Inequality and the Marriage Gap

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Abstract

Marriage is one of the most important determinants of economic prosperity, yet most existing theories of inequality ignore the role of the family. This paper documents that the distributions of earnings and wealth are highly concentrated, even when disaggregated into single and married households. At the same time, there is a large marriage gap: married people earn on average 26 percent more income, and they hold 35 percent more net worth. To account for these facts, I develop a general equilibrium model where females and males face uninsurable income risk and make decisions on consumption-savings, labor supply and marriage formation. In a calibrated version of the model, I show that selection into marriage based on productive characteristics, an effective tax bonus for married couples, and stronger bequest motives for households with descendants are key to accounting for the marriage gap in earnings and wealth. A policy experiment of moving from joint tax filing for married couples to separate filing yields output gains and more marital sorting.

Keywords: Inequality; Wealth Distribution; Marriage Gap.

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1 Introduction

Marriage is one of the most important determinants of economic prosperity. Yet, perhaps surprisingly, most existing theories of inequality abstract from the role of the family: the standard framework for studying inequality treats all households as being comprised of a single decision-maker, without making the role of marital status explicit. The main contribution of this paper is to fill this void and present a theory that can account for the observed inequality between single and married households.

The cross-sectional distributions of earnings, income and wealth in the United States display a large degree of concentration.[1] When disaggregated into married and single households, economic prosperity remains very unequally distributed *within* both subgroups. At the same time, there is a striking divergence *between* both subgroups: on average, married people have 32.3 percent higher labor earnings, they earn 25.5 percent more income, and they are 34.9 percent richer than singles. This disparity, the marriage gap, is not driven by very rich households as the corresponding ratios of medians look similar, and it is robust to controlling for age and other potentially confounding factors. In light of the empirical relevance of the family – in the year 2013, half of the adult population in the United States was married – reconciling the strong association between marital status and economic outcomes is a challenge that models of inequality must face.

To account for these stylized facts, I develop a dynamic general equilibrium model where females and males transit stochastically through a life cycle that consists of a working age and a retirement phase. Throughout working age, they face uninsurable, idiosyncratic labor productivity risk, and they make decisions on consumption, labor supply and savings. Single individuals further participate in a marriage market where they randomly meet individuals of opposite gender and decide whether to get married. Marriage formation decisions in the model are bilateral, i.e. both partners have to be better off entering marriage, and they depend on the productive characteristics – permanent and time-varying labor productivities, individual assets – of both persons. Married households pool their income and savings, and they commit to a Pareto-efficient allocation subject to exogenous divorce risk. Once retired, households make consumption-savings decisions taking into account their bequest motives. Finally, there is a firms sector producing a homogeneous good with capital and labor services, and there is a government that taxes income and pays pension

[1] See, for example, Heathcote, Perri and Violante (2010), Hintermaier and Königer (2011), and Kuhn and Ríos-Rull (2016).

benefits to retirees.

A calibrated version of the model is largely successful in accounting for the facts from the data. The model generates substantial inequality within the subgroups of single and married households, and it predicts a positive marriage gap for earnings, income and wealth. Three factors are key for generating the marriage gap. First, the model creates endogenously strong selection effects into marriage: more productive and asset-rich individuals are also more likely to find a spouse on the marriage market. With persistent productivity levels, this force shapes the composition of the population of single and married households and contributes crucially to generating the marriage gap. Second, one of the novel features I propose in this paper is the notion of stronger dynastic ties in households with descendants. The benchmark models embeds this idea by allowing bequest motives to depend on the presence of descendants. Since married households tend to have more descendants, a dynastic saving motive adds to explaining the marriage gap in wealth. Third, the model captures the differential tax treatment of single and married households as implied by the U.S. tax code. I show that married couples often face lower effective income taxes by filing their taxes jointly, which leads them to work longer hours and raises their permanent disposable income. Since precautionary saving is tightly associated with a target wealth-to-permanent-income ratio, married couples are also led to save more. In setting up a series of counterfactuals, I show that all three factors contribute significantly to generating the marriage gap, with the largest contribution coming from selection into marriage.

In further experiments, I explore the behavior of single and married households along the wealth distribution. A key finding emerging from the analysis is that marriage plays a relatively larger role for poor and middle-class households. For instance, I show that divorce risk has a disproportionally larger effect on savings for asset-poor couples. One reason is that the precautionary motive leads these couples to insure against the risk of losing access to intrahousehold insurance. A second reason is that the possibility of potentially returning to the marriage market in the future provides an additional incentive to accumulate assets. In fact, I show that marriage rates are strongly responsive to the amount of initial wealth brought into the marriage market, in particular for asset-poor individuals. As a final experiment, I conduct a hypothetical policy reform that abolishes the possibility of joint tax filing for married couples. I find that such a reform would lead to substantial output gains and a rise in hours worked driven by increasing labor supply of secondary earners in married couples. My results further suggest a strong rise in assortative mating as joint filing is relatively more advantageous for couples with very different incomes.

This paper relates to two strands of literature. First, it builds upon a host of studies addressing income and wealth inequality in general equilibrium frameworks, e.g. Aiyagari (1994), Huggett (1996), Krusell and Smith (1998), Castañeda, Díaz-Giménez and Ríos-Rull (2003) and De Nardi (2004). All of these studies, however, abstract from modeling the marital status of a household. A second body of literature makes this distinction explicit by considering single and married households separately; some examples include Aiyagari, Greenwood and Guner (2000), Greenwood, Guner and Knowles (2003), Regalia and Ríos-Rull (2001), Hong and Ríos-Rull (2007), Heathcote, Storesletten and Violante (2009), and Guvenen and Rendall (2015). To the best of my knowledge, there is little theoretical work on the role of marital status and cross-sectional inequality in a joint context. The study most closely related is Guner and Knowles (2004) who investigate the link between marriage and wealth in an OLG setting. In their model, single agents and married couples make decisions on consumption, hours and savings, and they decide whom to marry and when to divorce. Their model can generate a positive wealth gap. The mechanism is based on their modeling of consumption within married households as a public good and calibrating it using estimates for adult equivalence scales. Since their setup only consists of three periods, it neglects intrahousehold insurance effects on savings and may perform poorly when tested along the cross-sectional dimension. Mustre-del-Río (2015) develops a model that matches the wealth distribution of married households; however, he does not include singles in the analysis. Greenwood, Guner, Kocharkov and Santos (2016) construct a framework of marriage, divorce, educational attainment and married female labor force participation. Their analysis focuses on the impact on income inequality without looking explicitly at wealth inequality. Several other studies examine the relationship between marital sorting and income inequality in a static context: Fernández and Rogerson (2001), Choo and Siow (2006) and Greenwood, Guner, Kocharkov and Santos (2014) are some examples from this literature.

This paper contributes to a growing literature employing dynamic life-cycle models with equilibrium marriage markets. Caucutt, Guner and Knowles (2002) explore the link between wage inequality and marriage decisions of young women. However, like Greenwood, Guner and Knowles (2003) and Greenwood, Guner, Kocharkov and Santos (2016), they assume that agents are unable to borrow or save. Other studies allow for savings in dynamic life-cycle models, but they treat marital transitions as exogenous shocks. For instance, Cubeddu and Ríos-Rull (2003) study the implications of marital turnover for macroeconomic aggregates, and Fernández and Wong (2014) investigate the link between marital instability and married women's labor force participation.

So far only a handful of papers have embedded savings into a dynamic model of equilibrium household formation/destruction. Mazzocco, Ruiz and Yamaguchi (2007) propose a collective household model of labor supply, savings and marriage decisions. Their analysis is centered on individual household behavior, while my paper focuses on cross-sectional inequality and the marriage gap. Voena (2015) constructs a collective model of household decision making to explore how divorce laws affect couples' intertemporal behavior. Her focus is on studying the role of limited commitment in different divorce regimes. She models remarriages as exogenous events, while in my paper household formation is modeled explicitly and divorces are exogenous. Santos and Weiss (2016) assess to what extent the rise in labor income volatility over the last decades can explain the decline and delay in first-time marriages. While they also consider a unitary model of the household, a key difference to my framework is that they do not allow for divorces and remarriages.

The divergence in effective taxation between single and married households and the role of joint tax filing is studied by Guner, Kaygusuz and Ventura (2012). These authors construct a life-cycle economy populated by single and married workers who differ according to their labor efficiency and age. At the heart of their analysis lies an exogenous utility cost of participating in the labor market which allows them to focus on the extensive margin of married female labor supply. The authors use their model to evaluate various tax reforms, *inter alia* the abolition of joint tax filing. Their results associate substantial output gains with such a reform and, thus, share a commonality with my own findings. However, their framework does not allow for endogenous adjustments along the household formation margin which is an important model ingredient put forward in this paper.

The literature has identified bequest motives to generate a lifetime saving profile consistent with the data. De Nardi (2004) shows that intentional bequests can explain the emergence of very large estates at the upper tail of the wealth distribution. Fuster, Imrohoroglu and Imrohoroglu (2008) study the significance of intergenerational links for the impact of various tax reform proposals. They find that tax reforms can have very different implications depending on whether individuals derive utility from bequeathing to their descendants or not. Laitner (2001) introduces the existence of intentional and accidental bequests in a common framework. In his model, a constant fraction λ of households cares about their heirs; the remaining households care only about their own utility. In comparison to his approach, my framework relates the existence of a bequest motive explicitly to the presence of a descendant.

The remainder of the paper is organized as follows. Section 2 documents the empirical facts. In Section 3, I present my benchmark model and define a stationary equilibrium. Section 4 describes the calibration strategy, and Section 5 contains my results. Section 6 assesses the implications of moving from joint tax filing to separate filing. Concluding remarks are offered in Section 6.

2 Empirical Facts

To motivate this study, this section presents empirical evidence on the relationship between the marital status and cross-sectional inequality in earnings, income and wealth in the United States.

2.1 Data Description

Most of the analysis is based on data from the Survey of Consumer Finances (SCF). The SCF is well suited to document empirical facts on the cross-sectional distributions of labor earnings, income and wealth for two reasons. First, it provides information on all three variables of interest, whereas e.g. the Current Population Survey (CPS) does not collect any data on household wealth. Second, the SCF explicitly oversamples wealthy households and employs appropriate weighting schemes to adjust for higher non-response rates among rich households. Therefore, it provides a more accurate description of the upper tails of the various distributions, as distinguished from other U.S. household surveys such as the CPS or the Panel Study of Income Dynamics (PSID).

For the purpose of this study, I restrict the sample to comprise only households where the head is at least 23 years old. Furthermore, I exclude the wealth-richest 0.1 percent of households: in the model presented in the next section, agents draw their labor efficiency based on a stochastic earnings process that has been estimated from PSID data. Since the very rich households are neither present in the PSID nor in my model, I exclude them from the sample.[2] A detailed description of the data and the sample selection is provided in Appendix A.

[2] Heathcote, Storesletten and Violante (2010) and Hintermaier and Königer (2011) pursue a similar strategy. Castañeda, Díaz-Giménez and Ríos-Rull (2003) show that matching the concentration at the very top of the wealth distribution requires a small-probability state of extremely high hourly wages. For instance, in their benchmark economy agents in the highest efficiency state are more than 100 times more productive than those in the second-highest state, and they are more than 1,000 times more productive than agents in the lowest state.

Table 1: Summary statistics

	Mean ($)	Median ($)	Gini	Bottom 40%	Top 5%
All households					
Labor earnings	60,570	33,480	0.64	3.2	33.5
Total income	84,019	48,393	0.55	10.5	33.1
Wealth	469,343	86,700	0.81	0.1	57.2
Married households					
Labor earnings	84,746	55,799	0.57	7.2	29.7
Total income	113,724	71,017	0.51	12.4	31.2
Wealth	652,870	154,520	0.79	1.0	53.7
Single households					
Labor earnings	27,380	13,189	0.68	0.2	34.7
Total income	43,237	29,421	0.49	13.0	29.1
Wealth	217,384	35,801	0.81	−1.6	56.7

NOTES: The table shows statistics from the 2013 wave of the Survey of Consumer Finances (SCF).

