

The Changing Wage Distribution and the Decline of Marriage*

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Abstract

In the last forty years, the share of married adults has declined in the United States. At the same time, the structure of labor market earnings has greatly changed, both in its cross-sectional distribution and in terms of life-cycle dynamics. In this paper, I estimate a novel equilibrium model of the marriage market characterized by search frictions, endogenous divorce, aging, and wage mobility. This structural approach allows me to provide a quantitative assessment of the impact of changes in the wage distribution on the decline of marriage. With respect to previous works, this paper is the first to provide a quantitative assessment of the impact of changes in the entire age profile of wages and in wage mobility on marriage patterns. I find that changes in the wage distribution can account for about a third of the decline in the share of married adults between the 1970s and the 2000s, and partly explain why the decline has been stronger among the low educated. Worsened labor market conditions result in widespread welfare losses among men: these are amplified through the marriage market. Women enjoy welfare gains due to rising wages, although these are partly offset by welfare losses on the marriage market. Increased inequality among men and the shrinking gender wage gap have caused the gains from marriage to shift from household specialization to the possibility of joining efforts on the labor market.

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1 Introduction

In the last few decades, Americans have faced major changes in the structure of their labor market earnings. In particular, wage inequality has increased both between and within educational groups (Acemoglu and Autor, 2011). Coincidentally, Americans have also experienced a radical transformation of their family life: the share of married adults has steadily declined since the 1970s, and a decomposition of this trend reveals that the decline has been larger for the low educated.

The relationship between these two synchronous trends has drawn a great deal of attention in the economic literature. Many authors have stressed that increased wage dispersion - and particularly increased college premium - results in amplified income inequality across households due to the way people sort on the marriage market. However, only few papers have discussed how the marriage market adjusts when we consider changes both in the cross-sectional inequality and in the life-cycle dynamics of labor market earnings. In particular, the structure of wage dynamics along the life-cycle may affect the expected duration of marital relationships and singlehood spells. This is a highly pertinent economic issue as being exposed to longer singlehood spells - either before the first marriage or after a divorce - can bear significant welfare implications.

In this paper, I provide a quantitative assessment of the adjustments of marriage and divorce patterns spurred by the changes in the wage distribution that occurred between the 1970s and the 2000s. To the best of my knowledge, this paper is the first to analyze how the marriage market equilibrium responds to changes not only in wage inequality across education and gender groups, but also in the age profile of wages and in the degree of wage mobility.¹ The empirical analysis focuses on changes in the extensive margin of the marriage market, i.e., the decline of married adults. In particular, the paper aims to address the following questions: *to what extent can changes in the wage distribution explain the overall decline of marriage? How have these changes affected different subgroups of the population, i.e., the high vs the low educated or the younger vs the older? And, finally, how have these changes reshaped the distribution of welfare?*

In order to answer these questions, I build an empirically tractable search-and-matching model of the marriage market where the motives for getting married are both economic and noneconomic. The economic gains from marriage stem from both household specialization

¹Kopczuk et al. (2010) suggest that a natural measure of mobility is the rank correlation in earnings from year t to year $t+p$: I focus on hourly wage mobility in the empirical analysis, and employ an analogous measure - wage rank correlation - to characterize mobility.

and economies of scale. However, along the life-cycle, risk-averse agents face wage shocks and random changes in the quality of the relationship: married couples benefit from the intrinsic insurance mechanism provided by the marriage contract, but, in lack of full commitment, uncertainty may as well lead them to break up. After a divorce, agents are free to marry again, although their prospects change with time due to age and mobile wages. On the aggregate level, systematic differences in matching behavior across educational groups arise as the result of the complex interplay between the primitives of the model: these include the structure of earnings, the home technology, the taste for homogamy, and the way single people meet each other. When taken to the data, the model can rationalize both the cross-sectional marital patterns - *who is married, and with whom* - and the odds of getting married or divorced at different stages of the life-cycle for different subgroups of the population.

This structural approach is motivated by the two following considerations: first, a model is needed to single out the role of changes in labor market earnings in explaining the decline of marriage, as opposed to other confounding factors. This is particularly important when comparing marital patterns across an extended timespan, as many factors of different kinds - including demographic, technological, legal and cultural factors - change simultaneously. Second, a model is needed to derive the welfare implications of changes in the expected length of singlehood and marriage spells. In this way, it is possible to identify the population subgroups that have experienced the largest welfare losses.

The empirical analysis relies on the following steps. I first extend the empirical strategy of [Goussé et al. \(2017b\)](#) and provide a formal discussion on how to separately identify the key unobserved parameters of the model: the meeting function, the domestic production function and the cost of divorce. I estimate the model at its stationary state using data moments from both the Current Population Survey (CPS) and the Panel Study of Income Dynamics (PSID) for the American population aged between 20 and 60: the estimation is performed on two separate samples for the 1970s and for the 2000s. I then simulate a series of counterfactual equilibria in order to isolate the role played by changes in a primitive parameter - e.g., the wage distribution - in the transition between the 1970s to the 2000s.

I find that changes in the wage distribution of both men and women can jointly induce a 5.3-percentage-point decrease in the share of married adults. Hence, they account for about a third of the overall decline of marriage between the 1970s and the 2000s. In particular, I show that the shrinking gender wage gap has eroded the economic gains from household specialization for a large part of the population. Most women experience improved labor market conditions over the life-cycle: they can afford being more selective when choosing a partner and value noneconomic gains more than in the past. This leads to the overall decline of marriage.

Changes in the wage distribution can also partly explain why the share of married adults among the low educated has decreased more than among the high educated. The decrease induced by the changing wage distribution is 6pp for men without a college degree and only 2.8pp among male college graduates. Men without a college degree and at the bottom of the wage distribution suffer from the strongest wage cuts: these individuals are thus less suitable for a role of primary earner in a “traditional” household that relies on specialization. On the other hand, high-wage men retain their comparative advantage within the couple over low-wage women and can still enjoy the gains from specialization. Alternatively, they can form couples of two earners with high-wage women, as the spouses’ pooled labor income is sufficiently large to take full advantage of the economies of scale and make the match convenient.

