{t+1}) + \beta s_t^{c,2}(1-s_t^{c,1}) R_{t+1}^{s,2}(a_{t+1}) \Big] \tag{16}$$

$$c_t + a_{t+1} = (1+r)a_t + (1-\tau_{SS})(Y_r^{1,c} + Y_r^{2,c}) \tag{17}$$

$$a_t \geq 0 \quad \forall t \tag{18}$$

[2]An alternative specification is to use the collective model and solve the Pareto-efficiency intro-household allocation along the line of, for example, Chiappori (1988, 1992), and Browning and Chiappori (1998).

4 The data and the heterogeneity by gender and marital status

We use both PSID and HRS data (see Appendix for a discussion of these data sets and how we use them) for the cohort of men and women born between 1941 and 1945. We pick this cohort so that their entire life span is first covered by the PSID, which starts from 1968, from which we use the rich information about wages for men and women, and then by the HRS, which starts covering people at age 50 and has rich information on mortality by many observable characteristics.

4.1 Heterogeneity in wage processes and life expectancy

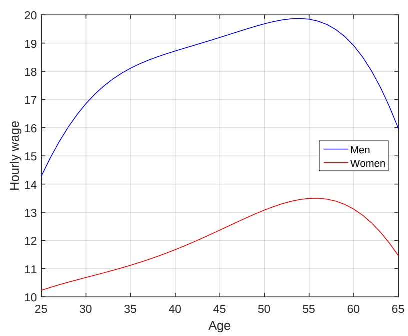


Figure 1: Potential wages over the life cycle for men and women born in the 1941-1945 cohort (PSID data)

Figure 1 displays mean potential wage by gender for our cohort, as computed from the PSID data, should everyone in our sample choose to work. It displays two important facts. First, for this cohort, given their previous educational achievements, the wages of women are significantly lower than those for men for their whole working lives. For instance, at age 25, men start their working life with an average potential wage of over \$14 an hour (which we express in 1998 dollars) while women's potential hourly wage is just above \$10. Thus, the gap between men and women at age 25 is four dollar an hour, that is 40% of women's wages. Second, men's wages grow faster than women's until age 35, while women's wages grow faster after age 35-40. The result is that even at age 55-60, when women's potential wages are peaking, the potential wage gap across genders is over \$7, which is more than one-half of what an average woman would make per hour, should she choose to work.

Parameter	Men	Women
Persistence	0.973	0.963
Variance prod. shock	0.016	0.014
Initial variance	0.128	0.122

Table 1: Estimated processes for the wage shocks for men and women (PSID data)

Table 1 reports estimates for the stochastic component of earnings that we assume to be an AR(1) (As specified in equation 3) and we estimate from the PSID data. It shows that women experience slightly smaller persistence in wages than men, 0.96 compared to 0.97, but similar variances.

Table 2 compares life expectancies at age 70, 80 and 90 from the 2013 U.S. life table (source: Social Security Administration (SSA)) and our calculations from the HRS. The numbers refer to different populations, as the U.S. life table is a cross-sectional life table for the year 2013, while our calculations use the period 1998-2013, control for cohort effects, and refer to the 1941-45 cohort. Despite these differences, our HRS sample generates very similar life expectancies for women and underestimates the life expectancy for men by only nine months at age 70. At more advanced ages, our estimates become even more precise. According to our HRS sample, there is a large gap in life expectancy at age 70 between singles and married individuals: married men expect to live 2.5 years longer than single men and married women expect to live 2.1 years longer than single women. These gaps shrink at older ages. The appendix reports details on how we use the PSID and the HRS data to compute these processes.

4.2 Life cycle patterns

Next, we show graphs of lifecycle patterns of participation, hours, labor income, and wealth drawn from the data for the cohort we are interested in. To construct these graphs we take averages using the PSID data for individuals born between 1936-1950, that is we include two five-years cohorts adjacent to the cohort of interest (the one born in 1941-45) in order to have enough observations in each age cell and at the same time minimize the impact of cohort effects.

To characterize the life cycle pattern of assets, we adopt a somewhat different procedure because in the PSID assets are observed only in a few waves. That is, we select

Gender	U.S. life tables	All	Single	Married
At age 70				
Women	16.4	16.4	15.4	17.5
Men	14.2	13.5	11.5	14.0
At age 80				
Women	9.6	9.7	9.5	10.3
Men	8.2	8.0	7.3	8.2
At age 90				
Women	4.8	4.6	4.6	4.8
Men	4.0	3.8	3.7	3.9

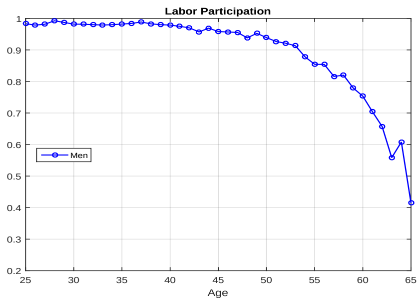
Table 2: Life expectancy at ages 70, 80 and 90 in years. First column: U.S. life tables from Social Security Administration. Other columns: Our computations based on HRS data

individuals born between 1931 and 1955, to have enough observations, and estimate a fourth-order polynomial in age with ordinary least squares following individuals up to age 75 (age 70 in the case of single men and single women). It is this estimated polynomial in age that is plotted in our graphs.

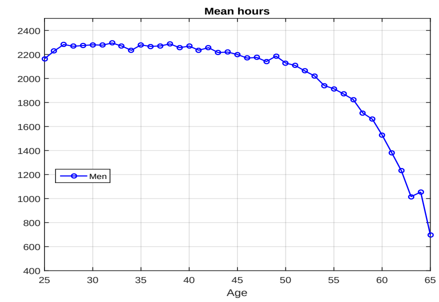
We start by displaying figures for men only, as these are the profiles we use in our singles economy, and then we show the profiles distinguishing between gender and marital status, relevant for our marriage economy.

4.2.1 Men over the life cycle

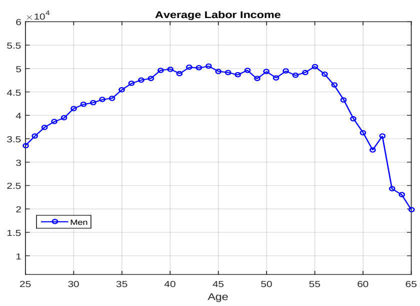
Graph (a) in Figure 2 shows the lifecycle pattern of participation for men born between 1936 and 1950. Their labor participation stays around 98% until age 40 and then starts declining. The rate of decrease is faster starting at age 50, with male participation dropping to 40% by age 65. Average hours (panel (b) in the same figure) follow a similar pattern, starting at around 2,200 hours at age 25, increasing to 2,300 hours by age 27, and then declining slowly after age 40 and much faster after age 50, reflecting decreasing participation. Panel (c) highlights that average labor income increases gradually to $50,000 by age 40 due to the increase of average hourly wage shown in Figure 1, stays roughly constant until age 55, and then drops sharply after that age due to drops in both average hourly wage and hours worked. As panel (d) of the figure shows, average assets for men tend to increase until age 65, reaching $250,000, although after age 50 the growth rate gradually slows down.