2.2 Cross-sectional Inequality: Married and Single Households

The upper panel in Table 1 summarizes a selection of distributional statistics in the United States, based on data from the 2013 wave of the SCF. As is well known, labor earnings, total income and wealth are very unequally distributed, with wealth being by far the most concentrated one among them. For instance, households belonging to the bottom 40 percent of the respective distribution receive only 10.5 percent of aggregate income and their contribution to aggregate net worth is virtually zero. The Gini coefficient exceeds 0.5 for all variables of interest and is particularly high for wealth (0.81). These numbers indicate that the cross-sectional distributions of earnings, income and wealth are highly skewed to the right, with fat lower tails and a very thin upper tail.

The middle and lower panels in Table 1 display the same set of statistics when the sample is partitioned into married and single households. Two observations stand out. First, there is a substantial amount of within-group inequality in the two subsamples: earnings, income and wealth remain very unequally distributed as evidenced by the various inequality measures. The Gini coefficient of wealth, for example, is around 0.8 within both subpopulations, just as in the whole population. Second, there is a striking disparity between the two samples: married households earn significantly more income and they hold substantially more assets than single households, even when dividing by the number of potential earners (cf. Table 1, first two columns). To make this point more explicit, I now turn to defining this disparity formally as the *marriage gap* – the per-capita difference between married and single individuals.

2.3 The Marriage Gap

I define the marriage gap in variable x (e.g. mean labor earnings) as

$$\Delta(x) \equiv 100 \cdot \Big(\frac{1}{2}\, x^{\mathcal{M}} / x^{\mathcal{S}} - 1 \Big), \tag{1}$$

where I divide the value for married households, $x^{\mathcal{M}}$, by 2 in order to compute the per-capita value. The marriage gap $\Delta(x)$ is then obtained as the percentage deviation between married and single persons. For instance, for the numbers presented in Table 1 from the 2013 SCF, the marriage gap in mean wealth can be computed as $100 \cdot\ (0.5 \cdot 652,870/217,384 - 1) = 50.2$.

To provide a comprehensive picture of the marriage gap, I proceed as follows. First, for the case of labor earnings, I consider only working-age households between 23 and 64 years of age. Second, and more importantly, I extend the data sample to comprise the latest five waves of the SCF ranging from 2001-2013. Based on this sample, I then compute the marriage gap in the data by regressing the respective dependent variable (e.g. mean per-capita earnings) on a marriage dummy and a set of dummies to control for time effects.

Table 2 reports my results. As can be seen in column (1), married people earn on average 32.9 percent more labor income than singles. The marriage gap in mean income amounts to 25.5 percent, and married peoples' net worth is on average 34.9 percent larger than singles' net worth. Put differently, while about 60 percent of the population in the sample is married, they hold almost 80 percent of the total wealth and they earn 81 percent of the total labor income. Are these values driven by extreme observations, e.g. by very rich households? Column (1) in Table 2 also displays estimates for the median marriage gap based on a set of quantile regressions. My results indicate that the disparities in median labor earnings (23.6 percent) and median income (17.4 percent) are slightly smaller than the corresponding values for the means. On the other hand, the median married individual owns almost 77 percent more wealth than the median single, which is substantially larger than the value for the mean.

Table 2: The marriage gap

Dependent variable	(1)	(2)	(3)	(4)
Labor earnings				
Mean	32.3***	28.9***	23.2***	23.0***
	(3.08)	(3.02)	(2.97)	(3.04)
Median	23.6***	20.6***	15.6***	16.9***
	(1.92)	(2.06)	(1.81)	(1.86)
Total income				
Mean	25.5***	18.9***	13.6***	12.6***
	(3.40)	(3.32)	(3.26)	(3.31)
Median	17.4***	7.9***	4.5***	4.8***
	(1.63)	(1.22)	(1.14)	(1.23)
Wealth				
Mean	34.9***	42.4***	29.9***	29.6***
	(4.79)	(4.96)	(4.72)	(4.80)
Median	76.9***	33.9***	27.5***	29.2***
	(5.40)	(2.26)	(2.07)	(1.88)
Constant	yes	yes	yes	yes
Time	yes	yes	yes	yes
Age	no	yes	yes	yes
Race	no	no	yes	yes
Child below 6	no	no	no	yes
Number of obs	23,534	23,534	23,534	23,534

NOTES: SCF: 2001-2013, five waves. The table reports the percentage deviation in per-capita values between married and single individuals. These numbers are obtained by regressing the respective dependent variable (first column) on a marriage dummy and varying sets of controls. Columns (1)-(4) refer to different specifications, where "age" represents a full set of age dummies, "race" represents a full set of race dummies, and "child below 6" is a dummy variable. To obtain the percentage deviation reported above, the estimated coefficient on the marriage dummy is divided by the predicted sample average, where all other controls are evaluated at their respective means. Sampling weights have been included in all regressions. Standard errors are reported in parentheses; * denotes $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

To what extent do age effects explain the marriage gap? Most people get married later than at the age of 23, which implies that they enter the sample of married households at a later point of their increasing life-cycle profile of earnings and wealth. To gauge the importance of age effects, I run another set of regressions, this time controlling for age. The estimates – reported in column (2) in Table 2 – indeed indicate that part of the marriage gap is explained by life-cycle components, especially for the medians. The median wealth gap, for instance, substantially decreases from 77 percent to 34 percent. On the other hand, the marriage gap in mean wealth increases from 35 percent to 42 percent. On a broader level, the numbers suggest that married people earn significantly more income and they hold significantly more wealth than singles, even after controlling for age.

The quantitative analysis based on a structural model presented in the next section will investigate the role of selection into marriage based on productive characteristics, the differential tax treatment of single and married households, and the role of stronger intergenerational ties in households with descendants as potential determinants of the marriage gap. One concern is that marriage is masking other dimensions of heterogeneity which ultimately explain the marriage gap, but which are not included in the quantitative model, e.g. race, the presence of young children, or the geographical region. To assess this notion, I extend my regression framework to control for the race of the household head and the presence of a child below 6 years of age (Table 2, columns (3) and (4)). As can be seen in the table, the marriage gaps are slightly smaller when race effects are taken out. While a more complex framework could attempt to account for differential marriage patterns across races, in this paper I will focus on the large unexplained remainder of the marriage gap.[3] Regarding the presence of young children in the household, the estimates presented in the last column (4) suggest a negligible impact on the marriage gap. Finally, I assess the impact of the geographical region. Since the SCF does not provide data on the state of residence, I conduct a similar empirical analysis using the 2013 wave of the Current Population Survey (CPS). While the CPS does not provide data on household net worth, its much larger sample size also allows me to assess the robustness of the empirical findings derived so far. The estimates – delegated to Appendix B – turn out to be very similar to those from the SCF. Moreover, they indicate that the state of residence does not provide substantial explanatory power to the marriage gaps in earnings

[3]Caucutt, Guner and Rauh (2016) explore why marriage rates have declined much more for blacks than for whites since the 1970s. They find that differences in incarceration rates can explain a large share of the racial divide in marriage.

and income.

To summarize, the preceding empirical analysis has uncovered two main findings: first, the cross-sectional distributions of earnings, income and wealth in the United States are highly concentrated and skewed to the right. This holds true for the sample of all households, and for the subsamples of single and married households. Second, married people earn considerably more income and they are richer than singles. This marriage gap – the difference in per-capita values between married and single individuals – is robust to controlling for age and other potentially confounding factors. With the aim of constructing a theory that is consistent with these empirical facts, I now turn to presenting my structural model.

3 The Model

Consider an overlapping-generations production economy populated by individuals, firms and a government. Time is discrete and runs forever. I describe a stationary environment in which all prices and distribution measures are constant over time.

3.1 Economic Environment

Demographics. At the beginning of each period, a cohort of new individuals enters the economy. Half of them are born as females, the other half are born as males. The total population measure of individuals of each gender is normalized to unity. Females and males live through a stochastic life cycle with two phases: working age and retirement. At the end of each period, working-age individuals face a constant exogenous probability ϕ^R of retiring, and retired individuals face a constant exogenous probability ϕ^D of dying. Dying individuals are replaced by an equal measure of newborns to keep the population size constant.

An individual can live either in a one-person (single) or two-person (married) household. Married households are comprised of two adults, one female and one male. Marriages are formed endogenously by single agents participating in a marriage market, while divorces occur exogenously at rate ψ. I assume that only working-age individuals form new marriages and are subject to divorces, while households remain stable once they retire. Married households retire and decease jointly.

Preferences. Agents enjoy the consumption of an aggregate good and they dislike working.

Preferences of individuals of gender $g \in \{f, m\}$ can be described by a per-period utility function $U^g(c, h)$ where c and h denote consumption and hours worked respectively, and a common discount factor β. In addition, they enjoy leaving bequests and they potentially derive utility from being married (details follow).

Labor market. In each period, agents are endowed with one unit of disposable time and a labor productivity level e that depends on their history of idiosyncratic shocks. Retired agents are not productive at all, i.e. $e = 0$. In the working-age phase, the labor productivity of individual i is given by

$$e^i = \exp\left(\xi^i + z^i\right), \tag{2}$$

where $\xi^i \in \Xi$ is a permanent component that is determined when an agent is born and may be interpreted as an ability shock. The time-varying component of labor productivity z^i evolves according to an AR(1) process,

$$z^{i\,\prime} = \rho^\xi z^i + \epsilon^i, \qquad \text{with } \epsilon^i \overset{\text{i.i.d.}}{\sim} N(0, \sigma_\epsilon^\xi), \tag{3}$$

where ρ^ξ measures the longevity of temporary productivity shocks and σ_ϵ^ξ the volatility of innovations. Both parameters are allowed to depend on the permanent component and are later calibrated to match education-specific estimates from the Panel Study of Income Dynamics (PSID).

Asset markets. There are no markets for state-contingent contracts in the economy; hence, workers cannot insure perfectly against idiosyncratic labor market uncertainty. Also, there is no annuity market to insure individual mortality risk. The only asset in the economy is physical capital, which pays out the risk-free interest rate r. Individuals in this economy are not allowed to borrow, which imposes a zero lower bound on their asset holdings. This assumption also implies that agents cannot die in debt.

Marriage market. At the beginning of each period, there is a marriage market where single persons participate with probability p and randomly meet a single person of opposite gender. In the benchmark model, the meeting probability will be set to $p = 1$, so every single working-age person participates in the marriage market each period. Upon meeting, the two potential spouses observe each other's characteristics, i.e. their individual permanent and time-varying labor productivities and their capital holdings, and they decide whether they want to get married. The marriage decision is bilateral, i.e. both partners have to be better off entering marriage. A couple that considers forming a married household enters a cooperative bargaining process that prescribes efficiency for the resulting allocation. They can fully commit to this outcome until their marriage is dissolved exogenously or they die together. The married household maximizes a weighted sum of its members' utilities where relative weights are set upon matching and remain fixed thereafter. In this paper I adopt a unitary model of the household and treat utility weights as parameters. I also introduce a fixed utility gain χ of being married. This parameter captures cultural and other non-economic gains and will serve to match the empirical share of married households. A meeting between two individuals that does not result in a new marriage leaves both persons as singles for the remainder of the period. Note that random matching implies that the probability of meeting a potential future mate with specific characteristics depends on the actual availability of singles of opposite gender, represented by the equilibrium distribution on the marriage market.