The rich characterization of the wage distribution allows me to delve further into these findings. While I document an increase in wage mobility among men and a decrease among women, I show that - holding wage levels constant - changes in mobility only have a small impact on the marriage market outcome. I argue that this is due to the estimated high cost of divorce, which indicates that marriage contracts imply a strong commitment, both in the 1970s and in the 2000s. In other words, spouses are likely to insure each other when a labor market shock hits. On the other hand, this implies that individuals are very selective in the choice of the partner, and that adjustments in the equilibrium shares of married adults occur on the entry side: in the 2000s, singles are more selective and search longer before getting married with respect to the 1970s.

Finally, the structural model allows me to quantify the implications of changes in wages on the distribution of welfare and on the gains from marriage. I build intertemporal measures of welfare that account for both the expected stream of labor market earnings during the life-cycle and the expected timing, duration and characteristics of marriage market matches. I show that the improvement of women’s labor market conditions with respect to the 1970s leads to welfare gains among women. However, these welfare gains are offset by the lower expected marriage surplus due to worsening marriage prospects over the life-cycle. In addition, men that experience the largest welfare losses due to worsening expectations about their working careers are also those who suffer from the largest losses in terms of expected gains from marriage. I conclude by recovering the distribution of welfare for the 2000s: I show that the market has shifted from an equilibrium where the low and the high educated enjoy, on average, the same level of gains from marriage to an equilibrium where individuals with a college degree enjoy more gains. Hence, individuals at the bottom of the wage and schooling distribution have not only lost ground in terms of human wealth with respect to those at the top², but are also relatively less successful in taking advantage of the additional welfare surplus generated by the

²Here and throughout the text, human wealth refers to the discounted sum of life-cycle earnings.

marriage market. These considerations leave room for redistributive policies that take into account the monetary value of the gains from marriage.³

The paper provides two main contributions. The first is methodological, and consists in a new type of search-and-matching model that is suitable for the empirical analysis of marriage and divorce decisions along the life-cycle. The model is one of the very first of this kind and includes a number of attractive features that extend previous setups, including wage uncertainty, risk aversion, discrete family labor supply choices and marriage across cohorts: the technical contributions are discussed in detail in the following paragraphs. The framework is potentially suitable for several alternative applications, some of which are discussed in the conclusion. The second contribution is empirical, and consists in a detailed decomposition of the transition from the marriage market outcome observed in the 1970s to the one observed in the 2000s, with the purpose of shedding light on the main driving forces behind the changes. With respect to the previous literature, the paper is the first to deal with the implications of changes in the age profile of wages, in wage mobility, and in the way people meet each other on the marriage market.

The theoretical framework employed in this paper builds on the seminal work of [Shimer and Smith \(2000\)](#), who extend the classic assignment problem of [Shapley and Shubik \(1971\)](#) and [Becker \(1973\)](#) to its two-sided search-and-matching version under Transferable Utility. [Chade and Ventura \(2002\)](#) extend it to allow for random shocks to the agent's types. [Wong \(2003\)](#) estimates the model of Shimer and Smith in order to study marital sorting with respect to wages and education. [Goussé et al. \(2017a, henceforth, GJR\)](#) and [Goussé et al. \(2017b\)](#) merge a non-cooperative household model of consumption, housework and labor supply into a similar search framework: they endogenize divorce by introducing random shocks to the quality of the match, and study the relationship between the marriage market, within-couple bargaining power, and labor supply. [Wiebe \(2018\)](#) is the first to introduce aging in a simplified version of their model without wage heterogeneity. The present paper extends the theoretical framework by GJR in several directions, and in particular by introducing wage uncertainty, risk aversion, aging and discrete labor supply at once. Other working papers moving in the same direction are the works of [Flabbi and Flinn \(2015\)](#), who model both the labor and the marriage market equilibrium, and [Shephard \(2018\)](#). The latter also introduces the life-cycle dimension in the search framework, but complements it with savings and human capital accumulation; the paper focuses on the analysis of age asymmetries in marriage behavior: some key differences between

³In the current paper, I do not provide a monetary equivalent of the gains from marriage identified through the matching behavior of agents. Throughout the paper, I briefly discuss how to extend the tools proposed by [Chiappori and Meghir \(2014\)](#), i.e., their Money Metric Welfare Index, to the present search-and-matching framework. This is left to future work.

this model and the one in the present work, particularly on the commitment device available to households, are discussed throughout the paper.

From a broader perspective, this work is methodologically related to a larger literature on marriage and matching. [Choo and Siow \(2006\)](#) and [Galichon and Salanié \(2015\)](#) discuss the identification of match surplus when the econometrician observes part of the ex-ante heterogeneity but not the match transfers. Applications to the marriage market are becoming more and more common (e.g. [Dupuy and Galichon, 2014](#)). Extensions to the dynamic case - where agents are free to choose the age of marriage - include [Choo and Siow \(2007\)](#); [Choo \(2015\)](#); [Bruze et al. \(2015\)](#): the latter endogenize divorce in a similar fashion to GJR, but introduce a duration-dependent cost function. This group of papers bears interesting similarities with the search-and-matching literature outlined in the previous paragraph, particularly in the identification strategy: these similarities will be discussed throughout the paper.

Another strand of literature incorporates elements of search and/or competitive matching in order to discuss the macroeconomic implications of marital sorting. [Aiyagari et al. \(2000\)](#) and [Fernández and Rogerson \(2001\)](#) study the relationship between Positive Assortative Mating (PAM) and intergenerational mobility; [Fernández et al. \(2005\)](#) focus on the relationship between human capital investment, PAM and household income inequality. [Regalia and Rios-Rull \(2001\)](#) and [Greenwood et al. \(2003\)](#) set up intergenerational models of household formation and dissolution in order to study how marital patterns, fertility and inequality are jointly determined at equilibrium. [Greenwood et al. \(2016\)](#) focus on the determinants of rising cross-sectional income inequality: they estimate a dynamic model of educational choice, marriage, divorce, and labor supply, and show that marriage market adjustments as a response to changes in wages can partly account for the increase in the Gini coefficient. The propagation mechanism they describe explains why the share of married adults falls, and is similar to the one suggested in this paper: in particular, both papers stress the importance of increasing wage inequality and of the shrinking gender wage gap. However, in the present paper, I move the focus away from cross-sectional household income inequality and build measures of intertemporal welfare that take into account one's expectations about both his/her future working career and his/her future gains from marriage.