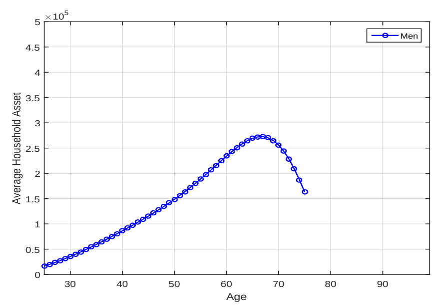
(a) Participation



(b) Hours worked



(c) Labor income



(d) Assets

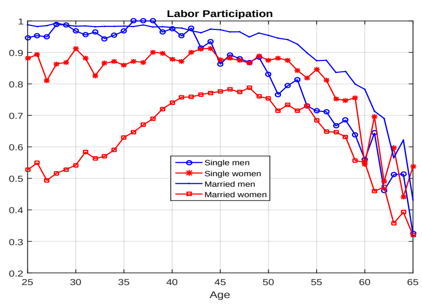
Figure 2: Life cycle profiles for men

4.2.2 Single and married men and women over the life cycle

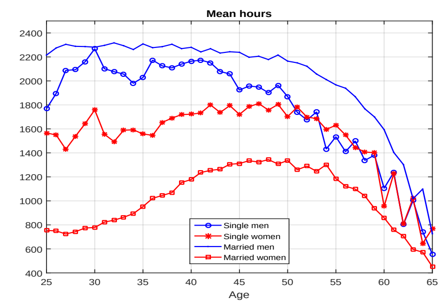
To understand the role of gender and marital status in affecting life cycle labor market outcomes and assets accumulation, we now turn to displaying life cycle profiles by gender and marital status. Figure 3, panel (a), displays average labor participation for single and married men and women.

Married men display on average the highest participation rate, over 98%, until they turn 40, and only slowly decreasing participation until age 50, while single men participation starts dropping fast after age 40. Single women's participation looks like a shifted down version of that of married men's by about 10 percentage points, but displays a very similar shape to that of married men over the life cycle. Also, single women's participation after age 45 declines much more slowly than participation of single men.

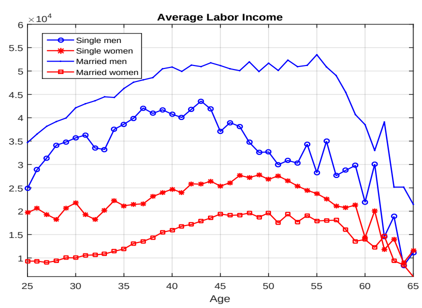
Married women display a different pattern, with a low (around 50%) but increasing participation rate between ages 25 and 40, when they are more likely to have small children. Their labor participation increases to 78% in the 45-50 age range, and declines after that age at a rate similar to those of the other groups. Average hours are shown in panel (b) of the same figure and follow a broadly similar pattern. Married men work more hours than everyone else, including single men, on average. In addition, women, not only have a participation rate lower than men on average, but also display lower average hours, even conditional on participation.



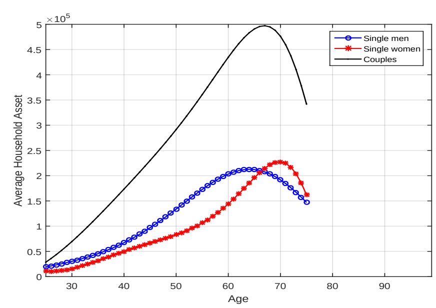
(a) Participation



(b) Hours worked



(c) Labor income



(d) Assets

Figure 3: Life cycle profiles by gender and marital status

Turning to labor income and assets for single and married men and women, Figure 3, panel (c), shows that married men have a much higher labor income than any other group: This is due to their high participation, high average number of hours, and higher hourly wage compared to women. Women, both singles and married, have a much lower average income at all ages, due to the low average number of hours coupled with the low hourly wage. While for single men average labor income drops after age 45, for women, both single and married, it increases until 50, due to their increasing participation profile. In panel (d) we report average assets for couples and for single men and women. Average assets increase until age 65 for all groups, with women accumulating the lowest amount and showing no sign of a slowdown in accumulation before age 65.

4.3 The importance of gender and marital status for the aggregates

These facts highlight different patterns by demographics over the life cycle: Women behave differently than men and married people behave differently than single people. Table 3 shows that these differences matter for the aggregate economy. The first line reports the fraction of workers who are women by age. For the cohort that we consider, this number increases from 37% at age 25 to 48% at age 65. The next two lines report the fraction of hours worked by women as a fraction of total hours and the fraction of total earnings that is earned by women. Both are sizeable. The fraction of hours worked by women rises from 28% at age 25 to 43% at age 65, while the fraction of earnings earned by women raises from 23% at age 25 to 27% at age 65. The bottom panel of the table shows that married people make up for the majority of the population at each age group, going from 86% at age 25 to 74% ate age 65. The fraction of hours worked by married people stays remarkably constant around 87% from age 25 to age 65 and so does the fraction of earnings by married people, that stays around 89%.

Group	Age 25	Age 35	Age 45	Age 55	Age 65
Fraction women among workers	0.37	0.40	0.46	0.46	0.48
Fraction hours worked by women	0.28	0.31	0.38	0.40	0.43
Fraction earnings by women	0.24	0.23	0.29	0.27	0.27
Fraction married among workers	0.86	0.85	0.84	0.82	0.74
Fraction hours worked by married	0.86	0.87	0.87	0.88	0.87
Fraction earnings by married	0.88	0.88	0.89	0.91	0.90

Table 3: Top three lines: Fraction of women, hours worked by women, and earnings earned by women in a given age group. Bottom three lines: Fraction of married people, hours worked by married people, and earnings earned by married people in a given age group

Group	Age 25	Age 35	Age 45	Age 55	Age 65
Fraction of married women	0.43	0.42	0.40	0.39	0.37
Fraction of married men	0.43	0.46	0.44	0.43	0.44
Fraction single women	0.07	0.07	0.10	0.12	0.13
Fraction of single men	0.07	0.05	0.06	0.06	0.06

Table 4: Fraction of married women, married men, and single women and single men by age

To complete our discussion of the importance of explicitly modelling married and single men and women, Table 4 reports the fraction of married men and women and single men and women by age group. For instance, in this cohort, at age 25, 43% of the people are married men and 43% married women, while 7% are single men and single women. At age 65, 37% of people are married women, 44% are married men, 13% are single women and 6% are single men.

Thus, the aggregates (earnings, hours, and number of people working) are comprised of large fraction of women and married people, who are not typically modelled, and whose behavior is very different from that of single decision maker that is typically modelled. In fact, single decision makers are a minority in the data and also earn a relative small fraction of total earnings at all ages.