Intergenerational links. Successive generations are partially linked through the presence of descendants. Descendants have an impact on the bequest motive and the transmission of estates left behind upon dying, potentially reflecting stronger dynastic ties. The presence of descendants is captured by a binary variable, $d \in \{0, 1\}$. Newborn individuals enter the economy without descendants ($d = 0$). During the working-age phase, each period there is an exogenous arrival probability. This probability is allowed to depend on the characteristics of the households: married households are assigned descendants with per-period probability $\pi^{\mathcal{M}}$, and single-person households are assigned descendants with probability $\pi^{\mathcal{S},\xi}$. These probabilities potentially reflect differential fertility patterns by marital status and, for single households by educational background. New marriages where at least one partner has descendants result in a married household with descendants. Divorcing households with descendants form two single households with descendants. Retired households are not subject to descendants shocks anymore.

Dying households with descendants leave their estates as directed bequests to newborns. Estates coming from dying households without descendants are simply redistributed by the government as accidental bequests to provide a minimum initial wealth level for all newborns. I assume that directed bequests coming from a deceased married couple with descendants are transferred randomly to two new entrants in equal shares, i.e. each of the two entrants inherits half of the assets. Directed bequests coming from single persons are simply transferred randomly to one new entrant.[4]

[4]In principle, a constant population size requires that each deceased individual has on average one descendant. For simplicity, I assume that married couples with $d = 1$ bequeath only to two heirs even though they could have more than two heirs and, similarly, that a single person bequeaths only to one heir.

Government. The government levies taxes on income, collects payroll taxes and pays out benefits to retired individuals. Income taxation for single and married households is characterized by two functions, $\tau^{\mathcal{S}}(y)$ and $\tau^{\mathcal{M}}(y)$, where total household income y is composed of labor earnings, capital income and retirement benefits. Payroll taxes are levied on a flat-rate basis on labor earnings, where the tax rate is denoted by τ_p. Retirement benefits are allowed to depend on the gender and ability mix of all household members. The government cannot issue any debt and is thus required to balance its budget on a period-by-period basis.

Firms. Production of the aggregate good is conducted by a continuum of competitive firms. The representative firm operates a technology that can be represented by the Cobb-Douglas production function $F(K, L) = K^{\alpha}L^{1-\alpha}$, where K is the aggregate stock of capital, L is aggregate labor in efficiency units and $0 < \alpha < 1$ is the capital share of income. Female and male labor are assumed to be perfect substitutes, $L \equiv \theta L^m + (1-\theta)L^f$, where θ is a parameter that pins down relative productivities and can thus be used to model the gender gap in wages. The firm's maximization problem is static: given a rental price of capital r and gross wages per efficiency unit for females and males $\bar{w}^f$ and $\bar{w}^m$, respectively, the first-order conditions are:

$$F_K(K, L) = r + \delta \tag{4}$$

$$\theta F_L(K, L) = \bar{w}^m \tag{5}$$

$$(1-\theta)F_L(K, L) = \bar{w}^f, \tag{6}$$

where $\delta > 0$ denotes the depreciation rate of capital. Net wage rates for females and males are denoted by $w^f = (1-\tau_p)\,\bar{w}^f$ and $w^m = (1-\tau_p)\,\bar{w}^m$, respectively.

3.2 Bellman Equations

Single working-age households. For a single individual of gender g the relevant state variables are current wealth a, the permanent and the time-varying components of labor productivity, ξ and z, and whether there are descendants, $d \in \mathcal{D} = \{0, 1\}$. The problem of a single working-age household can be formulated recursively as

$$
\begin{aligned}
\mathcal{V}^g(a,\xi,z,d) \;&=\; \max_{c,h,a'} \Big\{ U^g(c,h) + \beta(1-\phi^R)\,\mathbb{E}\Big[p\,\tilde{\mathcal{V}}^g(a',\xi,z',d') + (1-p)\mathcal{V}^g(a',\xi,z',d')\Big] \\
&\qquad\qquad + \beta\phi^R\,\mathbb{E}\left[\mathcal{V}^{g,R}(a',\xi,d')\right]\Big\} \qquad (7) \\
\text{s.t.} \qquad c + a' \;&=\; y - \tau^{\mathcal{S}}(y) + a, \\
y \;&=\; hew^g + ra, \\
c \geq 0, \qquad 0 \leq h &\leq 1, \qquad a' \in \mathcal{A}, \qquad \text{and (2), (3),}
\end{aligned}
$$

where $\mathcal{A} = \left[0, \overline{A}\right]$, and $\overline{A}$ is an upper bound for asset holdings that is sufficiently large such that it never binds. In (7), $E\,\mathcal{V}^{g,R}(a',\xi,d')$ denotes the expected continuation value of a single household who retires after the realization of the descendants shock. Further, $E\tilde{\mathcal{V}}^g(a',\xi,z',d')$ is the expected value of participating in the marriage market at the beginning of next period. Towards defining this value function, let $\tilde{\nu}^{g*}(a^*,\xi^*,z^*,d^*)$ denote the distribution of single individuals of opposite gender in the marriage market, and let $\mathcal{X} = \mathcal{A}\times\Xi\times\mathbb{R}\times\mathcal{D}$ be the state space for single households. Then the value of participating in the marriage market for a single person of gender g is given by

$$
\begin{aligned}
\tilde{\mathcal{V}}^g(a,\xi,z,d) \;&=\; \int_{\mathcal{X}} \Big(\mathcal{I}^{g*}(a,\xi,z,d,a^*,\xi^*,z^*,d^*)\max\Big\{\mathcal{V}^g(a,\xi,z,d), \mathcal{W}^g(a+a^*,\xi,\xi^*,z,z^*,\tilde{d})\Big\} \\
&\qquad + \big(1-\mathcal{I}^{g*}(a,\xi,z,d,a^*,\xi^*,z^*,d^*)\big)\mathcal{V}^g(a,\xi,z,d)\Big)\, d\tilde{\nu}^{g*}(a^*,\xi^*,z^*,d^*), \qquad (8)
\end{aligned}
$$

where $\mathcal{W}^g(a+a^*,\xi,\xi^*,z,z^*,\tilde{d})$ is the individual value function of entering marriage and will be defined below. If a married household is formed, the assets are pooled, and $\tilde{d}=1$, if $(d=1)\vee(d^*=1)$, and $\tilde{d}=0$ otherwise. It is important to note that the option value of entering marriage is only available if the other party agrees, as reflected by the indicator function $\mathcal{I}^{g*}(a,\xi,z,d,a^*,\xi^*,z^*,d^*)$. This indicator function is in turn an endogenous object which is defined as:

$$
\mathcal{I}^{g*}(a,\xi,z,d,a^*,\xi^*,z^*,d^*) \;=\; \begin{cases} 1 & \text{, if } \; \mathcal{W}^{g*}(a+a^*,\xi^*,\xi,z^*,z,\tilde{d}) \;\geq\; \mathcal{V}^{g*}(a^*,\xi^*,z^*,d^*) \\ 0 & \text{, otherwise.} \end{cases} \qquad (9)
$$

Single retired households. Single individuals in retirement do not participate in the marriage market and in the labor market anymore. Their value function is given by

$$\mathcal{V}^{g,R}(a,\xi,d) \;=\; \max_{c,a'} \left\{ U^g(c,0) + \beta(1-\phi^D)\,\mathcal{V}^{g,R}(a',\xi,d) + \beta\phi^D\,\lambda^g(a',d) \right\} \tag{10}$$

$$\text{s.t.} \qquad c + a' \;=\; y - \tau^{\mathcal{S}}(y) + a,$$

$$y \;=\; b^g(\xi) + ra, \qquad c \geq 0, \qquad a' \in \mathcal{A},$$

where $b^g(\xi)$ are retirement benefits, and $\lambda^g(a',d)$ is a bequest utility function. As in de Nardi (2004), bequest motives are of the "warm-glow" type where individuals only care about total bequests left behind, but not directly about consumption or utility of the recipients. The utility from bequests increases with estates left behind, and the marginal utility is larger if descendants are present: $\lambda^g_{a'}(a',1) \geq \lambda^g_{a'}(a',0) \geq 0$, $\forall a'$. The latter assumption reflects the notion of stronger bequest motives for individuals who have descendants.

Married working-age households. Consider now the maximization problem faced by a married household. As explained above, the utility of each individual in the household carries a weight, reflecting the relative power of that individual in the household. Under full commitment, that is, when household members can commit to future intrahousehold allocations, individual weights are set when the household is formed and remain unchanged thereafter. These utility weights are assumed to be fixed parameters which are homogeneous across couples. Let $\mu \in [0,1]$ be the Pareto weight on the female's utility. Then the recursive problem of a married working-age couple can be formulated as

$$\begin{aligned}
\mathcal{W}(a,\xi^f,\xi^m,z^f,z^m,d) \;=\; \max_{c^f,c^m,h^f,h^m,a'} \Big\{ & \mu\left(U^f(c^f,h^f) + \chi^{\xi^f}\right) + (1-\mu)\big(U^m(c^m,h^m) + \chi^{\xi^m}\big) \\
& + \beta(1-\psi)\mathbb{E}\left[(1-\phi^R)\,\mathcal{W}(a',\xi^f,\xi^m,z^{f\prime},z^{m\prime},d') + \phi^R\,\mathcal{W}^R(a',\xi^f,\xi^m,d')\right] \\
& + \beta\psi\,\mathbb{E}\Big[(1-\phi^R)\left(\mu\mathcal{V}^f(a'/2,\xi^f,z^f,d') + (1-\mu)\mathcal{V}^m(a'/2,\xi^m,z^m,d')\right) \\
& \quad + \phi^R\left(\mu\mathcal{V}^{f,R}(a'/2,\xi^f,d') + (1-\mu)\mathcal{V}^{m,R}(a'/2,\xi^m,d')\right)\Big]\Big\}
\end{aligned} \tag{11}$$

$$\begin{aligned}
\text{s.t.} \qquad c^f + c^m + a' \;&=\; y - \tau^{\mathcal{M}}(y) + a, \\
y \;&=\; h^f e^f w^f + h^m e^m w^m + ra, \\
c^f, c^m \geq 0, \qquad 0 \leq h^f, h^m \leq 1, & \qquad a' \in \mathcal{A}, \qquad \text{and (2), (3),}
\end{aligned}$$

where $\mathcal{W}^R(a,\xi^f,\xi^m,d)$ is the value function of a retired married couple. Note that joint utility maximization with fixed Pareto weights implies that married couples assign these weights to all contingencies, including divorce. The continuation values in case of a divorce reflect the fact that assets are split equally between the two household members. The individual value functions for a married female, $\mathcal{W}^f(a, \xi^f, \xi^m, z^f, z^m, d)$, and for a married male, $\mathcal{W}^m(a, \xi^f, \xi^m, z^f, z^m, d)$, can then be readily obtained from the solution to problem (11). Finally, the parameter χ^ξ captures cultural and other non-economic gains of being married that are not explicitly modeled here. This utility gain is allowed to depend on an individual's permanent ability and will be used to match marriage rates by educational attainment.