In spite of a much simplified labor supply setting, this paper is also related to a large strand of literature that studies labor supply, savings, fertility and/or childcare decisions along the life-cycle. Building on the seminal work of [Eckstein and Wolpin \(1989\)](#), many works in this literature include marital status as one of the household's state variable, and transitions are modeled as exogenous shocks (e.g. [Eckstein and Lifshitz, 2011](#); [Blundell et al., 2016](#); [Adda et al., 2017](#)). Some works focus on marital dissolution and take the initial family composition

as given: for instance, [Gemici \(2011\)](#) and [Voena \(2015\)](#) study the determinants of divorce - focusing on geographical mobility and divorce laws respectively - taking the initial household composition as given.

Building on this life-cycle labor supply literature, a growing number of papers considers endogenous marriage and divorce decisions: a precursor is [Van der Klaauw \(1996\)](#), while more recent examples are [Sheran \(2007\)](#), [Keane and Wolpin \(2007\)](#), [Keane and Wolpin \(2010\)](#), [Bronson \(2014\)](#), [Mazzocco et al. \(2017\)](#) and [Fernández and Wong \(2017\)](#). Each of these papers focuses on a specific empirical issue, but all of them feature a rich characterization of household behavior (particularly, of savings and human capital accumulation) and a focus on the welfare implications of changes in earnings, policy parameters and marriage market opportunities. In this paper, I depart from this literature by treating the supply of available partners as an endogenous equilibrium object rather than imposing an exogenous distribution from where to draw candidate partners. Two notable exceptions are the works of [Reynoso \(2017\)](#) and [Beauchamp et al. \(2018\)](#): the first studies the impact of divorce laws on marriage, labor supply and divorce; the marriage market is thought as a static matching game played at the beginning of adulthood, and remarriage is not allowed. The second paper estimates an equilibrium model of the marriage market with divorce and remarriage in order to study the determinants of single parenthood: their definition of equilibrium differs from the one used in this paper as agents are only allowed to marry within their own cohort.

The paper is structured as follows: I first present the model in section 2; I provide a formal discussion on how to identify its key unobserved parameters in section 3; I introduce the CPS and PSID samples in section 4; I provide details about the empirical specification and the estimation procedure in section 5; I present the results of the estimation, of the counterfactual analysis and of the welfare analysis in section 6; I conclude in section 7.

2 The Model

The theoretical framework extends the original two-sided search-and-matching model by [Shimer and Smith \(2000\)](#) in the vein of GJR. Single agents search for possible partners on the marriage market. Married households face two layers of uncertainty: first, about the future quality of the current match; second, about the future wage rates of the spouses. When uncertainty is resolved, the couple needs to make a decision about whether to continue the match or not: in this way, divorce decisions are endogenous.

In contrast with the previous literature, I introduce some key elements that extend the

empirical analysis to the life-cycle level. First, I introduce aging: agents get older as time goes by, and age influences their odds of marriage, divorce and remarriage. Second, I assume agents are risk-averse and experience wage shocks along the life-cycle: wage uncertainty partly explains marital instability, as economic gains from marriage may disappear following a wage shock.

Before turning to the setup, let me anticipate some key implications of these assumptions. On the one hand, the definition of a *deterministic* steady-state equilibrium⁴ requires some strong assumptions on market entry and exit. In the stationary environment, new cohorts do not differ from the previous ones in terms of size and composition, and, on the aggregate, display the same matching behavior along the life-cycle: both business cycles and secular drifts are not captured by the model, and only comparative statics can help make sense of differences across time and space. On the other hand, the introduction of aging does not require the wage process to be stationary, nor new marriages to be outbalanced by an equal amount of divorces for a given group of agents. Different groups *within* the same cohort may take strongly diverging paths in terms of both earnings and family achievements, exactly as we see in the data.

The section is organized as follows. First, in subsections 2.1, 2.3 and 2.2, I describe the general environment and the *ex-ante* heterogeneity characterizing agents. Then, in subsections 2.4, 2.5 and 2.6, I describe the household problem for couples and singles. Finally, in subsections 2.7, 2.8, 2.9 and 2.11, I describe the search environment and marriage and divorce decisions, and, in section 2.12, I conclude by providing a definition of the steady-state equilibrium.

2.1 Heterogeneous Agents and Aging

Men are *ex-ante* heterogeneous and are associated with a publicly observable *type* i , a vector comprising the following elements:

- a time-invariant human capital type h_i ;
- age a_i , which is deterministically updated over time;
- current wage w_i , which changes over time according to an $AR(1)$ random process described in the section 2.3.

⁴As opposed to a *stochastic* steady-state, where equilibrium quantities are functions of an aggregate state of the world. In this search-and-matching model, there are several assumptions that could be relaxed in order to introduce aggregate uncertainty. Some possible extensions will be discussed in this section and in the conclusion.

Similarly, the type of a woman is given by $j = (h_j, a_j, w_j)$. The men's (women's) set of types is named \mathcal{I} (\mathcal{J}) and is discrete. Note that the time subscript t is unnecessary, since I will focus on the steady-state equilibrium. Agents care about time because of the aging and stochastic wage process, but live in a stationary environment.

Aging individuals discount future by means of a factor β , and face an exogenous probability of exiting the market. A man i exits the marriage market with probability $1 - \psi_m(i)$ at the end of the period. If he survives, he grows one-year older, so that i' is such that $a_{i'} = a_i + 1$. A similar process governs women's aging, with a different vector of survival probabilities ψ_f . In addition, assume agents eventually leave with probability one at \bar{a} , i.e., $\psi_m(\bar{a}) = \psi_f(\bar{a}) = 0$. Market exit is primarily intended as death, although it could also encompass other situations where the agent is unable to live in a two-adult household nor to look for a partner: these may include active duty in the army, incarceration, long-term stay in health-care institutions, and so on.