5 Calibration

We calibrate two economies. The singles economy is a standard one-gender, no marriage, life-cycle framework, which we calibrate using data on men. This model is a stripped down version of model that we have described, in which the decision problem is that of single decision maker, where the crucial aspect is that there is not another household member potentially providing labor supply and facing wage shocks. Whether the calibration of this single agent is done using data on single men or all men, is a less important aspect than the the presence of two spouses in one household.

The marriage economy explicitly models single and married men and women over the life cycle. We calibrate it using the corresponding data for each of these groups.

In both cases, we assume that the U.S. is an open economy and we set the interest rate r to 4% and the risk aversion parameter, γ, to 2. The Social Security tax, τ_{ss}, on workers is set to be 3.8%, which was the worker's tax rate for Old-Age, Survivors, and Disability Insurance program in 1968. We choose this year because we focus on birth cohorts of 1941-1945, who were age 23-27 in 1968, and thus recently started working.

Parameters		Value
r	Interest rate	4%
γ	risk aversion coefficient	2
τ_{SS}	Social Security tax rate on employees	3.8%

Table 5: Calibration of the interest rate, risk aversion, and Social Security tax rate

5.1 The singles economy

For the singles economy we use the survival probabilities and the wage process for men that we described in Section 4. The top panel of Table 6 reports the parameters that we use to match our targets, that we list in the bottom part of the same table. The Social Security benefit is chosen to match the government budget constraint for this cohort. All the parameters are consistent with those used in the literature. In particular, the value of labor participation cost is very close to that in French (2005).

Parameters		Value
β	Discount factor	0.955
ω	Consumption weight	0.507
$\phi_t^{i=1,j}$	Labor participation cost	0.282
$Y_r^{i=1,s}$	Social Security benefit	$8,010
Moments	Data	Model
SS budget deficit	0.000	-0.001
Average assets, single men at 50	137,747	138,197
Average hours, single men at 50	2,129	2,124
Participation, single men at 50	0.939	0.971

Table 6: Top panel: Parameters used in the singles economy. Bottom panel: Target moments for the singles economy. The data moments come from our computations using PSID and HRS data. The SS budget deficit is expressed as the ratio to SS budget for this cohort

5.2 The marriage economy

For the marriage economy, we use the survival probabilities for single men, single women, and married men and women, and the wage processes for men and women that we have estimated and described in Section 4. The top panel of Table 7 reports the parameters that we choose for the marriage economy to match the corresponding target moments that are listed in the bottom panel of the same Table.

Parameters		Value
β	Discount factor	0.961
ω	Consumption weight	0.495
$\phi_t^{i=1,j}$	Men participation cost	0.316
$\phi_t^{i=2,j=1}$	Single women part. cost	0.372
$\phi_t^{i=2,j=2}$	Married women part. cost	See text.
$Y_r^{i=1,s}$	Single men SS benefit	\$5,723
Moments	**Data**	**Model**
SS budget deficit	0.000	0.001
Avg. assets, single men at 50	131,598	168,171
Avg. assets, single women at 50	85,860	82,209
Avg. assets, couples at 50	271,126	223,264
Avg. hours, single men at 50	1,869	1,854
Avg. hours, single women at 50	1,703	1,692
Avg. hours, married men at 50	2,165	2,005
Avg. hours, married women at 50	1,337	1,544
Part., single men at 50	0.831	0.910
Part., single women at 50	0.875	0.892
Part., married women at 35	0.630	0.638
Part., married women at 45	0.776	0.690
Part., married women at 55	0.683	0.652

Table 7: Top panel: Parameters used in the marriage economy. Bottom panel: Target moments for the marriage economy. The data moments come from our computations on PSID and HRS data. The SS budget deficit is expressed as the ratio to the SS budget for this cohort

The Social Security benefit for single men is chosen to match the government budget constraint for this cohort. We pin down the Social Security benefits for the other groups by fixing the ratios of benefits by group relative to single men to match the data reported in 1997. According to SSA, in 1997, median income for elderly unmarried women was 98.8% of that for unmarried men, and median income for elderly married couples was 183.0% that for unmarried men.[3]

We use participation costs to match the labor participation rate and hours worked at age 50 for a given group. For single men, married men, and single women, we assume that these costs are constant over the life cycle. For married women, to capture the role of child reading in a simple way, we assume that married women face a time-varying participation cost over their life cycle, which is a quadratic function $\phi_t^{i=2,j=2}$. The corresponding coefficients are $0.0009, -0.0233, -1.0297$. The additional targets for married women are average hours and participation at ages 35, 45, and 55. Figure 4 displays the life cycle labor participation costs that we use for each group. As it turns out, the participation cost for married women is relatively high during the peak childbearing years, but then decreases to reconcile their labor income patterns, due to their lower wage and higher family assets. The participation cost for single women turns out to be higher than that of both married women and men to match their low participation rate. In reality, they might be stuck in low-paying jobs expecting to get married. Thus, the participation cost is a stand in for more than just commuting costs.

6 Results

In this section, we describe the model's fit to data for both the singles and the marriage economy.

6.1 The singles economy

Figure 5 displays labor supply participation, average hours, consumption, and savings over the life cycle in the actual data and the singles economy.[4] The model matches well the main features of the data but tends to over predict participation and hours after age 55, where we might be missing the role of health shocks. It also

[3]We calculated the ratios using the 1997 SSA report, that reads "In 1997, median income for elderly unmarried women (widowed, divorced, separated, and never married) was $11,161, compared with $14,769 for elderly unmarried men and $29,278 for elderly married couples. Elderly unmarried women – including widows – get 51 percent of their total income from Social Security. Unmarried elderly men get 39 percent, while elderly married couples get 36 percent of their income from Social Security." Thus, we set SS benefits to $5,692 for single women, to $5,760 for single men, and to $10,540 for couples (https://www.ssa.gov/history/reports/women.html).

[4]Panel (c) does not plot actual data on consumption because total consumption is not available in the PSID data.