Married retired households. The problem of a retired married couple is

$$\mathcal{W}^R(a, \xi^f, \xi^m, d) = \max_{c^f, c^m, a'} \Bigg\{ \mu \left(U^f(c^f, 0) + \chi^{\xi^f}\right) + (1-\mu)\left(U^m(c^m, 0) + \chi^{\xi^m}\right)$$

$$+ \beta(1-\phi^D)\, \mathcal{W}^R(a', \xi^f, \xi^m, d) + \beta\phi^D \Big(\mu\lambda^f(a'/2, d) + (1-\mu)\lambda^m(a'/2, d)\Big) \Bigg\} \tag{12}$$

$$\text{s.t.} \quad c^f + c^m + a' \;=\; y - \tau^{\mathcal{M}}(y) + a,$$

$$y \;=\; b(\xi^f, \xi^m) + ra, \qquad c^f, c^m \geq 0, \qquad a' \in \mathcal{A},$$

where $b(\xi^f, \xi^m)$ are retirement benefits. In the event of a death shock, an individual's bequest utility function corresponds to the one for a single individual with half of the assets of the deceased couple. This assumption implies that an individual's bequest motive does not intrinsically depend on his/her marital status, but only on the estates left (and the presence of descendants).[5]

3.3 Stationary Equilibrium

In a stationary equilibrium, the time-invariant factor prices for capital and labor need to equal marginal productivities. Moreover, agents need to form expectations of the steady-state distribution of single individuals in the marriage market, and these expectations need to be consistent with the actual distribution. Let $\nu^g(a, \xi, z, d)$ and $\nu^{R,g}(a, \xi, d)$ denote the steady-state distributions of single working-age and single retired individuals of gender g respectively. Since only working-age singles participate in the marriage market, the normalized distribution of prospective mates is defined as

$$\tilde{\nu}^g(a, \xi, z, d) \;=\; \frac{\nu^g(a, \xi, z, d)}{\int_{\mathcal{X}} d\nu^g(a, \xi, z, d)}. \tag{13}$$

[5]Of course, a more general formulation of the bequest function could capture a potential dependence on the marital status as well. This would require estimating the joint distribution of bequests, marital status and the presence of descendants.

Towards defining an equilibrium, let $\nu^x(a,\xi^f,\xi^m,z^f,z^m,d)$ and $\nu^{R,x}(a,\xi^f,\xi^m,d)$ denote the steady-state distributions of married couples in working age and retirement respectively, and write the state space compactly as $\mathcal{X}^R = \mathcal{A}\times\Xi\times\mathcal{D}$ for retired singles, as $\mathcal{Y} = \mathcal{A}\times\Xi\times\Xi\times\mathbb{R}\times\mathbb{R}\times\mathcal{D}$ for working-age couples, and as $\mathcal{Y}^R = \mathcal{A}\times\Xi\times\Xi\times\mathcal{D}$ for retired couples.

Definition. A stationary competitive equilibrium in this economy is described by a list of value functions $\{\mathcal{V}^g, \mathcal{V}^{g,R}, \mathcal{W}, \mathcal{W}^R, \mathcal{W}^g, \mathcal{W}^{g,R}\}$, policy functions $\{c^f, c^m, h^f, h^m, a', \mathcal{I}^g\}$, for $g = f, m$, aggregate factor inputs $\{K, L^f, L^m\}$, a distribution of households $\{\nu^f, \nu^{f,R}, \nu^m, \nu^{m,R}, \nu^x, \nu^{x,R}\}$, a set of prices $\{r, w^f, w^m\}$, and a government policy $\{\tau, \tau_p, b\}$, such that:

1. For given prices, taxes and benefits, $\mathcal{V}^g, \mathcal{V}^{g,R}, \mathcal{W}, \mathcal{W}^g, \mathcal{W}^{g,R}$ and $\mathcal{W}^R$ solve household problems (7) and (10)-(12), and c^f, c^m, h^f, h^m, a' are the associated policy functions.
2. The policy function for marriage formation decisions $\mathcal{I}^g$ is determined by condition (9).
3. For given prices, K, L^f and L^m satisfy the firm's first-order conditions (4)-(6).
4. Aggregate factor inputs are generated by the policy functions of the agents:
$$\begin{aligned}
K &= \int_{\mathcal{X}} a^{f\prime}(\cdot)\, d\nu^f + \int_{\mathcal{X}^R} a^{f\prime}(\cdot)\, d\nu^{f,R} + \int_{\mathcal{X}} a^{m\prime}(\cdot)\, d\nu^m + \int_{\mathcal{X}^R} a^{m\prime}(\cdot)\, d\nu^{m,R} + \\
&\quad \int_{\mathcal{Y}} a'(\cdot)\, d\nu^x + \int_{\mathcal{Y}^R} a'(\cdot)\, d\nu^{x,R}, \\
L^f &= \int_{\mathcal{X}} e^f\, h^f(\cdot)\, d\nu^f + \int_{\mathcal{Y}} e^f\, h^f(\cdot)\, d\nu^x, \\
L^m &= \int_{\mathcal{X}} e^m\, h^m(\cdot)\, d\nu^m + \int_{\mathcal{Y}} e^m\, h^m(\cdot)\, d\nu^x.
\end{aligned}$$
5. The distributions of single females $\{\nu^f, \nu^{f,R}\}$, single males $\{\nu^m, \nu^{m,R}\}$ and married couples $\{\nu^x, \nu^{x,R}\}$ are time-invariant.
6. The government budget is balanced.

4 Parameterization and Calibration

The model period is set to one year. I select parameter values to reproduce a set of informative data targets for the United States derived from the Current Population Survey and the Survey of Consumer Finances. Some parameters are set externally, while others are calibrated internally so that the stationary equilibrium in the model matches a list of data moments.

4.1 Parameterization

Preferences. The per-period utility function for females and males is parameterized as follows,

$$U^g(c,h) \;=\; \frac{1}{1-\sigma}\left(c \,-\, \varphi_h^g\,\frac{h^{1+\gamma^g}}{1+\gamma^g}\right)^{1-\sigma} \qquad \text{for } g=f,m, \tag{14}$$

where $\varphi_h^g > 0$ is a parameter, γ^g represents the inverse of the Frisch elasticity of labor supply, and σ is the coefficient of relative risk aversion. I choose a GHH-preference specification, because it eliminates wealth effects on labor supply.[6] These wealth effects would lead single individuals to work longer hours than married individuals, which is counterfactual: in the data, married persons work on average 8.7 percent more hours than singles. With specification (14), the benchmark model comes very close to this value with 7.4 percent. The bequest utility function is identical for females and males and, similarly to de Nardi (2004), is parameterized as

$$\lambda(a',d) \;=\; \frac{\varphi_b^d}{1-\sigma}\big[(a'+\varphi_b^{lux})^{1-\sigma}-1\big]. \tag{15}$$

In equation (15), the parameters $\varphi_b^0, \varphi_b^1 > 0$ are utility shifters measuring the strength of bequest motives. Here they also reflect an individual's desire to leave bequests depending on whether he/she has descendants or not. The parameter φ_b^{lux} measures the extent to which bequests are luxury goods.

Tax functions. The mapping between household income and effective taxes paid is parameterized as follows:

$$\tau^{\mathcal{S}}(y) \;=\; [\,\kappa_0^{\mathcal{S}} \;+\kappa_1^{\mathcal{S}}\,\log(y)\,]\,y \tag{16}$$

$$\tau^{\mathcal{M}}(y) \;=\; [\,\kappa_0^{\mathcal{M}}+\kappa_1^{\mathcal{M}}\log(y)\,]\,y. \tag{17}$$

In a recent study, Guner, Kaygusuz and Ventura (2014) provide parametric estimates for these tax functions based on a large cross-sectional data set from the U.S. Internal Revenue Service that is representative of the universe of U.S. taxpayers. They estimate (16) and (17) separately for unmarried and married households, and they show that the fitted effective tax functions track the data very well at all levels of income.[7]

[6] See Greenwood, Hercowitz and Huffman (1988).

[7] Guner, Kaygusuz and Ventura (2014) also provide estimates that further distinguish by the number of children in the household. However, there are several issues that would make it problematic to explicitly account for children in the tax function without introducing another state variable. First, the concentration of children may still differ

Figure 1 presents a graphical representation of their estimates. The red line marked with triangles depicts the effective average tax rate function for single households and the blue line marked with circles depicts effective average tax rates for married households.[8] As can be seen, effective taxes rise strongly with income, and they are substantially higher for single households than for married households. This differential is due to a host of factors, e.g. differences in the levels of income concentration, standard deductions and personal exemptions, the concentration of dependents, the structure of tax brackets etc. It is also well known that joint filing can result in a more favorable tax bracket for married couples, in particular, if the two partners earn fairly different incomes. For instance, a married couple with combined income equal to mean household income pays an average tax rate of 8.5 percent while two singles where one of them earns everything would pay an average tax rate of 10.5 percent. This difference shrinks if the two partners earn similar incomes. The black dotted line in Figure 1 traces out the effective tax schedule of two single households with identical incomes. The figure indicates that the differential tax treatment of single and married households may result in a tax bonus or a tax penalty, depending on the level of household income and the combination of individual incomes within married households. I return to this point in the quantitative analysis below.

4.2 Parameters Calibrated Externally

Demographics. Individuals enter the economy at the age of 23, and they retire and die stochastically. I target the expected duration of their working life to be 40 years and set $\phi^R = 1/40$. Similarly, I target the expected duration of retirement to be 20 years and set $\phi^D = 1/20$. I assume that an individual's permanent component of labor productivity can take on one of two values, $\xi^i \in \{0, \xi^{co}\}$, and I interpret this as the educational background: no college education (nc) or college education (co). From the March 2013 Supplement to the CPS, I estimate the shares

between single and married households, even when conditioning on a strictly positive number. Second, and more importantly, households can only claim dependents for qualifying children within a limited age range (typically until the age of 19), which could call the approximation within the stochastic life cycle model into question. In this paper I focus on using (16) and (17) because they implicitly capture all dimensions of heterogeneity that are representative of the underlying population.

[8] In line with the rest of the paper, I use the term "single" here when referring to unmarried households. This group of households includes all those filing as *single* or as *head of household*.

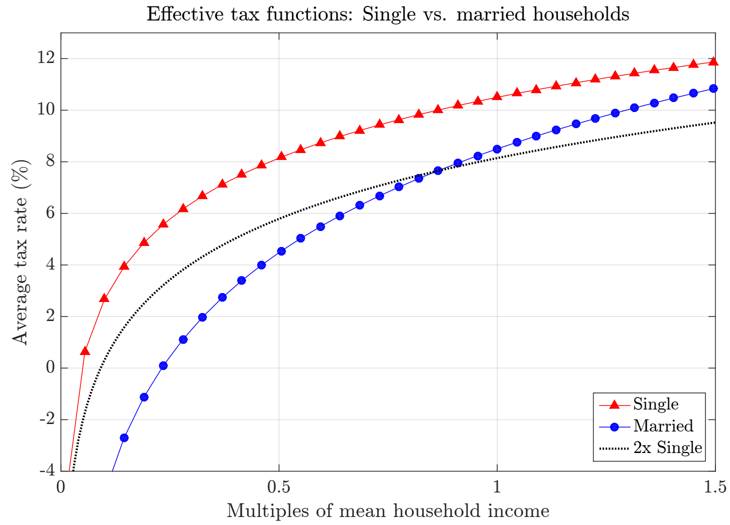

Figure 1: Effective tax functions

of females and males with college education to be 0.42 and 0.41, respectively.[9] Regarding the divorce rate for married couples, based on estimates from the National Longitudinal Survey of Youth 1979, I target a 40-percent chance that a marriage ends in divorce.[10] Given the transition rate from working age to retirement, this pins down the annual divorce probability at $\psi = 0.01$. The per-period meeting probability in the marriage market is set at $p = 1$, i.e. all working-age singles participate every period.

Preferences. Common values for the coefficient of relative risk aversion in the literature are between 1 and 3. I pick an intermediate value and set $\sigma = 1.5$. Estimates for males' Frisch elasticity of labor supply range from 0.2 to 0.6 (see Domeij and Flodén (2006)). Blundell and MaCurdy (1999) find that for females this elasticity is 3-4 times larger than for males. I target values of 1/3 and 1 for males and females, respectively, and set $\gamma^f = 1$ and $\gamma^m = 3$. The female's Pareto weight in married households is set at $\mu = 0.5$.

Labor productivity. Krueger and Ludwig (2016) estimate an AR(1) process as specified in equation (3) from the PSID separately for individuals with and without college education. I set the persistence and volatility parameters based on their estimates: $(\rho^{nc}, \sigma_\epsilon^{nc}) = (0.928, 0.139)$ and $(\rho^{co}, \sigma_\epsilon^{co}) = (0.969, 0.100)$. In addition, I allow for a correlation structure of temporary shocks

[9] Individuals are classified to be college educated if they have obtained some college degree (value of 41 or higher in item '*a-hga*' in the CPS). Appendix A contains a list of all relevant variable definitions.