2.2 Marital Status and Timing

Time is discrete, and a period is defined as the timespan between t and $t + 1$. In t , an agent is associated with his (her) current type i and (j) and is either married or single. Married couples are characterized by the joint type (i, j) . At the very beginning of the period, in t_+ , uncertainty is resolved. First, agents learn whether they will live on to the next period, with exit probabilities described by ψ_g , $g \in \{m, f\}$. If they do, they grow one-year older and draw new wages according to the $AR(1)$ wage process described in the next section.

Consider the time-line of a given period for a man i and a woman j that are married at the beginning of the period (see figure 1). On top of drawing new wages, the couple also observes the realization of a vector $\boldsymbol{\eta}$ of temporary shocks that help characterize the quality of the current match. The distribution and exact role of $\boldsymbol{\eta}$ will be described in the next section. However, assume from now that the vector $\boldsymbol{\eta}$ is *i.i.d.* across time and couples. Conditionally on their new types i' and j' and on $\boldsymbol{\eta}$, the spouses decide whether they should stay together until the end of the period. If they divorce, they both stay single until the end of the period. Finally, conditionally on their updated marital status, agents make consumption and labor supply choices.

Consider the time-line of a given period for an individual who is single at the beginning of the period (see figure 2). In t_+ , she draws a new wage and learns her new type, and she may also meet a someone of the opposite of sex (in the case of women, they could meet a man of type i). The pair draws a vector of shocks $\boldsymbol{\eta}$ that will influence the subsequent matching

decision, namely whether to get married or to stay single until the end of the period. Finally, the woman makes consumption and labor supply choices, either alone or with her new husband.

2.3 Wage Process

Wages follow an $AR(1)$ process, so that, at the beginning of every period, a man draws a new wage $w_{i'}$ conditionally on both his current wage w_i and his deterministic traits h_i and a_i . Because of the randomness of the wage process, the probability of transiting from type i to type i' is denoted $\pi_m(i, i') \equiv \Pr(i'|i)$. The notation used for $\pi_m(i, i')$ stresses that $\pi_m(i, i')$ depends on the full vector i , i.e., on both the current wage w_i , age a_i and human capital h_i .⁵ Analogous considerations hold for women, whose probability of transiting from j to j' is given by $\pi_f(j, j')$, where π_f is possibly different from π_m .

The wage process does not need to be stationary due to life-cycle dynamics being taken into account. Importantly, for a given cohort of people, mean wages depend on age, and a cohort's wage dispersion may increase along the life-cycle. While I let time-invariant traits and age directly influence the conditional distribution of wages, I do not attempt to decompose wages in multiple factors, and in particular to distinguish between a permanent and a temporary component as it is common in the literature (see [Meghir and Pistaferri, 2011](#)). Therefore, wage shocks need to be interpreted as permanent: I will often refer to *wage mobility* as the extent to what individuals are likely to move along the wage distribution from one period to the next (see [Kopczuk et al., 2010](#)).

Finally, note that the assumption that the wage process is fully exogenous - and in particular that it is not affected by the agent's marital status - is likely to be highly counterfactual, particularly for women. Joint household labor supply decisions may have an impact on human capital accumulation, especially if household specialization plays an important role as a motive to marry. Hence, one's marital status may influence the evolution of his/her wage rate. These crucial limitations are discussed in the conclusion.

2.4 Household Problem: Preferences and Domestic Production

With time-lines 1 and 2 in mind, it is possible to characterize agents' rational behavior by solving backwards for their optimal choices. In this section, I will introduce agents' preferences, while

⁵Note that the corresponding transition matrix $(\pi_m(i, i')) \in \mathbb{R}^{|\mathcal{I}| \times |\mathcal{I}|}$ is such that $\pi_m(i, i') = 0$ if $h_{i'} \neq h_i$ or if $a_{i'} \neq a_i + 1$.

in sections 2.5 and 2.6 I will solve the household problem. Only starting from section 2.7, I will proceed by describing the optimal matching decisions (i.e., marriage and divorce).

Agents enjoy utility from the consumption of both a private good q and a public good Q . The agents' utility is represented by the following function:

$$u(q, Q) = \frac{1}{2} \log q + \frac{1}{2} \log Q. \quad (2.1)$$

The good Q can be thought of as intermediary and is produced domestically using both time and money input. The production function of Q is

$$Q = \begin{cases} (t_m + t_f)^{\gamma_1(i,j)} \exp(\gamma_2(l_f; j) + \gamma_3(i, j) + \eta_{lf}) & \text{for married households} \\ t_m^0 & \text{for single men} \\ t_f^0 & \text{for single women.} \end{cases} \quad (2.2)$$

For married households, t_m and t_f represent the husband's and wife's share of public good expenditure, assumed to be perfect substitutes. The elasticity of Q with respect to the total expenditure is equal to γ_1 , and may depend on the spouses' characteristics: γ_1 plays an important role in the empirical analysis of marriage, in that it determines the size of the economies of scale enjoyed by married couples. As concerns single adults, they can only produce Q via a monetary input: t_g^0 is the share of their budget allocated to home production.⁶

The total amount of time available to an agent is normalized to one, so that $l_f \in \mathcal{L}_f$ represents the wife's share of time spent on the labor market, where \mathcal{L} is assumed to be discrete. Married men always spend the entire time endowment on the labor market: while the theoretical framework does not require the labor supply of men to be fixed, restricting the choice set in this direction is convenient for the empirical analysis and is broadly consistent with the patterns observed in the data.⁷ There exist possible public benefits of having a stay-at-home spouse, which are captured by the productivity shifter γ_2 . In other words, if γ_2 is decreasing in l_f , the couple benefits from a higher public good production when the spouse reduces her labor market effort, all else constant. In practice, γ_2 is left unrestricted and is estimated for different levels l_f in the empirical analysis.