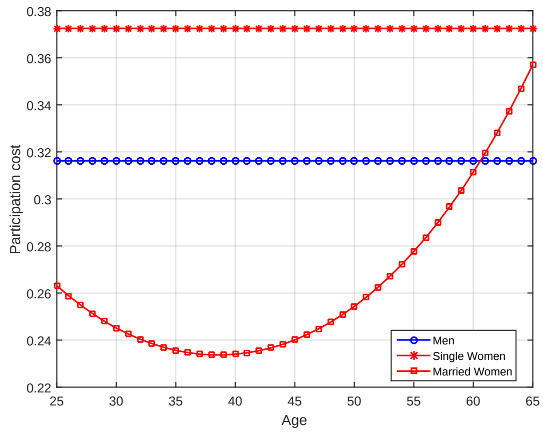


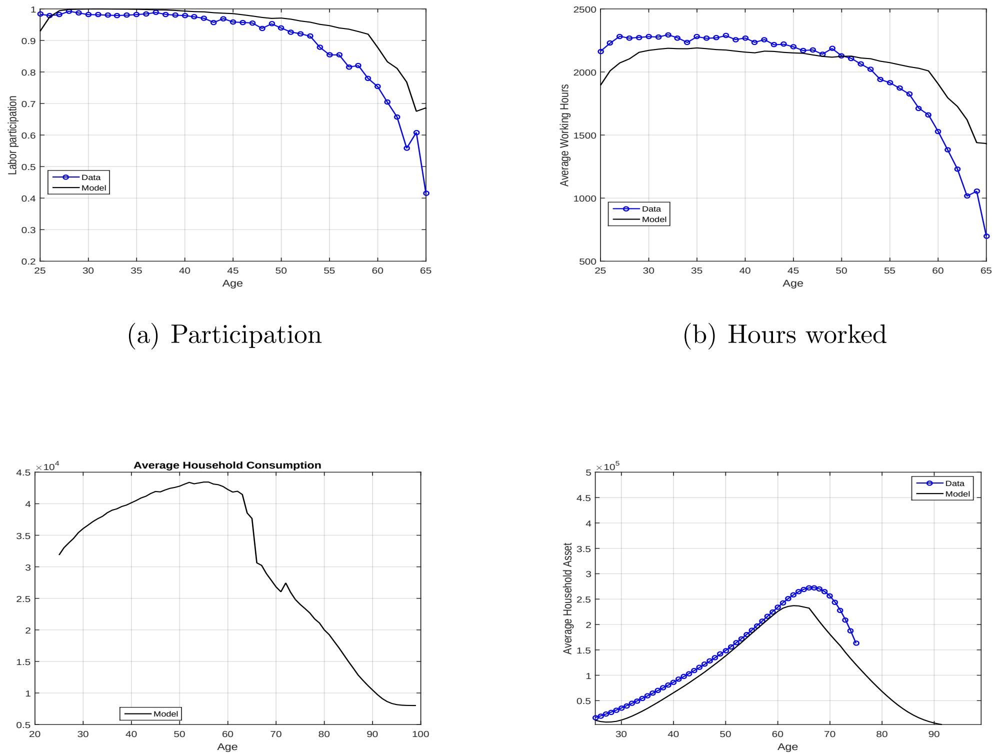
Figure 4: Estimated lifecycle labor participation cost in time

generates a hump-shaped consumption profile as is well-documented in the literature. Consumption drops right at retirement when singles stop working and decreases gradually when mortality risk increases. Compared with the data of life cycle consumption shown in Figure 7 in Dotsey et al (2012), the drop of consumption generated by our model is bigger because we abstract from home production. Overall, however, the model matches the most important features of the data over the life cycle well.

6.2 The marriage economy

The top panel of Figure 6 displays the life cycle profiles of labor participation rate by gender in the data (left panel) and the model (right panel). Here, too, the model captures the main aspects of the data. Single women are more likely to participate in the labor market than married women, despite the fact that single women face a larger participation cost. Married women have a lower labor participation rate than single women because of division of labor among couples in presence of a fixed cost of working and lower wages for women than men. Single men participate less than married men in the labor market when older.

The bottom panel of Figure 6 displays average hours worked. As in the data, the model delivers a large difference in hours worked by gender among singles: Single women work less on average than single men because single women faces a larger participation cost. As in the data, married men work much more than married



(a) Participation

(b) Hours worked

(c) Consumption

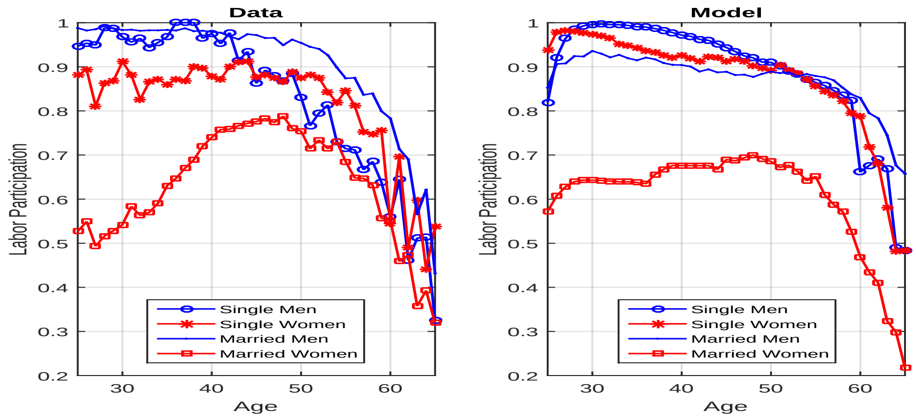
(d) Assets

Figure 5: Lifecycle profiles (singles economy)

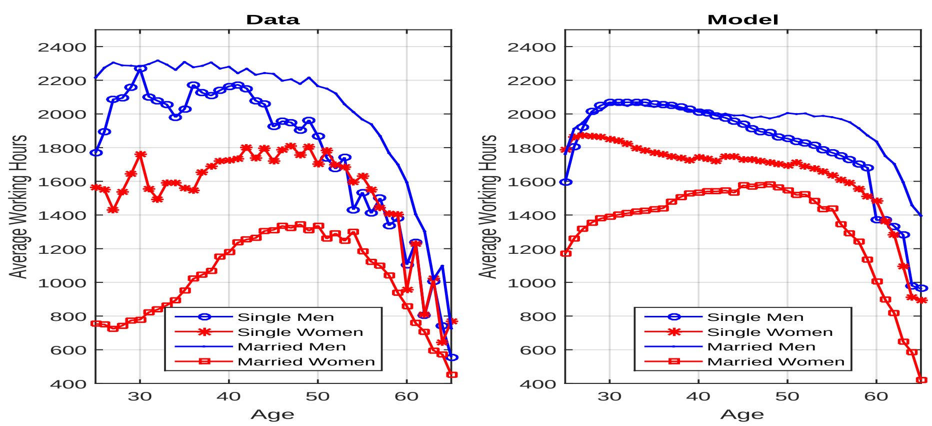
women because married couples care about the total household income and maximize household utility and because women on average earn lower wage than men, they enjoy more leisure.

Figure 7 displays the life cycle profiles of average household consumption by gender and marital status generated by the marriage economy. The average consumption of single women is lower than consumption of single men because of lower wages. However, women consume more than men late in life because women have a longer life expectancy thus have a lower effective discount rate. The reason why consumption for single women increases after retirement is than when the man in a married couple dies, his widow transitions to being a single woman and since married couple hold more net worth than singles, an average widow consumes more than an average single woman. Total average consumption of married couples is higher than that for singles.

Figure 8 displays life cycle profiles of average household assets by gender and



(a) Participation



(b) Hours

Figure 6: Labor participation and hours, in the data (Left panel) and in the marriage economy (Right panel)

marital status. Before age 70, assets among single women are lower than assets among single men because single women have lower earnings capacity. However, women hold more assets than men late in life because women live longer thus consume more and also because they expect to incur larger health expenditure. Average asset among married couple is much higher than that for singles but still fall short of what is observed in the data.