[10] See Aughinbaugh, Robles and Sun (2013).

within married households. Following Heathcote, Storesletten and Violante (2010), I target a cross-spouse correlation for temporary shocks of 0.15 (see Hyslop (2001)).

Technology. The annual capital depreciation rate is set to $\delta = 0.1$, and the capital share of income is $\alpha = 0.36$; both are standard values in the macro literature.

Table C1 in Appendix C presents a list of all externally calibrated parameters.

4.3 Parameters Calibrated Internally

The remaining parameters are calibrated to match a list of moment conditions. While it is not possible to uniquely identify each parameter by a particular data target, I report below in parenthesis the parameter that has the largest influence on a specific moment.

Preferences. The utility weights on hours worked are set to align the time people spend on market work with estimates from the data. While females work on average 25.5 percent of their discretionary time, the corresponding value for males is 34.5 percent. These estimates are based on the CPS, where I assume that the disposable daily time endowment is 14 hours. $(\varphi_h^f, \varphi_h^m)$ The fixed utility gains of being married are set to match the proportions of married individuals by educational background: in the CPS, 66 percent of people with college education and 57 percent of people without college education are married. (χ^{nc}, χ^{co}) As is well known in the literature, the subjective discount factor can be used to match a capital-output ratio of 3. (β) De Nardi and Yang (2016) calibrate the parameters of the bequest utility function to match moments of the aggregate bequest distribution. I follow these authors and target a bequest-wealth ratio of 0.88 percent (see also Gale and Scholz, 1994). The model allows the strength of bequest motives to depend on the presence of descendants. I use wealth data on old-age individuals from the SCF as a proxy for bequests and estimate a differential of 20.2 percent in asset holdings between individuals with and without descendants. The bequest utility parameters in the model are inferred to match this differential (Appendix C provides a detailed description of the calibration procedure). Finally, I use the luxury goods parameter to match the 90th percentile of the bequest distribution normalized by income (see also Hurd and Smith, 1999). $(\varphi_b^0, \varphi_b^1, \varphi_b^{lux})$

Wage premia and descendants. The parameter θ, which determines the gender wage gap, is set to match a ratio between average female and male hourly wages of 0.78, as estimated from the CPS. (θ) Regarding the college wage premium, I estimate a ratio between average wages of college-

Table 3: Parameters calibrated internally

Description	Param.	Value	Moment	Target	Model
Discount factor	β	0.983	Capital-output ratio	3.00	3.02
Utility weight (f)	φ_h^f	2.26	Hours worked females	0.26	0.26
Utility weight (m)	φ_h^m	16.6	Hours worked males	0.35	0.35
Bequest utility (no desc)	φ_b^0	4.70	Bequest-wealth ratio (%)	0.88	0.88
Bequest utility (desc)	φ_b^1	30.2	Wealth differential 73+	0.20	0.20
Bequest utility	φ_b^{lux}	1.60	90th perc bequest distr	4.34	4.52
Gender premium	θ	0.56	Gender wage gap	0.78	0.78
College premium	ξ^{co}	0.54	College wage gap	1.74	1.74
Marriage utility	χ^{nc}	0.81	Frac married nc HH	0.57	0.57
Marriage utility	χ^{co}	0.75	Frac married co HH	0.66	0.66
Prob. descendants	$\pi^{\mathcal{S},nc}$	0.04	Frac with desc single nc	0.77	0.77
Prob. descendants	$\pi^{\mathcal{S},co}$	0.02	Frac with desc single co	0.68	0.69
Prob. descendants	$\pi^{\mathcal{M}}$	0.08	Frac with desc married	0.95	0.94

educated individuals and non-college-educated individuals of 1.75. The permanent component of labor productivity for college-educated individuals is calibrated to match this target. (ξ^{co}) As for the per-period arrival rates of descendants, I target the empirical fractions of retired households who have descendants. Specifically, I estimate that 77 percent of single non-college households in retirement have children inside or outside of the household. The corresponding value for single college households is lower at 68 percent, while the share of married households with descendants is much higher at 95 percent. The arrival rates are set to match these targets (see Appendix C for further details). ($\pi^{\mathcal{S},nc}, \pi^{\mathcal{S},co}, \pi^{\mathcal{M}}$)

Taxes and retirement benefits. The coefficients for the effective income tax functions are taken from Guner, Kaygusuz and Ventura (2014). I rescale them appropriately to account for mean household income in the model. ($\kappa_0^{\mathcal{S}}, \kappa_1^{\mathcal{S}}, \kappa_0^{\mathcal{M}}, \kappa_1^{\mathcal{M}}$). Retirement benefits are calibrated by implementing a version of the U.S. Social Security system into the model economy. An exact implementation would require keeping track of each individual's lifetime earnings history, which is computationally expensive. Instead, I employ a simpler version where pensions are a function of average earnings during working age for each household type. For instance, retirement benefits for married households with two college-educated spouses are calculated on the basis of average labor earnings by wives and husbands in college/college-households. Appendix C details the calibration of retirement benefits based on Social Security formula bend points. $(b^{f,nc}, b^{f,co}, b^{m,nc}, b^{m,co}, b^{nc,nc}, b^{co,nc}, b^{nc,co}, b^{co,co})$ Finally, the payroll tax rate τ_p is simply set to balance the government budget. The implied value for τ_p in the model is 6.20 percent, which is just slightly lower than 7.65 percent, the employee's share of the US payroll tax in 2013. (τ_p)

Table 3 presents a list of all internally calibrated parameters not related to fiscal policy, along with the model fit. The list of fiscal parameters is relegated to Table C2 in Appendix C.

5 Results

5.1 The Benchmark Model

In this section, I set out to evaluate to what extent the calibrated model economy can account for the empirical regularities derived in Section 2. I focus on two key stylized facts. First, the data implies that the cross-sectional distributions of earnings, income and wealth are highly concentrated. This holds true for the whole population, but also within the subsamples of single and married households. Second, there is a large marriage gap for all three variables: per-capita values are substantially higher for married individuals than for single persons.

Table 4 displays the first set of results. Panel A reports a selection of distributional statistics for labor earnings, income and wealth in the benchmark model. Panel B contrasts the marriage gap in means and medians in the model with the corresponding values from the SCF. The results presented in Table 4 suggest that the model is broadly consistent with the salient features of the data. Firstly, the model succeeds to generate a degree of dispersion that is in accordance with the U.S. distributions of earnings, income and wealth, perhaps with the exception of the respective upper tails where the model understates the degree of concentration. Secondly, the benchmark model generates a positive marriage gap in means and medians for all three variables of interest. In the following, I discuss these results in more detail.

A closer look at Panel A reveals that the model correctly accounts for the fact that the distribution of wealth is far more concentrated than the others. The Gini coefficient is 0.66, and the poorest 40 percent households hold only 2.4 percent of aggregate wealth. The latter measure is not far away from the empirical value of 0.1 percent in the 2013 SCF (cf. Table 1). On the other hand, the model does not quite match the concentration at the top: the richest 5 percent households own

Table 4: Main results

A. Model Statistics		Gini	Bottom 40%	Top 5%
Labor earnings†	All households	0.43	13.1	17.9
	Married	0.32	20.1	14.9
	Single	0.46	11.8	23.9
Total income	All households	0.46	12.5	20.4
	Married	0.37	17.9	17.2
	Single	0.48	12.5	22.2
Wealth	All households	0.66	2.4	30.4
	Married	0.59	5.3	25.2
	Single	0.69	2.2	32.1

B. Marriage gap		Δ^{Mean}	Δ^{Median}
Labor earnings†	Data	+ 32.3	+ 23.6
	Model	+ 5.6	+ 21.0
Total income	Data	+ 25.5	+ 17.4
	Model	+ 7.2	+ 23.3
Wealth	Data	+ 34.9	+ 76.9
	Model	+ 26.0	+ 99.8

Notes: † Only working age. Panel A reports distributional statistics from the benchmark model. Panel B presents the data values and the corresponding model values for the marriage gap. Δ^{Mean} and Δ^{Median} measure the marriage gap in means and medians, respectively (cf. equation (1)).

roughly 30 percent of aggregate wealth, while the data value exceeds 56 percent. The failure of the model to generate enough wealth inequality at the top is a well-known problem of models based on PSID-estimated earnings processes (cf. de Nardi and Fella (2017) for a recent survey of the literature). The model also generates substantial cross-sectional dispersion in the two subsamples of single and married households. In fact, inequality seems to be slightly larger across single households than across married households, which holds true in the data as well. Labor earnings and income are less concentrated than wealth, with a Gini coefficient around 0.45. The data values from the 2013 SCF are slightly higher at 0.56 for earnings and 0.55 for income respectively (not shown).[11] The broad picture that emerges is similar for all variables: while the model fails

[11]Note that the numbers presented in Table 1 are based on the whole sample, i.e. the analysis for labor earnings

to match the concentration at the respective upper tails, it does generate substantial inequality in the whole sample and in the two subsamples.

Panel B reports values for the marriage gap. As can be observed, the model correctly accounts for the fact that married people are richer and that they earn more income than singles. In the model, the per-capita difference in mean earnings is below its empirical counterpart: married people in the model earn on average 6 percent more labor income while the data value exceeds 30 percent. On the other hand, the median married person earns 21 percent more labor income which is only slightly lower than the data value. For total income a similar pattern emerges: the model underpredicts the mean marriage gap (+7.2 percent vs. +25.5 percent) but comes fairly close to matching the median marriage gap (+23.3 percent vs. +17.4 percent). In terms of net worth, married persons in the model are on average 26 percent richer than singles. In the data, this number is slightly larger at 34.9 percent. On the flip side, the median wealth gap in the model (+99.8 percent) is larger than its empirical counterpart (+76.9 percent). Overall, the model does a good job of generating positive per-capita differences between married and single households. In the next subsection, I turn to addressing the question which channels in the model contribute to generating the marriage gap.

5.2 The Marriage Gap: A Decomposition Analysis

To shed more light on this question, I simulate a series of alternative models and compare their predictions for the marriage gap in earnings, income and wealth. The objective is to ascertain the importance of three factors: (i) stronger bequest motives for individuals with descendants; (ii) the differential tax treatment of single and married households; and (iii) selection into marriage based on productive characteristics. Starting from the benchmark model, I shut these channels down one by one and recalibrate each model appropriately. The results are reported in Table 5.[12]

Intergenerational ties. One of the novel features proposed in this paper is the notion of stronger dynastic links in households with descendants. In the benchmark model, this idea is captured by allowing bequest motives to depend on the presence of descendants (cf. specification (15)). In the first counterfactual (M1), I shut down this channel by restricting the strength of bequest

is not constrained to working-age households.

[12] I have experimented with a series of alternative models where the three channels are deactivated in a different order; quantitatively, the results are similar.

motives to be identical for individuals with and without descendants, i.e. I impose $\varphi_b^0 = \varphi_b^1$. The model is then recalibrated to match the set of data moments, with the exception of the target that relates to differential asset holding for old-age individuals. As can be seen in Table 5, the marriage gaps in mean wealth and median wealth shrink by 5.6 and 15.9 percentage points in this model. The benchmark model generates larger values because households with descendants decumulate wealth at a smaller pace late in life so as to leave more estate to the next generation. Since descendants tend to be more concentrated in couple households, the dynastic saving motive contributes to explaining the marriage gap in wealth. This finding is reflected in old-individuals' asset holdings in the two models as well. In the benchmark model, the weight in the bequest utility function (15) is allowed to depend on the presence of descendants. This flexibility enables the calibrated model to match a wealth differential of +20.2 percent between old-age individuals with and without descendants. By contrast, the restriction of identical weights in model M1 implies a strongly counterfactual differential of -32.2 percent. This suggests that accounting for stronger intergenerational ties in households with descendants is important.