The term γ_3 is an additional productivity shifter, which depends on the couple's type (i, j) only. It has the role of capturing the relevance of additional interactions between traits, such

⁶The elasticity of Q with respect to t_g^0 is normalized to 1. The role of this normalization to ensure the identification of the model is remarked in section 3.

⁷In the CPS, only about 10% of married men between 20 and 60 are out of the labor force in the 1970s, 8% in the 2000s.

as a preference for educational homogamy or age proximity. Finally, the term η_{l_f} is a random shifter taken from the vector $\boldsymbol{\eta} \in \mathbb{R}^{|\mathcal{L}_f|}$: each option l_f is associated with an element of $\boldsymbol{\eta}$, and each η_{l_f} is distributed logistically with location and scale parameters normalized to 0 and 1 respectively. While $\boldsymbol{\eta}$ is *i.i.d.* across time and couples, its elements may be correlated with each other, with $0 < \sigma_\ell \leq 1$ representing their degree of independence (see Train, 2009, Chapter 4, for details, and note that with $\sigma_\ell = 1$ we have a standard logit model).

In the case of married households, an allocation $(q_m, q_f, t_m, t_f, l_f)$ is feasible if the following private budget constraints are respected:

$$q_m = w_i - t_m \tag{2.3}$$

$$q_f = l_f w_j - t_f \tag{2.4}$$

where the sign of t_m and t_f is unrestricted. Hence, $t_m < 0$ ($t_f < 0$) implies that the wife (husband) is actually transferring money into the husband's (wife's) pocket.

Analogous budget constraints hold for single agents. However, it is assumed hereafter that singles always work full-time. Since the household problem is fully static, the labor supply of singles does not have an impact on their future marriage choices, and is thus not included in the analysis.⁸

2.5 Household Problem: Public Good

As a first step to solve the household problem for married agents, assume the optimal household allocation $(q_m^*, q_f^*, t_m^*, t_f^*, l_f^*)$ is efficient. This assumption puts the model in the general collective framework introduced by Chiappori (1988, 1992). Moreover, the preferences implied by the utility function (2.1) verify the Transferable Utility (TU) property.

The efficiency assumption and the TU property bear two important implications. First, the demand for public good $Q^*(l_f; i, j)$ conditional on the wife's labor supply l_f does not depend on the point of the Pareto frontier chosen by the household. On the other hand, the couple may disagree on the repartition (t_m, t_f) : this will be dealt with in the next section. Second, the spouses always agree on the level l_f that puts them on the outermost Pareto frontier. This second statement relies on the absence of private incentives (e.g., private leisure) for the wife to manipulate her supply l_f : in this particular case, the $|\mathcal{L}|$ Pareto frontiers are parallel, and there

⁸Allowing singles to adjust their labor supply is possible, and would be crucial if human capital accumulation choices were considered. However, it implies a slightly more complicated discrete choice setting. Shephard (2018) shows a convenient way of handling larger discrete choice sets by partly postponing the resolution of uncertainty after the matching phase.

is no disagreement about how much the wife should work. The underlying economic intuition is that, while the wife might be “unhappy” about the selected l_f , she can always be compensated through a more favorable division of the public good expenditure.

In order to derive the demand for public good, substitute the budget constraints (2.3) and (2.4) into the utility function (2.1) and define the *conditional indirect utilities* as follows:

$$\begin{aligned}\phi_m(t_m, t_f, l_f; i, j) + \frac{\eta_f}{2} &= \frac{1}{2} \log(w_i - t_m) + \frac{\gamma_1(i, j)}{2} \log(t_m + t_f) + \frac{\gamma_2(l_f; j)}{2} + \frac{\gamma_3(i, j)}{2} + \frac{\eta_f}{2} \\ \phi_f(t_m, t_f, l_f; i, j) + \frac{\eta_f}{2} &= \frac{1}{2} \log(l_f w_j - t_f) + \frac{\gamma_1(i, j)}{2} \log(t_m + t_f) + \frac{\gamma_2(l_f; j)}{2} + \frac{\gamma_3(i, j)}{2} + \frac{\eta_f}{2}.\end{aligned}$$

The demand $Q^*(l_f; i, j)$ is then obtained by maximizing any weighted sum of ϕ_m and ϕ_f with respect to t_m and t_f , holding l_f fixed. The share of household budget used as an input for Q is:

$$\frac{\gamma_1(i, j)}{1 + \gamma_1(i, j)}(w_i + l_f w_j). \quad (2.5)$$

It is possible to provide a linear characterization of the Pareto frontier associated with a given level l_f by summing up the exponentials of the indirect utility functions (see Chiappori and Gugl, 2014). Their sum is equal to a constant, and helps characterize the Pareto set in a way that the Pareto frontier is a straight line with slope -1 :

$$\exp(\phi_m(t_m, t_f, l_f; i, j)) + \exp(\phi_f(t_m, t_f, l_f; i, j)) \equiv \Gamma(l_f; i, j) \quad (2.6)$$

where Γ is calculated explicitly in appendix A.1.

When it comes to labor supply decisions, the spouses will choose l_f in order to select the outermost Pareto frontier, once the random shocks $\boldsymbol{\eta}$ are taken into account:

$$l_f^*(i, j) = \arg \max_{l_f \in \mathcal{L}} \Gamma(l_f; i, j). \quad (2.7)$$

2.6 Household Problem: Sharing Rule

Another key implication of the Transferable Utility property is that it is impossible to recover the *sharing rule* (t_m, t_f) , i.e., the exact point on the Pareto frontier chosen by the spouses. The solution $(t_m^*(l_f; i, j), t_f^*(l_f; i, j))$ can only be pinned down if the distribution of power within the household is known. As suggested by Becker (1973), the sharing rule within the couple responds to shifts in supply and demand of mates of a given type in the marriage market. However, when search frictions are present, it is not possible to uniquely characterize Pareto weights starting from the marriage market outcome (Shimer and Smith, 2000). The underlying intuition can

be explained with this thought example: consider a man who proposes to a woman and offers her a marriage contract that makes her just indifferent between marrying him and keeping on searching. Due to search frictions, she cannot turn to another similar man and agree on a better deal where she extracts a slightly larger share of surplus. In fact, waiting might be too costly, and, if the surplus is positive, the woman still has an incentive to accept. Yet, the marriage market still plays a crucial role in determining whether there is a set of allocations that make both candidates better off together than singles. If the set is not null, the choice of the allocation also depends on an additional *within-couple bargaining mechanism*. In some markets, the set of feasible allocations can be small, and competition might greatly reduce the role of within-couple bargaining; in others, the reverse can be true.