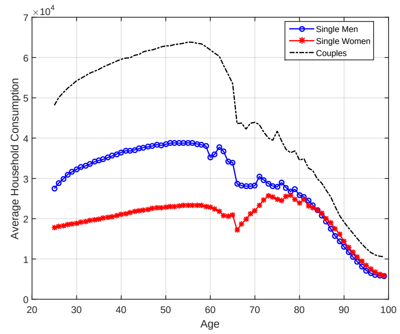


Figure 7: Average consumption in the marriage economy

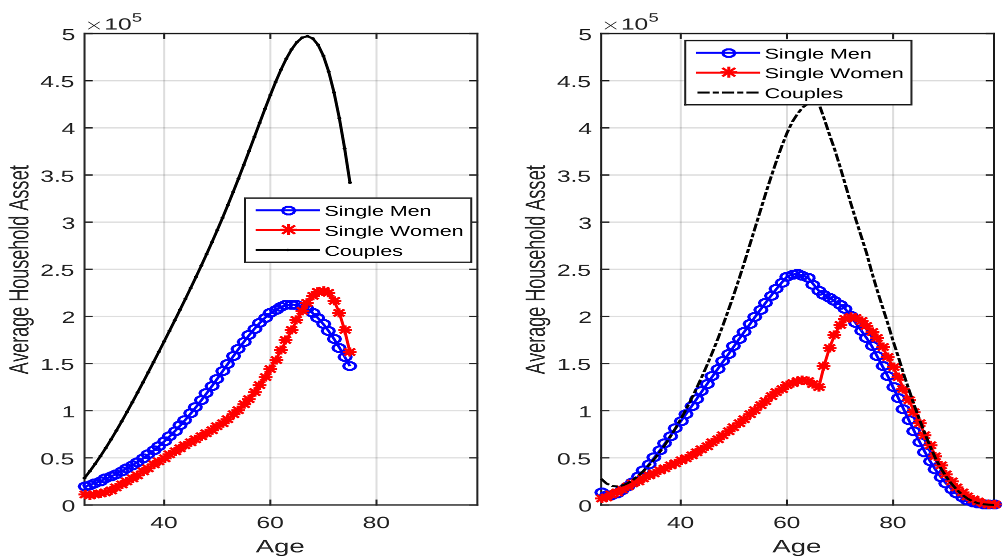
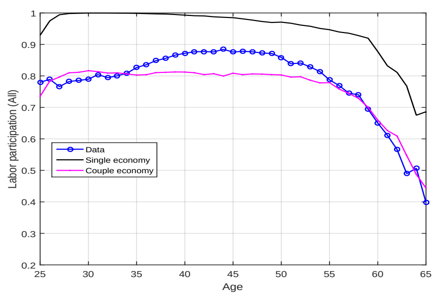


Figure 8: Average assets, in the data (Left panel) and in the marriage economy (Right panel)

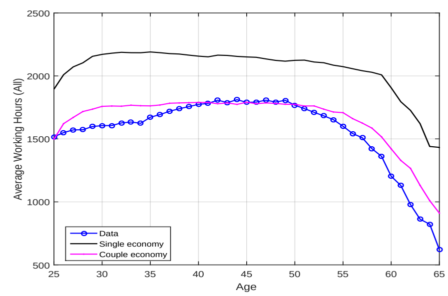
6.3 Aggregating up the profiles by gender and marital status

Men are only one part of the economy and it is important to also keep into account that some of the men are married, and thus their spouse has the potential to work, while some others are not. To start thinking about the shortcomings of a model with only single males, we look at some important outcomes over the life cycle, such as participation, hours, earnings, and assets in the data, once one takes into account all economic agents, thus including married and single men and women at every age. Then, we compare this profile from the data with those from our two models, that is the singles economy and the marriage economy.

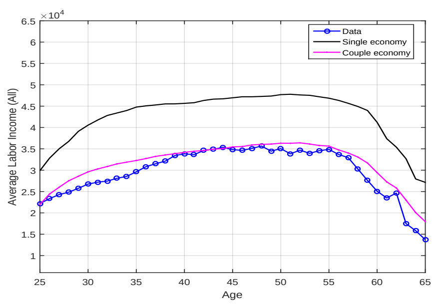
Figure 9 compares the aggregate life cycle profile by age for the observed data, the singles economy, and the economy with married and single men and women (the marriage economy). It shows that only modeling men misses important aspects of aggregate behavior over the life cycle. First, the economy with only men drastically overestimates participation by about 10 percentage points over the life cycle of this cohort. Second, it overestimates average hours over the life cycle by about 500 hours, which is almost one-third of actual aggregate hours in this cohort. Third, it overestimates average earnings by age. For instance, at age 45, average earnings are close to $35,000 a year, while the singles economy predicts over $45,000, thus almost over predicting earnings by one third. In contrast, the marriage economy does a much better job of fitting aggregate behavior by age (and thus across ages as well).



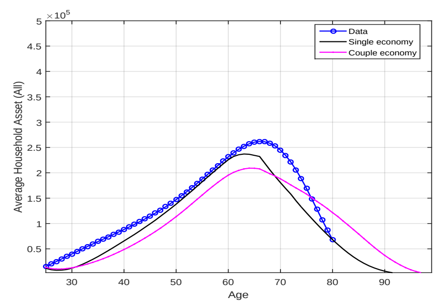
(a) Participation



(b) Hours worked



(c) Labor income



(d) Assets

Figure 9: Life cycle profiles for the aggregate economy, including all types of households

6.4 What is different between men and women?

Now that we have established that there are large difference in important economic behaviors between married and single men and women and that these differences are important to understand not only the observed differences across groups, but also the aggregates, we turn to better understanding what are the factors that give rise to the heterogeneity in outcomes that we observe for our subgroups.

There are two important differences in our our model between men and women: women live longer than men and women face lower wages than men. These differences are potentially key determinants of the labor supply of both members in a couple and of the labor supply of single women compared to that of single men. We now turn to understanding the effects of these differences on important market outcomes and their interaction with marital status.

6.4.1 The effects of gender differences in life expectancy

We now turn to discussing the role of gender differences in life expectancy on the life cycle profiles of wealth, earnings, and consumption. To do so, we give all women the life expectancy of a men with their same marital status: As a result, women now have a lower life expectancy than in the benchmark model.

Figure 10 plots the resulting change in average assets holdings, compared to our marriage benchmark economy. All households in which a woman is present, whether single or married save less as a result of a lower life expectancy and the resulting gap in assets opens up until age 80. For instance, assets at age 65 for single women are $20,000 lower and almost $30,000 lower for couples when all women have the life expectancy of men. At age 80, this difference in savings reaches it peak at over $40,000 for both single women and married couples. Thus, differences in life expectancy generate large differences in savings for both singles and couples, but the value of these differences also depends on marital status, starting from from age 35 and until age 70.