Differential tax treatment. The U.S. tax system treats the household – not the individual – as the basic unit of taxation. In the benchmark model, I capture the differential tax treatment of single and married households by implementing effective income tax functions that depend on the marital status (cf. Figure 1). As discussed in Section 4.1, the difference in income taxation may result in a tax bonus or a tax penalty, depending on the level of household income and the combination of individual incomes within married households.

In order to assess the impact of taxation on the marriage gap, I proceed as follows. As a first step, I use CPS data to obtain an estimate of married couples' average advantage/disadvantage embodied in the estimated tax functions. Specifically, for each married couple in the data I compute the difference in effective tax rates that results from applying the tax function for married couples (17), and a hypothetical where both spouses would pay taxes according to the schedule for singles (16). While this calculation can only serve as an approximation of the actual tax advantage/disadvantage, it captures the empirical concentrations at different income levels and the division of incomes within couples along the distribution. I find that about 70 percent of married couples in the sample benefit from a tax bonus, while 30 percent face a tax penalty, and that the average tax advantage amounts to 1.72 percentage points. In line with Figure 1, married couples with low and moderate incomes, and those with very different income combinations tend to benefit, whereas high-income couples and those with similar incomes tend to lose. As a second

Table 5: The marriage gap: Comparison of alternative models

	Labor earnings		Total income		Wealth	
	Δ^{Mean}	Δ^{Median}	Δ^{Mean}	Δ^{Median}	Δ^{Mean}	Δ^{Median}
Data	+ 32.3	+ 23.6	+ 25.5	+ 17.4	+ 34.9	+ 76.9
Benchmark model	+ 5.6	+ 21.0	+ 7.2	+ 23.3	+ 26.0	+ 99.8
M1: Intergenerational ties	+ 3.3	+ 18.2	+ 4.9	+ 21.6	+ 20.5	+ 83.9
M2: M1 + Tax treatment	+ 1.2	+ 15.6	+ 2.7	+ 19.7	+ 15.2	+ 73.5
M3: M1 + M2 + Selection	− 2.8	+ 9.2	− 2.7	+ 12.1	− 4.7	+ 44.7

step, I gauge how the average tax advantage of 1.72 percentage points impacts on the marriage gap. To this end, I shift the tax schedule for married couples up such that the average tax advantage disappears exactly, and I recalibrate the model accordingly (M2).

Table 5 indicates that tax policy affects the marriage gap in all three variables of interest. The intuition is that lower tax rates lead married people to work more hours and thus earn higher incomes. The marriage gap in median earnings, for instance, is 2.7 percentage points higher when correctly accounting for differential tax policies. Lower income taxes also affect the per-capita difference in asset holdings: the marriage gap in mean wealth increases by 4.3 percentage points, and the median wealth gap is even 9.7 percentage points larger. The intuition is that lower income taxes raise permanent disposable household income, which implies that married households accumulate more buffer-stock savings in order to reach their target wealth-to-permanent-disposable-income ratio (see Carroll (1997)). Taken together, these findings suggest that differential effective income taxation, which is ultimately shaped by the underlying characteristics of the population - the distribution and division of income, the marital status, the concentration of dependents, etc. - as well as the tax code itself – personal exemptions and deductions, tax brackets, etc. – is a model ingredient that contributes to explaining the marriage gap.

Selection into marriage. The benchmark model features a marriage market where single individuals of both genders meet randomly each period and decide whether to get married based on observable characteristics. As a consequence, the model can potentially capture the notion that more productive and asset-rich individuals are also relatively more likely to get married. Selection effects may, therefore, be crucial to generating the marriage gap. To illustrate the importance of selection into marriage, I set up the following counterfactual economy.[13] Instead of letting singles participate in the marriage market every year ($p = 1$) as in the benchmark economy, I reduce the participation probability to $p = 0.25$. That is, single individuals in this counterfactual economy (M3) get the chance to get married only on average every four years. I recalibrate all other parameters, in particular the marriage utility parameters to generate the same fraction of married individuals as in the benchmark model. In this counterfactual economy, exogenous shocks ("luck") play a much larger role for marriage formation than in the benchmark economy, where singles have the opportunity to select into marriage based on productive characteristics every year.[14]

Table 5 conveys the importance of selection for generating the marriage gap. Between counterfactuals M2 and M3, the per-capita differences between married and single people shrink universally by a substantial amount for all statistics of interest. For instance, the marriage gap in median earnings and median income are almost cut in half, and the corresponding values for the means decline by 4 and 6 percentage points respectively. The drop in the marriage gaps in mean and median wealth is even stronger with a decline of 21 and 30 percentage points respectively. These findings indicate that selection into marriage based on productive characteristics play a key role in shaping the marriage gap. Two remarks are in order. First, counterfactual M3 serves to illustrate the importance of selection into marriage without necessarily capturing all aspects quantitatively. The key finding of this exercise is that this channel is crucial to accounting for the data and that its contribution to the marriage gap is the largest one across the three factors explored in this section. Second, there may be selection out of marriage based on productive characteristics as well. That is, the unexplained remainder of the marriage gap in the benchmark model may be partly explained by selection upon divorces. The effect of exogenous divorce risk on savings by married couples will be explored in a separate exercise in Section 5.4.

[13]Designing a counterfactual that captures all aspects of selection without creating unintended side effects is not straightforward. For instance, if one assumes that couples are formed randomly based purely on exogenous shocks, rational single individuals would anticipate that asset pooling upon marriage creates huge implicit savings tax rates, which would lead to a precipitous drop in their savings. In Section 5.4, I show that improving marriage market prospects is an important driver for asset accumulation in the model.

[14]Setting the participation probability to $p = 0.25$ yields an average and median age at first marriage of 32 and 28 years, respectively, which are both very close to the corresponding values in the benchmark economy. Therefore, age effects do not play a significant role for the results.

5.3 The Role of Marriage along the Wealth Distribution

A recurrent theme in this paper is that it is important to consider single and married households for the purpose of studying cross-sectional inequality. This section aims at shedding more light on the marriage gap by exploring the role of the marital status along the wealth distribution. Figure 2 plots the fraction of married households across the distribution of assets, where the data line (red marked with triangles) is based on the 2013 wave of the Survey of Consumer Finances.[15] Two observations stand out. First, the share of married households increases with wealth: while only about 35 percent of households with a net worth of less than 100k dollars are married, this share increases monotonically to almost 80 percent of households with a net worth of 1 million dollars or more. This result is not surprising as the number of potential income earners is larger in married couples, and because married individuals tend to be richer, as illustrated in the previous sections. Second, an interesting pattern emerges for the gradient: while the empirical share initially rises steeply from 30 percent at zero to 55 percent at 300k dollars, it then remains almost flat until about 900k dollars where the fraction is about 63 percent. This suggests that marriage plays a relatively larger role for poor and middle-class households. The blue line marked with circles plots the corresponding function from the benchmark model. As can be seen, the model underpredicts slightly the share of married households at wealth levels below 250k dollars, and it slightly overpredicts the share above this value. On the other hand, the model does a good job of accounting for the gradient: the fraction of married household initially rises steeply for low- and middle-income households. It then flattens out for wealthy households, a pattern that is consistent with the data.

5.4 Further Analysis

In the remainder of this section, I use my benchmark economy to study (i) the extent to which labor productivity and wealth shape singles' marriage market prospects; (ii) the impact of divorce risk on married couples' savings; and (iii) the role played by intrahousehold insurance.

Marriage rates. An important result from the counterfactual analysis is that selection into marriage is a key determinant for the marriage gap. The benchmark model features a marriage

[15] For the figure, I group all households with non-positive net worth at 0; similarly, all households with net worth above 1 million dollars are grouped at 1 million dollars. The model values are rescaled by relative average household income in the model to make wealth levels comparable to those in the data.

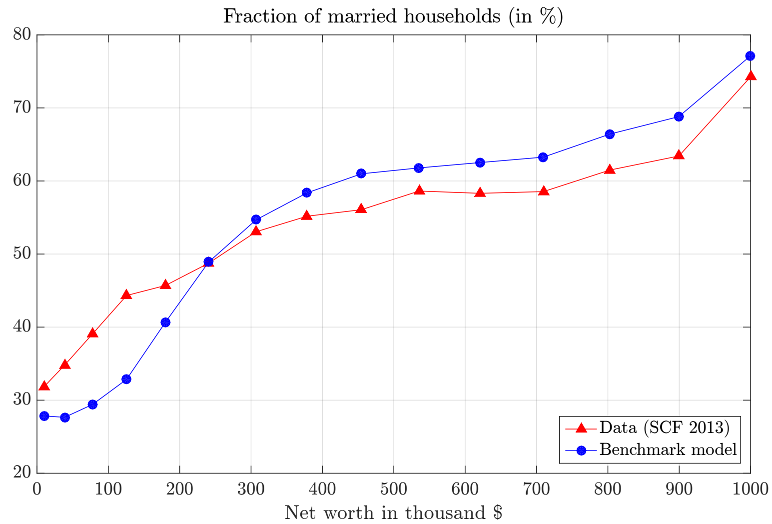

Figure 2: Fraction of married households along the wealth distribution

market that relies on bilateral agreement between prospective spouses. This implies that high-productive, asset-rich singles face a greater likelihood of meeting someone who is willing to marry them. On the flip side, they are also more picky in their own decision to accept or turn down a proposal than low-productive, asset-poor singles. Hence, it is not clear *a priori* how marriage rates depend on singles' wealth and productivity. To shed more light on this relationship, I compute the marriage rate – defined as the fraction of single households getting married in a given period – conditional on assets and productivity in the benchmark model. Figure 3 provides a graphical representation of this relationship. To ease visibility, I plot the marriage rate by assets for singles with $z = 1$, the mean time-varying component of labor productivity, in the left panel. Similarly, I plot the marriage rate by productivity for mean-wealth singles, $k = 0.77$, in the right panel.

As can be seen, marriage rates are hump-shaped in assets. Only about 1 percent of singles near the borrowing constraint get married every period. This fraction then rises rapidly to a peak of 6 percent at $k = 1.3$ – roughly 1.7 times mean wealth – before it starts to decline again. The intuition behind this pattern is that wealth-poor singles face very slim chances of meeting a partner who is willing to marry them. As they accumulate more wealth, their marriage market prospects increase substantially. Eventually, marriage rates decline again because very rich singles are also pickier and will turn down more proposals. The right panel of Figure 3 plots the marriage rate by productivity. The fraction of singles getting married is fairly flat for low- and medium-productive

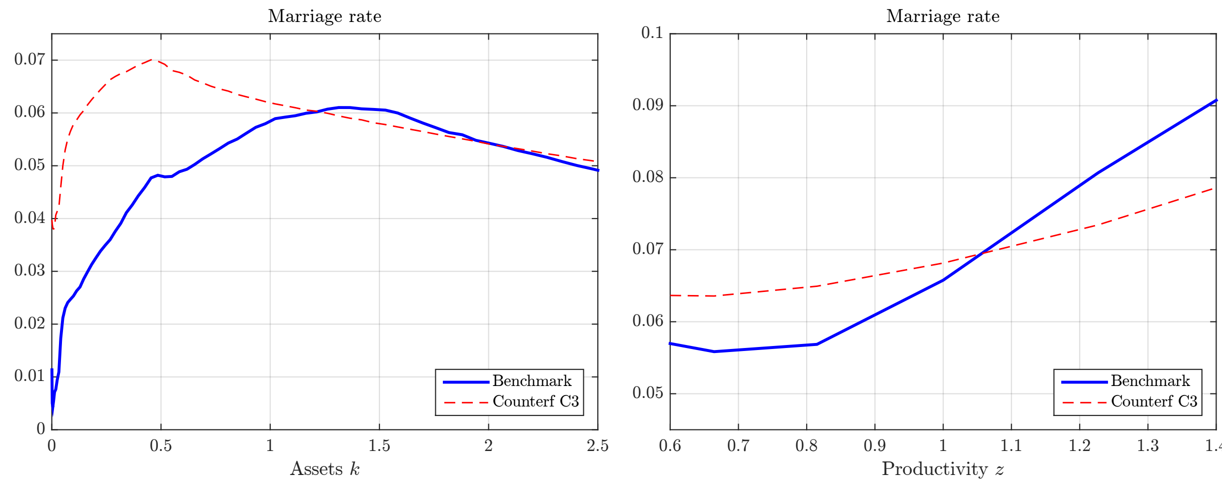

Figure 3: Marriage rates by assets and productivity

singles but then increases significantly for individuals with high productivity shocks. This analysis confirms the strong role of selection effects in the benchmark economy. As a means of comparison, I also plot marriage rates in the counterfactual economy C3 (red dashed line). In this economy, marriage decisions are to a much larger extent driven by exogenous shocks. This intuition is confirmed by a much weaker relationship between marriage rates and assets and productivity as indicated by a flatter slope than in the benchmark economy.