The discussion above implies that it is necessary to introduce an additional bargaining mechanism in order to recover the sharing rule and close the model. To understand how $(t_m^*(i, j), t_f^*(i, j))$ is selected, let me first introduce the relevant bargaining payoffs. These are given by the present discounted value of all expected flows in the future, once accounted for the possibility of breakups. Define $(W_m(t_m, t_f, l_f; i, j), W_f(t_m, t_f, l_f; i, j))$ as the *present discounted value of marriage* for a man and a woman in a couple (i, j) under sharing rule (t_m, t_f) and with labor supply l_f . In addition, define $(V_m^0(i), V_f^0(j))$ as the respective *present discounted value of singlehood*. The latter constitute the bargaining breakpoint and are shaped by the marriage market: agents take them as given during the bargaining phase.

Call $(t_m^*(l_f; i, j), t_f^*(l_f; i, j))$ the solution to the bargaining process for a couple (i, j) conditional on choosing labor supply l_f . The respective marriage payoffs are

$$V_m(l_f; i, j) + \frac{\eta_f}{2} \equiv W_m(t_m^*(l_f; i, j), t_f^*(l_f; i, j), l_f; i, j) + \frac{\eta_f}{2} \quad (2.8)$$

$$V_f(l_f; i, j) + \frac{\eta_f}{2} \equiv W_f(t_m^*(l_f; i, j), t_f^*(l_f; i, j), l_f; i, j) + \frac{\eta_f}{2}. \quad (2.9)$$

I assume that $(t_m^*(l_f; i, j), t_f^*(l_f; i, j))$ are chosen so that the following *surplus splitting rule* holds:

$$V_f(l_f; i, j) - V_f^0(j) = \frac{V_f(l_f; i, j) - V_f^0(j) + V_m(l_f; i, j) - V_m^0(i)}{2} \equiv \frac{S(l_f; i, j)}{2} \quad (2.10)$$

where S is the *systematic marriage surplus*, i.e., the total surplus net of the temporary match-quality shock η_f . In practice, the spouses split the total surplus in equal parts.

The splitting rule assumed in this model is arguably a simple one. Yet, it is able to generate a significant amount of variation across individuals in terms of private consumption. A closed-form equation for individual demand functions q_m^* and q_f^* is derived in appendix A.2. Once the sharing rule has been recovered, it is possible to derive the per-period indirect utilities $v_g(l_f; i, j) \equiv \phi_g(t_m^*(l_f; i, j), t_f^*(l_f; i, j), l_f; i, j)$ for $g \in \{m, f\}$.

In the previous literature, [Shimer and Smith \(2000\)](#) and GJR assume that couples select a sharing rule through Nash bargaining. Collective models are a more general representation of the household problem: in this paper, I restrict *Pareto weights* to 0.5 for all couples. This simple rule has the advantage of delivering a closed-form equation for surplus, and thus to make the computation of the steady-state equilibrium faster.⁹

To conclude this section, the following lemma can now help characterize the wife's labor supply decision.

Lemma 2.1. *Assume that ϕ_m and ϕ_f verify the Transferable Utility property and that surplus is split according to rule (2.10). Then,*

$$S(l_f; i, j) + \eta_f > S(l'_f; i, j) + \eta'_f \Rightarrow \Gamma(l_f; i, j) > \Gamma(l'_f; i, j). \quad (2.11)$$

Proof. It is possible to write $V_m(l_f; i, j) = \phi_m(t_m^*(l_f; i, j), t_f^*(l_f; i, j), l_f; i, j) + C_m(i, j)$ and $V_f(l_f; i, j) = \phi_f(t_m^*(l_f; i, j), t_f^*(l_f; i, j), l_f; i, j) + C_f(i, j)$, where C_m and C_f are, respectively, the continuation values for the husband and the wife. The latter do not depend on current labor supply due to the household problem being static. Consider l_f and l'_f such that $S(l_f; i, j) + \eta_f > S(l'_f; i, j) + \eta'_f$, and introduce the notation $\delta f(x) = \delta f(l_f; x) - f(l'_f; x)$, so that $\delta S(i, j) + \delta \eta > 0$. Both the reservation utilities and continuation values are the same regardless of the choice of l_f : hence, the surplus differential is given by $\delta S(i, j) = \delta \phi_m(i, j) + \delta \phi_f(i, j)$. Similarly, the husband's surplus differential is $\delta V_m(i, j) + \delta \eta/2 = \delta \phi_m + \delta \eta/2 = \delta S(i, j)/2 + \delta \eta/2$, where the last equality is due to the splitting rule (2.10). Since $\delta S(i, j) + \delta \eta > 0$, both $\delta \phi_m + \delta \eta/2$ and, for analogous reasons, $\delta \phi_f + \delta \eta/2$ are positive. Now, recall that a necessary and sufficient condition for the TU property to hold is the existence of two functions g_m and g_f , continuous and increasing, s.t. the Pareto frontier can be expressed as

$$g_m(\phi_m(t_m, t_f, l_f; i, j) + \frac{\eta_f}{2}) + g_f(\phi_f(t_m, t_f, l_f; i, j) + \frac{\eta_f}{2}) = \Gamma(l_f; i, j),$$

a result exposed, e.g., in [Chiappori and Gugl \(2014\)](#) and [Demuyne and Potoms \(2018\)](#). Due to g_m and g_f being increasing, $g_m(\phi_m(l_f) + \frac{\eta_f}{2}) > g_m(\phi_m(l'_f) + \frac{\eta'_f}{2})$ and $g_f(\phi_f(l_f) + \frac{\eta_f}{2}) > g_f(\phi_f(l'_f) + \frac{\eta'_f}{2})$. Adding up the two inequalities, one obtains $\Gamma(l_f) > \Gamma(l'_f)$. \square