Assets for single men do not change before retirement because nothing changes for them. In contrast, assets after retirement differ because of sample composition after age 65: With higher mortality risk for married women, more married men lose their wife and become single. Since married men hold more asset than single men, the widowers are richer.

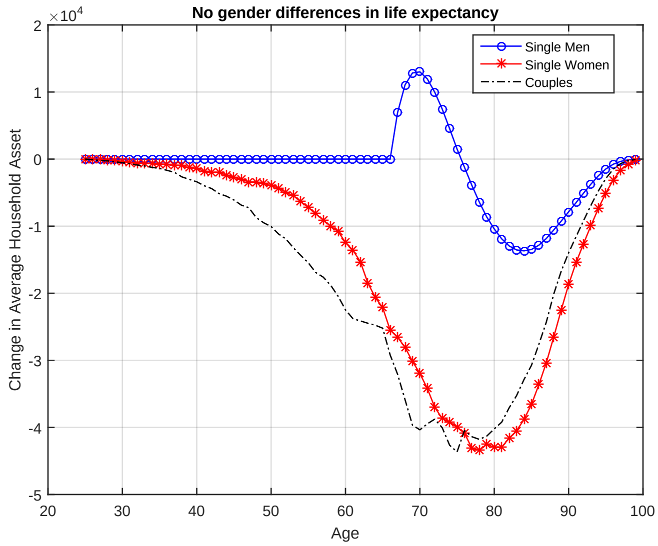
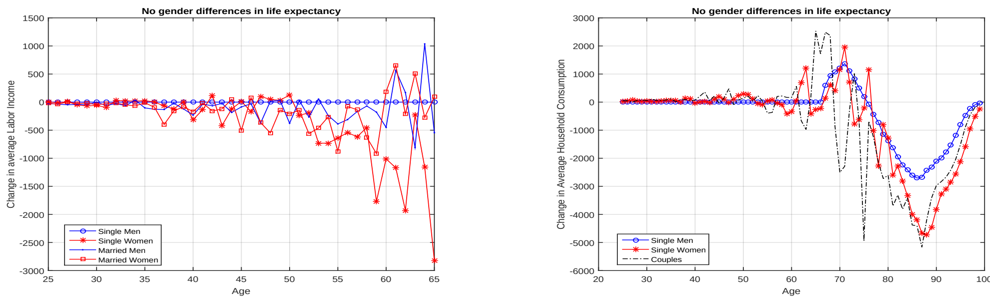


Figure 10: Change in assets when all women have the life expectancy of men of the same marital status

The change in assets reflects changes also in earnings and consumption. Figure 11 plots the change earnings resulting from lower life expectancy for women. The labor supply of single men does not change because their problem does not change. The labor supply of other groups is reduced because lower life expectancy requires smaller retirement savings and thus reduces working hours and increases leisure. Figure 11 plots the change in consumption when the life expectancy of women is reduced to that of men. The reduction in survival rates for women effectively reduces their discount factor, making consumption later in life less valuable. As a result, consumption for single women and for married couples before age 70 increases slightly and consumption afterwards drops significantly. The consumption of single men does not change before retirement because single men face an identical decision problem, while their consumption after retirement differ due to the same sample composition we have described above. That is, since consumption increases with assets, consumption after retirement follow the same pattern as assets.



(a) Labor income

(b) Consumption

Figure 11: Change in consumption and labor income when all women have the life expectancy of men of the same marital status

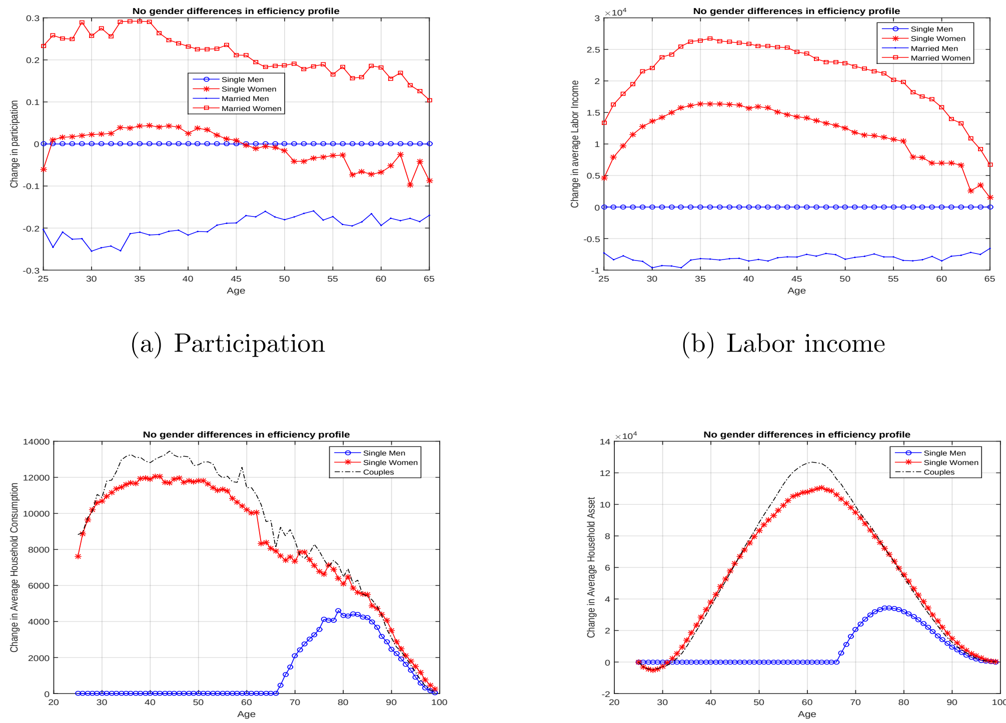
6.4.2 The effects of wage differences by gender

We now turn to discussing the role of the gender difference in wage on the life cycle profiles of participation, labor income, consumption, and wealth. To do so, we give all women the same efficiency profiles as men. As a result, all women have higher efficiency profiles than in the benchmark model. Figure 12 plots the resulting changes in labor participation, earnings, consumption, and assets in deviation from their levels in the benchmark model. First, married women increase their labor participation by over 20% until age 50 and still have a 10% higher participation rate by age 65. This increased participation by married women is counterbalanced by a significantly lower participation of married men, which almost counterbalances the increased participation of their wives. It should be noted that a model in which married men are not allowed to change their participation and hours would be missing this important and sizeable change. Thus, it would likely generate a smaller increase in female participation and thus underestimate the effects of a reduction of the gender gap in wages for female labor supply.

Single women now also have a much higher potential average wage and thus choose to participate more in the labor market when young, but less during middle age. The effects on the participation of single women are thus much smaller than those of married women, in part because they were already participating at higher rates, and in part because they do not have a partner who reduces their labor supply.

Single men do not face any changes in their optimal problem and thus work the same number of hours.