Divorce risk and savings. The savings effect of divorce risk has received some attention in the literature. An important research question in this literature is to what extent the risk of marital dissolution affects household savings.[16] To assess the role of divorce risk, I now use the benchmark model to compute the change in savings that would result from the removal of divorce risk. That is, starting from the equilibrium in the benchmark economy, I set $\psi = 0$ and then resolve the household problem of married couples to obtain the new policy function for savings. For the purpose of this exercise, I ignore general equilibrium effects and only focus on the implications for wealth accumulation of married couples.

[16] Doepke and Tertilt (2016) demonstrate using a theoretical model that divorce can have ambiguous effects on savings, depending *inter alia* on the divorce regime and the distribution of bargaining powers in married couples. Voena (2015) exploits variation in U.S. state laws to estimate married households' saving responses to divorce law reforms. Her results suggest that introducing unilateral divorce in states where assets are divided equally is associated with more asset accumulation. González and Özcan (2013) find that the legalization of divorce in Ireland in 1996 led to an increase in the propensity to save of married couples.

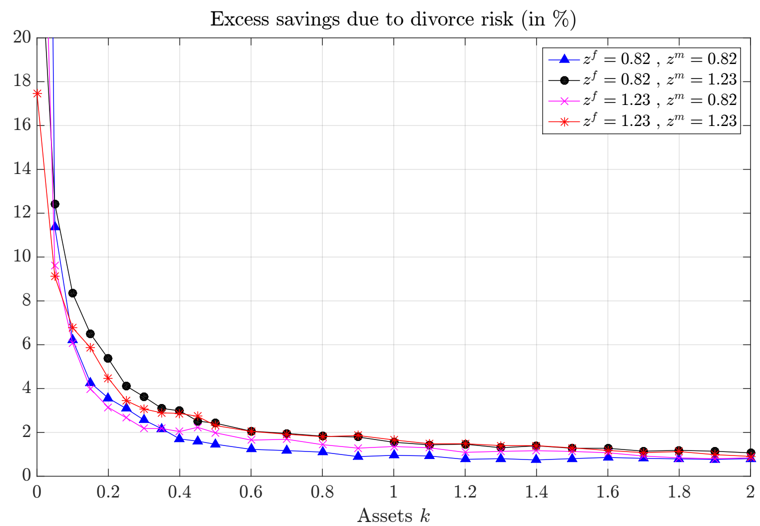

Figure 4: Effect of divorce risk on savings by married couples

Figure 4 displays the percentage differential in savings that is brought about by the presence of divorce risk (for illustrative purposes, the figure is based on two non-college-educated individuals without descendants). Several observations stand out. First, the possibility of a divorce leads married couples to accumulate more assets. In the model, there are two major forces driving this result: on the one hand, there is the precautionary motive that leads couples to insure against the risk of losing access to intrahousehold insurance. On the other hand, as illustrated in the previous subsection, the possibility of returning to the marriage market in the future provides an additional incentive to accumulate assets. This force would be absent in models that abstract from remarriage. The second key observation is that excess savings due to divorce risk are declining in couples' wealth. This finding suggests that the precautionary demand for savings is particularly strong for asset-poor couples and becomes weaker for richer households.

Intrahousehold insurance. When asset markets are incomplete, the presence of potentially binding borrowing constraints implies that individuals cannot fully insure against labor income risk. Single households use precautionary saving to self-insure against this risk. Married households, additionally, have access to intrahousehold insurance which enables them to share labor income risk efficiently through income pooling.[17] As a consequence, they save less for precaution-

[17] Blundell, Pistaferri and Saporta-Eksten (2016) estimate a two-earner life-cycle model using PSID data, and their estimates indicate significant evidence for insurance within the family. Focusing on employment risk, Ortigueira and Siassi (2013) find that within-household risk sharing has its largest impact among low-wealth households.

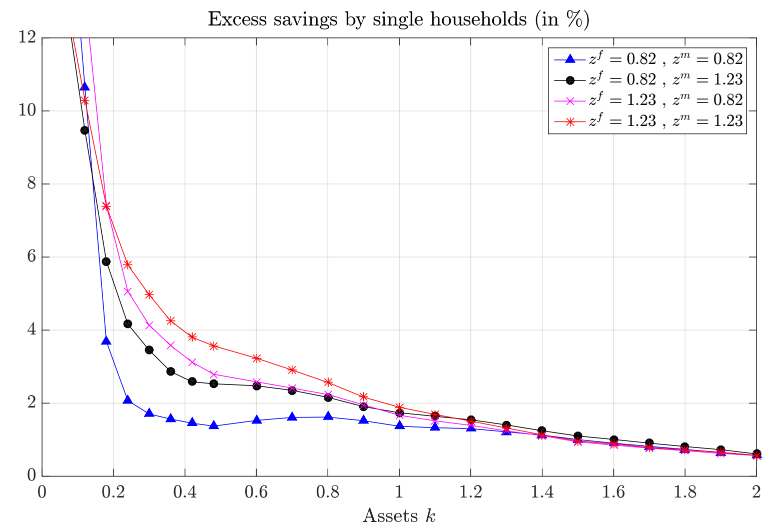

Figure 5: Effect of intrahousehold risk sharing on savings

ary reasons, which constitutes a natural counter-force to the marriage gap in wealth. To illustrate this point, I conduct the following exercise. Starting from the benchmark economy, I set both the divorce probability for married couples and the marriage market participation probability for singles to zero, $\psi = p = 0$, and I recompute the solution to all household problems. Then I compute the differential in savings between a married couple (with wealth a) and the combination of a single female and a single male (each with $a/2$). This exercise allows me to focus on excess savings by singles resulting from the lack of access to intrahousehold insurance. Figure 5 presents excess savings by single households for different combinations of idiosyncratic productivity shocks (as in the previous subsection the figure is based on two non-college-educated individuals without descendants). As can be seen, intrahousehold risk sharing has an impact on the saving behavior of all households across the wealth distribution, with particularly strong effects for asset-poor households. These finding confirm that better insurance possibilities for couples act as a counteracting force for the marriage wealth gap, and they also underpin the result that marriage plays a relatively larger role for poor and middle-class households.

6 Policy Experiment: Separate Tax Filing

In this section I evaluate the effects of abolishing the possibility to file taxes jointly for married couples in the context of a hypothetical tax reform in my benchmark economy. The fundamental

Table 6: Long-run effects of policy reform

Description	Joint	Separate	Description	Joint	Separate
Total output	0.602	0.618	Gini coefficient wealth	0.667	0.690
Aggregate capital	1.816	1.881	Δ^{Mean} Earnings	+5.6	+38.8
Aggregate labor	0.323	0.331	Δ^{Mean} Income	+7.2	+37.8
Real interest rate (%)	1.970	1.850	Δ^{Mean} Wealth	+26.0	+84.2
Average wage rate	0.558	0.561	Welfare females nc	–	-0.44%
Hours worked females	0.256	0.266	Welfare females co	–	$+0.90\%$
Hours worked males	0.345	0.349	Welfare males nc	–	-2.26%
Frac couples same educ	0.594	0.869	Welfare males co	–	$+0.24\%$

NOTES: Welfare effects are measured in terms of consumption equivalent variations.

modification is that all agents, single or married, are now subject to the same effective tax schedule. Specifically, I assume that married individuals face the tax function of a single ($\tau^{\mathcal{S}}$), where interest income from holding capital is split equally between the two spouses. The government budget is balanced in the form of a lump-sum tax/transfer to all individuals in the economy. For the purpose of this study, I focus on long-run effects and leave transitional dynamics aside. I also abstract from changes in fertility patterns or educational choices that could result from the reform and leave these issues for future research.

Table 6 contrasts a selection of aggregate variables under both tax regimes. In the new stationary equilibrium after the reform, aggregate capital is 3.6 percent larger, aggregate labor increases by 2.3 percent, and total output grows by 2.8 percent. Individuals supply substantially more hours than in the benchmark model: on average, females work 4.0 percent longer hours and males work 1.0 percent more hours. There are two main reasons for this result. First, the changes in aggregate factor inputs are accompanied by a decline in the real interest rate and a rise in the average wage rate. The latter induces individuals to supply more hours to market work. Second, moving from joint filing to separate filing implies significantly lower marginal tax rates for secondary earners in married couples. Since females constitute the majority of secondary earners in married households, hours worked increase relatively more for women than for men. This result is consistent with other studies. For instance, Guner, Kaygusuz and Ventura (2012) also find that separate filing generates positive output effects driven by a rise in married females' labor supply.

Interestingly, the policy reform induces a strong rise in assortative mating: while in the benchmark model roughly 60 percent of married couples are formed by individuals with the same educational background, this share increases to more than 80 percent in the new stationary equilibrium. The intuition behind this result is that joint tax filing benefits couples with very different incomes relatively more than those earning similar incomes. With this tax incentive removed under separate filing, individuals with high earnings potential are more inclined to look for partners with similar earnings prospects. On the flip side, people without college education have a harder time finding a spouse with high earnings potential on the marriage market and they are more likely to marry among themselves. This growth in assortative mating is accompanied by an increase in inequality and a large rise in the marriage gap: for instance, the marriage gap in mean wealth is predicted to go up from 26 percent to 84 percent. Finally, I evaluate the welfare consequences of implementing the policy reform. To this end, I compute the welfare effect for individuals entering the economy depending on their gender and educational background (as is standard in the literature, welfare effects are measured in terms of consumption equivalent variations). My findings indicate small welfare gains for college-educated individuals who benefit from lower marginal tax rates at high income levels when married. On the other hand, non-college-educated individuals lose from the policy reform because they face deteriorating marriage market prospects.

7 Concluding Remarks

While there has been significant progress in developing macroeconomic models that can account for the cross-sectional distributions of earnings, income and wealth, most of these frameworks do not explicitly acknowledge the role of the marital status. The main contribution of this paper is to derive a number of empirical facts pertaining to inequality across single and married households, and to present a model that is consistent with the salient features of the data.

This paper should be considered as an intermediate step towards a refined understanding of the interaction between marriage and economic inequality. The model has various limitations that are worth exploring in future research. For instance, endogenizing marriage dissolution decisions could help to account for the unexplained remainder of the marriage gap in wealth: if adverse labor market shocks lead to divorces, it is to be expected that the predicted wealth disparity increases even further. Another interesting extension would be to explicitly model economies of scale in two-person households, for instance, by means of a public good. A careful quantitative analysis would, however, be complicated by the fact that there is yet no empirical consensus on the magnitude of such scale economies within the household. This paper has also abstracted from differences in expected longevity: mortality rates are documented to depend on income, wealth and marital status (see e.g. Hu and Goldman (1990) and Pijoan-Mas and Ríos-Rull (2014)) which has implications for the dissaving pattern during retirement. Finally, in a search-theoretic context, Guler, Guvenen and Violante (2012) show that the opportunity to search jointly for couples can lead to higher average wages and thus explain part of the income gap. While extending the model in these directions is left for future work, this paper has also indicated important implications for policy design. It could be interesting to study policies that acknowledge the demand for redistribution by targeting single and married households in different ways.