Lemma 2.1 establishes that the splitting rule (2.10) implies that the household always chooses the level of labor supply associated with the highest total surplus $S(l_f; i, j) + \eta_f$. The

⁹GJR estimate the Nash bargaining parameter, which corresponds to the Pareto weight when utility functions are taken to be quasilinear (which is not the case in the current paper). They find it to be not significantly different than 0.5. Alternatively, the Pareto weight may be allowed to differ across couples, to depend on reservation utilities ($V_m^0(i), V_f^0(j)$) or even on some (time-invariant) *distribution factors* in the spirit of [Browning and Chiappori \(1998\)](#).

chosen level of labor supply l_f , $(t_m^*(l_f; i, j), t_f^*(l_f; i, j))$ lies on the outermost Pareto frontier if $S(l_f; i, j) + \eta_{l_f} > S(l'_f; i, j) + \eta_{l'_f}$.¹⁰ The proof suggests that, when switching from l'_f to l_f , the additional surplus is always redistributed proportionally, so that the ratio of the shares is always 0.5. Thanks to the additive separability of η_{l_f} and the logit assumption, the probability of selecting a given level l_f can be written as:

$$\begin{aligned} \ell(l_f; i, j) &\equiv \Pr \left\{ S(l_f; i, j) + \eta_{l_f} > S(l'_f; i, j) + \eta_{l'_f} \quad \forall l'_f \in \mathcal{L} \right\} = \\ &= \frac{\exp(S(l_f; i, j)/\sigma_\ell)}{\sum_{l' \in \mathcal{L}} \exp(S(l'; i, j)/\sigma_\ell)}. \end{aligned} \quad (2.12)$$

Taking expectations over marriage surplus with respect to the vector $\boldsymbol{\eta}$ yields the following expected surplus (named *inclusive surplus* in the GEV literature; see Train, 2009):

$$\bar{S}(i, j) \equiv \sigma_\ell \log \sum_k \exp(S(k; i, j)/\sigma_\ell). \quad (2.13)$$

2.7 Divorce Decisions

Up to now, household composition was treated as given. However, when the uncertainty is revolved in t_+ (see timeline 1), the couple may decide to break up. Conditionally on the realization of the wage shocks and on temporary shocks $\boldsymbol{\eta}$, spouses are free to compare the optimal household allocation that they can achieve in the coming period to what they can get if each of them were on his/her own. In other words, the new household allocation has to respect the spouses' individual rationality constraints. However, in this model, spouses also face a one-time cost of divorce.

The updated state of the couple in t_+ is given by the spouses' new types (i, j) and the updated vector of match-quality shocks $\boldsymbol{\eta}$. If, once accounted for the new shocks $\boldsymbol{\eta}$, the total surplus is not positive for the outermost Pareto frontier $\Gamma(l_f; i, j)$, then the spouses are better off breaking up. Given the logit assumption on $\boldsymbol{\eta}$, the probability of divorce is given by:

$$\begin{aligned} 1 - \alpha(i, j) &\equiv \Pr \left\{ \max_{l_f \in \mathcal{L}} (S(l_f; i, j) + \eta_{l_f}) < -\kappa \right\} = \\ &= \frac{\exp(-\kappa)}{\exp(-\kappa) + \left(\sum_{l_f} \exp(S(l_f; i, j)/\sigma_\ell) \right)^{\sigma_\ell}} = \frac{1}{1 + \exp(\bar{S}(i, j) + \kappa)}. \end{aligned} \quad (2.14)$$

¹⁰The caveat is that the sum $\phi_m(l_f) + \phi_f(l_f)$ does *not* necessarily provide an implicit representation of the Pareto frontier. It only does so in the case where ϕ_m (ϕ_f) is quasilinear in the private budget $w_i - t_m$ ($w_j - t_f$): in this case, the functions g_m and g_f required to obtain a linear representation of the Pareto frontiers as in (2.6) are actually linear functions.

where the last equality follows from the definition of inclusive surplus (2.13). The probability $\alpha(i, j)$ corresponds to the odds of continuing the current marriage. Finally, the parameter κ stands for the sunk cost of divorce: note that, *ceteris paribus*, a higher κ leads to a higher α .

When divorce cannot be ruled out, only limited commitment devices are feasible: these mechanisms have been widely studied in the economic literature on marriage and risk-sharing. In this model, it is assumed that, when uncertainty is resolved, agents are completely free to bargain over a new household allocation: if bargaining fails because of negative surplus, the couple splits after paying a one-time “fine”. In this model, the only source of commitment is the cost of divorce. However, the fact that married agents are free to rediscuss the sharing rule following any shock implies that they are not able to reduce the volatility of consumption as much as they wish. If given the choice, risk-averse agents would prefer to commit to a given sharing rule in order to smooth out future labor income shocks and only change it if there is a serious threat to the relationship.¹¹

2.8 Value of Marriage

The spouses’ Bellman equations recursively characterize the equilibrium marital payoffs for given reservation values $(V_m^0(i), V_f^0(j))$. Consistently with the household problem and the divorce rule described in previous sections, the Bellman equations of married agents can be written as:

$$V_m(l_f; i, j) = v_m(l_f; i, j) + \psi_m(i)\beta \sum_{i'} V_m^0(i')\pi_m(i, i') + \underbrace{\psi_m(i)\psi_f(j)\frac{\beta}{2} \sum_{i', j'} [\gamma_e + \log(\exp(-\kappa) + \exp(\bar{S}(i', j')))] \pi_m(i, i')\pi_f(j, j')}_{\text{Husband's continuation value}}. \quad (2.15)$$

$$V_f(l_f; i, j) = v_f(l_f; i, j) + \psi_f(j)\beta \sum_{j'} V_f^0(j')\pi_f(j, j') + \underbrace{\psi_m(i)\psi_f(j)\frac{\beta}{2} \sum_{i', j'} [\gamma_e + \log(\exp(-\kappa) + \exp(\bar{S}(i', j')/\sigma))] \pi_m(i, i')\pi_f(j, j')}_{\text{Wife's continuation value}}. \quad (2.16)$$

where γ_e is Euler’s constant.