Panel (b) of the figure displays that, consistently with the increase in female



(a) Participation

(b) Labor income

(c) Consumption

(d) Assets

Figure 12: Changes when all women have the efficiency profiles of men of the same marital status

wages and increased participation, the labor income earned by women increases a lot. This difference peaks between age 35 and 40, respectively at over \$25,000 for married women and over \$15,000 for single women. The labor earnings of married men drop by about \$5,000 a year, thus resulting in an increase in total labor earnings for married couples as a result of increased wages for women.

Panel (c) shows that, as a result, the consumption for couples and single women is much higher, with an increase peaking at over \$12,000 a year for married couples between ages 40 and 50 and at well over \$10,000 for single women in the same age range.

Finally, panel (d) shows that this increased earnings are saved to finance higher consumption during retirement by both married couples and single women, resulting in an increase in assets at retirement compared to our benchmark of over \$10,000 for both couples and single women.

7 Conclusion

Our paper provides multiple contributions. First, it documents the differences in participation, hours worked, and earnings, by gender and marital status. Second, it shows that married people and women make up for a large fraction of workers, hours, and earnings in the aggregate economy. Third, besides considering a standard life cycle model, it constructs a structural and dynamic model that explicitly models single and married men and women and calibrates it to both PSID and HRS data, and shows that its aggregate implications are consistent with the data and very different from those of the standard representative agent life cycle model, that is calibrated for men. Fourth, it shows that the interaction of modelling single and married men and women, with their observed differences in life expectancy and wages is very important. In fact, the observed differences between wages and life expectancy for men and women are important determinants of savings and labor supply over the life cycle and affect married and single men and women very differently. Thus, it is very important to model the observation that many people are married and that both wages and life expectancy are different for men and women, even if one is only interested in aggregate outcomes rather than in these subgroups more specifically.

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Appendix A:

In this appendix we describe the data sets and techniques used to compute the inputs for the models and the data outputs that the model is calibrated to match.

The PSID

The Panel Study of Income Dynamics (PSID) is a longitudinal study of a representative sample of the U.S. population. In the first year of the survey, 1968, about 5,000 families were first interviewed, with information gathered on these families and all of their descendants from that time onwards. Individuals are followed over time to maintain a representative sample of families. To accomplish this, the PSID sample persons include all persons living in the PSID families in 1968 plus anyone subsequently born to or adopted by a sample person. All sample members are followed even when leaving to establish separate family units. PSID families also include many non-sample persons, typically individuals who married sample persons after the beginning of the study in 1968. Information on non-sample persons such as spouses is collected while they are living in the same household as an individual in the original sample. However, once they stop living with a sample person, they are not followed further.

The original 1968 PSID sample was drawn from an over-sample of 1,872 low income families from the Survey of Economic Opportunity (the SEO sample) and from a nationally representative sample of 2,930 families designed by the Survey Research Center at the University of Michigan (the SRC sample).

Sample selection.

Selection	Individuals	Observations
Initial sample (observed at least twice)	30,587	893,420
Heads and wives (if present)	18,304	247,203
Born between 1931 and 1955	5,137	105,381
Age between 20 and 70	5,129	103,420

Table 8: Sample Selection in the PSID

We are interested in the cohort born in 1941-1945. To gather relevant information for this cohort, we select individuals born before or after the period 1941-1945, we control for cohort effects, and use results relative to the cohort of interest. More specifically, we select all individuals in the SRC sample who are interviewed at least twice in the sample years 1968-2013, select only heads and their wives, if present, and keep individuals born between 1931 and 1955. Thus, as we consider five-year-of-birth cohorts, we are including two younger cohorts (1931-35 and 1936-40) and two older cohorts (1946-50 and 1951-55) than our cohort of interest. Our larger sample, used to estimate potential wage, includes 5,129 individuals aged 20 to 70, for a total of 103,420 observations. When estimating the average wage rates, however, to minimize the impact of cohort effects, we restrict the information to individuals born between 1936 and 1951, as we detail below.

The wage rate is defined as annual earnings divided by annual hours worked. Gross annual earnings are defined as previous year's income from labor, while annual hours are previous year's annual hours spent working for pay.

Assets are only observed in 1984, 1989, 1994, 1999 and then every two years until 2013. We use total assets defined as the sum of all assets types available in the PSID, net of debt and plus the value of home equity. All monetary values are expressed in 1998 prices.

Wage profiles

We need an estimate of the potential wage profiles and wage processes by age and gender for all individuals, including those non participating in the labor market. To this goal, we first use an imputation procedure to estimate potential wage for non participants. We then estimate the average wage profile by age and gender and the persistence and variance of its unobserved component. We compute separate wage processes for men and women, without conditioning on marital status. Consequently, we use the same wage processes both in the singles and in the marriage economy.

Imputation. In the data, wages may be missing for two reasons: 1) An individual may have been active in the labor market but earnings or hours information (or both) are missing; 2) An individual has not been active in the labor market. In addition, because estimated variances are very sensitive to outliers, we set to missing observations with an hourly wage rate below half the minimum wage and above $250 (in 1998 values). We then impute all the missing values with the same procedure.

In our sample, out of a total of 103,420 observations, we observe the wage rate for 79,956 observations and we impute it for the remaining 23,464. Of those missing, 23% refer to individuals who were active in the labor market but have earnings and/or hours information missing. The remaining 77% of the missing refer to individuals who were not active in the labor market in a particular year.

We impute wage values using coefficients from OLS regressions run separately for men and women and for single and married individuals (four separate groups). To avoid endpoint problems with the polynomials in age, we include individuals aged 20 to 70 in the sample. The dependent variable in our regressions is the logarithm of the hourly wage rate. As explanatory variables we include: a fourth-order polynomial in age, cohort dummies, time dummies (adding up to zero and orthogonal to a time trend), family size (dummies for each value), education (dummies for three levels, less than high school, high school and college), number of children (dummies for each value), age of youngest child and an indicator of partner working if married. As an indicator of health we use a variable recording whether bad health limits the capacity of working, as this is the only health indicator available for all years (self-reported health starts in 1984 and is not asked before). This health indicator however is not collected for wives, so we do not include it in the married women regression. All regressions also include interactions terms between the explanatory variables. Using the estimated coefficients, the predicted value of the (logarithm of the) wage is taken as a measure of the potential wage for observations with a missing wage. When the wage is observed, we use the actual wage.

Alternatively, we could estimate fixed effect regressions separately for men and women and include marital status as an explanatory variable because it is not constant over time. From these estimates, we would obtain an estimate of the fixed effect for each individual, and use it along with the estimated coefficients it to impute missing values. With this procedure, however, we would obtain an estimate of the fixed effect only for individuals with at least two non-missing wages, while with OLS we can estimate the potential wage for all the individuals in the sample.