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Appendix A: Data Sources

A.1 Survey of Consumer Finances (SCF)

The empirical analysis is based on data from the Survey of Consumer Finances (SCF). The SCF is conducted in three-year intervals and gathers detailed information on the financial situation of families in the United States. For this study I use data from five waves: 2001, 2004, 2007, 2010 and 2013. The survey is designed to obtain a sufficiently large and unbiased sample of wealthy households and provides appropriate weighting schemes to adjust for non-respondents. The primary unit of observation is the household. A household comprises either an economically dominant single individual or a couple (married or living as partners) as well as all other individuals in the household who are financially interdependent with that individual or couple. I classify a household as married if the head of the household is legally married (and not separated), where I follow the SCF convention of defining the head as the male in core couple households. Then, I exclude all households where the head is less than 23 years old, and I exclude the wealth-richest 0.1 percent of households. The remaining pooled sample from five waves consists of 23,534 households; 14,975 of them are classified as married and 8,559 of them are classified as single. All monetary values are CPI-deflated and expressed in 2013 dollars. I employ the following variable definitions:

Labor earnings: Wages + salaries plus 66 % of business + self-employment income.

Total income: Sum of all income sources before taxes, i.e. wage income, self-employment income, net asset income, and private and public transfers.

Wealth: Net worth of the household, i.e. value of real and financial assets net of liabilities.

In the regressions, I define the following dummy variables:

Time: Dummies for the year of the survey (4 dummies).

Age: Dummies for age of household head for three-year cells (e.g. 26-28 years). This yields about 1000-2000 observation per cell (18 dummies).

Race: Dummies for race of household head: white, black/African-American, Hispanic/Latino, other (the public data set combines all remaining groups). (3 dummies)

Child below 6: Takes on the value 1 if there is a child below 6 years in the household.

A.2 Current Population Survey (CPS)

The analysis is based upon the March 2013 Annual Economic and Social Supplement (ASEC) to the Current Population Survey (CPS). The CPS is the primary source of labor force statistics in the United States. A representative sample of currently around 60,000 households is interviewed about a set of demographic and labor force questions at a monthly frequency. The Annual Social and Economic Supplement (or 'March Supplement') augments the basic survey by a set of more detailed questions on income and is extended by an additional sample of around 34,500 households.

I choose the family as the basic unit of observation and henceforth refer to it as a household interchangeably (the primary unit of observation defined in the CPS is the "housing unit", which may include multiple families). I exclude all households where the head is less than 23 years old. The remaining sample consists of 199,010 individuals organized in 81,229 households.

Next, I divide the main sample into two subsamples and call them married households and single households. A household is defined to be married if its head is currently married, and single otherwise. The definition of the household head can be described as follows. I first check whether there is an individual in the family who is of working age, i.e. between 23 and 63 years old. If so, the head is defined to be the oldest male person of working age or, alternatively, the oldest female person of working age in case there is no working-age male. If there are no individuals of working age in the household, I define the household head to be the oldest adult male (i.e. $\geq$ 18 years). If there are no adult males in the household, the head is defined to be the oldest adult female.

As a result, the subsample of married households consists of 129,759 individuals organized in 39,402 households. The subsample of single households consists of 69,251 individuals organized in 41,827 households. Labor earnings and total income are defined as for the SCF. Other variables are defined as follows:

Wage: To obtain an individual's hourly wage rate, I divide annual labor earnings by annual hours worked. Annual hours worked are computed as the product of the number of weeks worked and the number of hours worked per week (items '*wkswork*' and '*hrswk*').

Gender premium: I consider all working-age individuals who participate in the labor force, i.e. who work at least 260 annual hours (this corresponds to an average of 1 hour per working day). This sample consists of 81,831 individuals. The gender premium is computed as the ratio between the average wage rate earned by females and the average wage rate earned by males.

Table B1: The marriage gap (CPS 2013)

Dependent variable	(1)	(2)	(3)	(4)	(5)
Labor earnings					
Mean	25.8***	24.7***	21.6***	21.6***	21.7***
	(1.09)	(1.10)	(1.09)	(1.09)	(1.10)
Median	40.0***	35.4***	31.2***	30.3***	33.5***
	(1.32)	(1.29)	(1.25)	(1.17)	(1.24)
Total income					
Mean	16.2***	9.4***	6.3***	6.7***	8.0***
	(0.89)	(0.88)	(0.87)	(0.87)	(0.90)
Median	26.6***	15.7***	12.8***	12.4***	14.3***
	(0.93)	(0.79)	(0.77)	(0.76)	(0.76)
Constant	yes	yes	yes	yes	yes
Age	no	yes	yes	yes	yes
Race	no	no	yes	yes	yes
State	no	no	no	yes	yes
Child below 6	no	no	no	no	yes
Number of obs	81,229	81,229	81,229	81,229	81,229

Notes: 2013 Annual Social and Economic Supplement (ASEC) to the Current Population Survey (CPS). The table reports the marriage gap analogously to Table 2. Columns (1)-(5) refer to different specifications, where "age","race" and "state" represent full sets of age, race and state dummies, and "child below 6" is a simple dummy variable if there is a child below 6 years in the household. Sampling weights have been included in all regressions. Standard errors are reported in parentheses. * denotes $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

College: Individuals are defined to be college-educated if they have obtained some college degree (value of 41+ in item '*a-hga*'). To compute the college premium, I consider the same sample that is used to compute the gender premium. Then I calculate the ratio between the average wage rate earned by college-educated individuals and the average wage rate earned by non-college educated individuals. To partly control for the gender gap, I do this separately for both genders and then take the average.

Table C1: Parameters set externally

Description	Parameter	Value	Description	Parameter	Value
Probability of retiring	ϕ^R	1/40	Meeting probability	p	1
Probability of dying	ϕ^D	1/20	Capital share	α	0.36
Probability of divorce	ψ	0.01	Capital deprec. rate	δ	0.1
Risk aversion	σ	1.5	Wage persistence (co)	ρ^{co}	0.969
Inverse of Frisch elast.	γ^f	1	Wage persistence (nc)	ρ^{nc}	0.928
Inverse of Frisch elast.	γ^m	3	Wage volatility (co)	σ_ϵ^{co}	0.100
Fraction college (f)	$q^{f,co}$	0.42	Wage volatility (nc)	σ_ϵ^{nc}	0.139
Fraction college (m)	$q^{m,co}$	0.41	Cross-spouse correlation	ϱ	0.150
Pareto weight	μ	0.5			

Appendix B: The Marriage Gap in the CPS

In this appendix, I present estimates for the marriage gap in earnings and income based on data from the March 2013 Annual Economic and Social Supplement (ASEC) to the Current Population Survey (CPS). Table B1 reports regression results for various specifications. Column (1) provides estimates for the raw marriage gap where only a constant is included in the regression equation. The numbers turn out to be fairly similar to those obtained from the Survey of Consumer Finances (Table 2 in the main text): mean earnings for married individuals are about 26 percent higher than those of singles, and the mean income gap is 16 percent. The median gaps are slightly larger at 40 percent and 27 percent respectively. When age effects are taken out – column (2) –, the estimates shrink slightly but remain significantly positive. Columns (3)–(5) include various other observable characteristics, namely the race, the U.S. state of residence and the presence of a child below 6 years of age. As can be seen, these factors do not seem to have a large effect on the estimated marriage gaps.

Appendix C: More Details on the Calibration

Parameters set outside the model and fiscal parameters. Tables C1 and C2 list all parameters that are calibrated outside the model, and those that are related to fiscal policy (see description in the main text).

Cohort study. The following description details my calibration strategy for (1) the bequest utility parameters and (2) the arrival rates for descendants.

(1) The data moment for the differential in wealth holdings between individuals with and without descendants is derived from SCF wealth data for old-age individuals. Specifically, I select the sample of individuals who are 73 years of age or older. These correspond to model cohorts that have been in the retirement phase for at least 10 years. I also exclude widows from the sample, because in the model married couples are assumed to die together. Then I compute the differential in per-capita net worth between individuals who have children inside or outside the household and those that do not have children. The model-generated moment is computed accordingly: based on the solution to the model, I simulate a cohort of newborn individuals and select those who experience the retirement shock exactly after 40 years, and I track their individual histories until death. Then I select the sample of individuals who have been retired for at least 10 years. For this sample, I compute the differential in per-capita net worth between individuals who have descendants and those that do not have descendants.

(2) To compute the empirical fractions of households with descendants I consider only retired households. There are two reasons motivating this choice. First, most people have completed their fertility phase when they are retired. Second, this selection yields an adequate mapping to the model where descendants are assumed to arrive only during working age. The data values are simply obtained by calculating the shares of household heads who have children inside or outside the household. To compute the moments in the model, I proceed slightly differently. The reason is that, due to the stochastic life cycle structure, the model delivers a mass of individuals without descendants who have been hit by the retirement shock within just a few periods after entering the economy. Thus, simply matching the empirical shares would require setting excessively high per-period arrival rates. Instead, to obtain a clean mapping between the model and the data, I make use of the cohort study laid out above: based on the model solution, I simulate a cohort of individuals and select those who happen to retire exactly after 40 years. Since these individuals pass through a life cycle that resembles the duration in the data, this yields a more appropriate procedure to calibrate the per-period arrival rates by household type.

Retirement benefits. In order to set numerical values for pension benefits, I implement a version of the U.S. Social Security system into the model economy. In the United States, the Social Security Administration keeps track of a worker's earnings throughout his/her working

Table C2: Fiscal parameters

Description	Parameter	Value	Description	Parameter	Value
Tax function	$\kappa_0^{\mathcal{S}}$	0.143	Retirement benefits	$b^{m,nc}$	0.101
Tax function	$\kappa_1^{\mathcal{S}}$	0.034	Retirement benefits	$b^{m,co}$	0.138
Tax function	$\kappa_0^{\mathcal{M}}$	0.149	Retirement benefits	$b^{nc,nc}$	0.158
Tax function	$\kappa_1^{\mathcal{M}}$	0.058	Retirement benefits	$b^{co,nc}$	0.206
Payroll tax rate	τ_p	0.062	Retirement benefits	$b^{nc,co}$	0.195
Retirement benefits	$b^{f,nc}$	0.057	Retirement benefits	$b^{co,co}$	0.263
Retirement benefits	$b^{f,co}$	0.120			

career. Retirement benefits are then computed as a function of average indexed monthly earnings (AIME), which take into account the highest 35 years of a worker's earnings. This function is piecewise-linear and concave in its argument, the AIME, where the thresholds are called bend points. Specifically, retirement benefits are computed as the sum of (i) 90 percent of the AIME up to the first bend point ($791 in 2013), plus (ii) 32 percent of the AIME from the first bend point to the second bend point ($4,768 in 2013), plus (iii) 15 percent of the AIME in excess of the second bend point. For married households there is an additional regulation, the spousal benefit rule, which states that a married individual is entitled to 50% of his/her spouse's benefits. Hence, married households' benefits can be computed as the maximum between (a) the sum of individual benefits and (b) 1.5 times the highest of the two benefits.

An exact implementation of the U.S. Social Security system would require keeping track of each individual's earning history, which is computationally expensive. Instead, I employ a simplified version that relies on average earnings during working life for a given household type. For instance, retirement benefits for married households with two college-educated spouses are calculated on the basis of average labor earnings by wives and husbands in college/college-households. Bend points are computed as fractions of mean household income. Since mean household income is generally a function of benefits themselves, the calibration strategy involves finding a fixed point where pension benefits are consistent with the Social Security formula.