Estimation. We use the potential wage to estimate the deterministic age-efficiency profile e_t^i as a function of age. The sample is restricted to individuals born between 1936 and 1951, to account for changes in the age-efficiency profile. To estimate the profile, we run a fixed effect regression of the logarithm of the wage rate on a fourth-order age polynomial, separately for men and women. We then regress the residuals on time and cohort dummies to compute the average effect for the cohort born in 1941-1945 and use that estimate to fix the constant of the wage profile. To estimate the variance structure of the log wage rate we use residuals of the log wage rate computed with the same procedure just described, that is we first run a fixed effects regression and then we regress the residuals on time and cohort dummies.[5] In this case, to have enough observations to estimate the variances, we include all cohorts from 1931 to 1955. When computing the variances, we limit the age range between 25 and 55 and we use waves only up to 1997, the last wave in which yearly data are available. As we rely on residuals also taken from imputed wages, we drop the highest 0.5% residuals both for men and women, in order to avoid large outliers to inflate the estimated variances (however, the effect of this drop is negligible on our estimates).

The shock in log wage is modelled as the sum of a persistent component plus a white noise, which captures measurement error

$$\ln u_{t+1}^i = \ln \epsilon_{t+1}^i + \xi_{t+1}^i$$

$$\ln \epsilon_{t+1}^i = \rho^i \ln \epsilon_t^i + v_{t+1}^i$$

Where i indicates men and women and ξ_{t+1}^i and v_{t+1}^i are white noise processes with zero mean and variances equal to $\sigma_{i\xi}^2$ and σ_{iv}^2 respectively. This last variance, together with the persistent parameter ρ^i, characterize the AR process in the model. Estimation is carried out using minimum distance techniques, standard in the literature of earnings dynamics.

Parameter	Men	Women
Persistence ρ^i	0.973	0.963
Variance prod. shock v_{t+1}^i	0.016	0.014
Initial variance at 25	0.128	0.122
Variance white noise ξ_{t+1}^i	0.070	0.070

Table 9: Estimated processes for the wage shocks for men and women (PSID data)

Initial assets and wage shocks

We parameterize the joint distribution of initial assets and wage shocks at age 25 for either all individuals (singles economy) or for singles and couples (marriage

[5] In the second step we add time dummies (as in Deaton and Paxson, 1994), constrained to add up to zero and orthogonal to a time trend. Adding this sort of time dummies is not strictly necessary, as those business cycle shocks would be captured by the white noise component in the estimation of the variance of the unobserved component of wage.

economy) as a joint log normal in the logarithm of assets and the wage shock. We set a shift parameter δ_a for assets to have only positive values and to be able to take logs. The wage shock is the residual from the wage regressions described above, re-scaled in order to remove the white noise component.

$$\begin{pmatrix} \ln(a+\delta_a) \\ \ln \epsilon \end{pmatrix} \sim N \begin{pmatrix} \mu_a + \delta_a & \\ & , \Sigma_s \\ \mu_\epsilon & \end{pmatrix}$$

Where Σ_s is a 2x2 covariance matrix. This is done separately for men and women (in the singles economy we do not condition on marital status) or for single men and single women (in the marriage economy, where we condition on marital status).

For couples, in the marriage economy, we compute:

$$\begin{pmatrix} \ln(a+\delta_a) \\ \ln(\epsilon_h) \\ \ln(\epsilon_w) \end{pmatrix} \sim N \begin{pmatrix} \mu_a + \delta_a & \\ \mu_{\epsilon h} & , \Sigma_c \\ \mu_{\epsilon w} & \end{pmatrix}$$

Where Σ_c is a 3x3 covariance matrix computed on the data for married or cohabitating couples.

The HRS

We use the Health and Retirement Study (HRS) to compute inputs for the retirement period because this data set contains a large number of observations and high quality data for this stage of the life cycle. In fact, the HRS is a longitudinal data set collecting information on people aged 50 or older, including a wide range of demographic, economic, and social characteristics, as well as physical and mental health, and cognitive functioning.

The HRS started collecting information in 1992 on individuals born between 1931 and 1941, the so-called initial HRS cohort, which was then re-interviewed every two years. Other cohorts were introduced over the years, the AHEAD (Assets and Health Dynamics Among the Oldest Old) cohort, born before 1924, was first interviewed in 1993, while the Children of Depression (CODA) cohort, born 1924 to 1930, and the War Baby cohort, which includes individuals born 1942 to 1947, were introduced in 1998 and subsequently interviewed every two years. Younger cohorts, the Early Baby Boomer (EBB), born 1948 to 1953, and the Mid Baby Boomer (MBB), born 1954 to

1959, were first interviewed in 2004 and 2010 respectively.

To estimate input probabilities and outputs to be matched, we need information for individuals born during the 1941-1945 period. To this end, we include all individuals of all cohorts starting from wave 3 (year 1996). We estimate the relevant probabilities using all individuals born between 1900 and 1945, controlling for cohort effects and using coefficients relative to the cohort born in 1941-1945.

Our dataset is based on the RAND HRS files and the EXIT files to include information on the wave right after death. Our sample selection is as follows. Of the 37,317 individuals initially present, we drop individuals for which marital status is not observed (2,275 individuals) because marital status is a crucial information in our analysis. This sample consists of 35,042 individuals and 176,698 observations. We then select individuals in the age range 66-100 born in 1900 to 1945, obtaining a sample of 15,072 individuals and 67,744 observations.

Survival probabilities

We model the probability of being alive at time t as a logit function

$$\pi_{st} = Prob(S_t = 1/X_t^s) = \frac{\exp(X_t^s)}{1+\exp(X_t^s)}.$$

For the singles economy, we include as explanatory variables a fourth-order polynomial in age, gender, and interactions between these variables. For the marriage economy, we also include marital status and interactions of the previous variables with marital status. We also include cohort dummies and use coefficients relative to the 1941-1945 cohort in the model. As the HRS is collected every two years, we transform the biennial probability of surviving into an annual probability by taking the square root of the biennial probability. Having estimated survival probabilities for men and women (also by marital status in the marriage economy) in the age range 66-100, we apply standard formulae to compute life expectancy at various ages.

Appendix B: Sketch of the Solution Algorithm

The state space for average lifetime earnings and asset holdings is discretized into unevenly spaced grids. We use regular grid search to solve the model.

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

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

1. Compute the value function of the retired single person for all time periods after retirement, doing the usual backward iteration starting from the last period.

2. Compute the value function of the retired couple for all time periods after retirement, which uses the previous one in case of death of one of the spouses, doing the usual backward iteration starting from the last period.

3. Compute the value function of the single individual in a marriage for all time periods after retirement, adding up all of the discounted value of utility going backward, and computing the present value using the appropriate probabilities.

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

1. For any given time period, take as given the value of being a single person in a married couple for next period, which has been previously computed. Compute the value function of being single.

2. Given the value function of being single, compute the value function of the couple for the same age.

3. Given the optimal policy function of the couple, solve for the discounted present value of utility for each of the spouses in a marriage.

4. Keep going back in time until the first period we solve for.

After we solve the value functions and policy functions, we simulate as follows. We take initial distributions of people by marital status and wages from the PSID data. We then use the model to simulate our cohort until the end of its life cycle.