¹¹See [Ligon et al. \(2002\)](#) and [Mazzocco \(2007\)](#) for an exhaustive analysis of limited commitment: these papers discuss the ex-ante efficient contract. More recently, several other papers estimated intertemporal collective models with limited commitment: [Voena \(2015\)](#), [Reynoso \(2017\)](#) and [Shephard \(2018\)](#) are three noteworthy examples; see [Chiappori and Mazzocco \(2017\)](#) for a complete review.

Enforcing the splitting rule (2.10) on the lhs of equations (2.15) and (2.16), one can recover the per-period indirect utilities $v_m(l_f; i, j)$ and $v_f(l_f; i, j)$. The pair $(v_m(l_f; i, j), v_f(l_f; i, j))$ needs to be such that the household allocation lies on the Pareto frontier: hence, substituting v_m and v_f in equation (2.6) ensures that the wife's and husband's payoffs are both feasible and Pareto optimal. Moreover, this also yields a Bellman equation for the surplus function:

$$\begin{aligned}
 S(l_f; i, j) = & h(l_f, i, j) - \log \left[\exp \left(V_f^0(j) - \psi_f(j) \beta \sum_{j'} V_f^0(j') \pi_f(j, j') \right)^2 + \right. \\
 & \left. + \exp \left(V_m^0(i) - \psi_m(j) \beta \sum_{i'} V_m^0(i') \pi_f(i, i') \right)^2 \right] + \\
 & \underbrace{\psi_m(i) \psi_f(j) \beta \sum_{i', j'} [\gamma_e + \log(\exp(-\kappa) + \exp(\bar{S}(i', j')))] \pi_m(i, i') \pi_f(j, j')}_{\text{Couple's continuation value}}
 \end{aligned} \tag{2.17}$$

which yields a system of $|\mathcal{I}| \times |\mathcal{J}| \times |\mathcal{L}|$ equations with as many unknowns, the elements of $(S(l_f; i, j))$.¹² The function $h(l_f; i, j)$ depends on the shape of the Pareto frontier - their relationship is clarified in appendix A.1 - and, ultimately, on preferences: in this case, it corresponds to the following

$$h(l_f; i, j) = \tilde{\gamma}_1(i, j) + (\gamma_1(i, j) + 1) \log(w_i + l_f w_j) + \gamma_2(l_f; j) + \gamma_3(i, j). \tag{2.18}$$

where $\tilde{\gamma}(i, j)$ is a function of $\gamma_1(i, j)$ (see appendix A.1). By establishing the connection between preferences and the match payoff, the function h has a key role in the determination of the equilibrium marital patterns.

2.9 Meetings

Search for a partner is costless and singles of different sex meet each other randomly. In each period, the number of meetings between singles of different sex of a given type is given by a *meeting function* $\Lambda(i, j, n_{m,+}, n_{f,+})$. The measures $n_{m,+}$ and $n_{f,+}$ represent the available number of singles by type at time t_+ and are defined over $|\mathcal{I}|$ and $|\mathcal{J}|$ respectively: they will be formally defined in section 2.11, and are endogenously determined at equilibrium. The probability for a single man i of meeting a single woman j and the probability of a single woman j to meet a

¹²A convenient way of proceeding is actually to derive the corresponding Bellman equation for \bar{S} by using the expression for the inclusive surplus (2.13). For given reservation values (V_m^0, V_f^0) , it is possible to solve the system by first computing \bar{S} for couples where at least one spouse has age \bar{a}_g : these couples have a continuation value equal to zero. Then, it is possible to solve backwards by computing \bar{S} for couples where at least one spouse has age $\bar{a}_g - 1$, and so on.

single man i can be written as the following conditional probabilities:

$$\Lambda_m(i, j) \equiv \Lambda(i, j, n_{m,+}, n_{f,+})/n_{m,+}(i) \quad (2.19)$$

$$\Lambda_f(i, j) \equiv \Lambda(i, j, n_{m,+}, n_{f,+})/n_{f,+}(j). \quad (2.20)$$

The meeting function $\Lambda(i, j, n_{m,+}, n_{f,+})$ needs to respect some theoretical restrictions. The total number of meetings involving types i (or j) cannot exceed $n_{m,+}(i)$ (or $n_{f,+}(j)$)¹³:

$$\sum_j \Lambda(i, j, n_{m,+}, n_{f,+}) \leq n_{m,+}(i) \quad \forall i \quad (2.21)$$

$$\sum_i \Lambda(i, j, n_{m,+}, n_{f,+}) \leq n_{f,+}(j) \quad \forall j \quad (2.22)$$

The specification chosen for Λ is the following:

$$\Lambda(i, j) = \lambda(i, j) \frac{n_{m,+}(i)n_{f,+}(j)}{n_{m,+}(i) + n_{f,+}(j)} \quad (2.23)$$

with $\sum_i \lambda(i, j) \leq 1$ for each j and $\sum_j \lambda(i, j) \leq 1$ for each i . These conditions on λ ensure that constraints (2.21) and (2.22) are respected. In line with the search literature, the number of meetings depends on the availability of singles on each side of the market (Rogerson et al., 2005). However, with heterogeneity on both sides of the market, the number of meetings between types i and j depend on the specific supplies $n_{m,+}(i)$ and $n_{f,+}(j)$: the two act as inputs in a CES function where the elasticity of substitution is equal to 1.¹⁴ Moreover, $\lambda(i, j)$ acts as a shifter that captures the degree of homophily along observable traits in the meeting structure: the empirical specification of $\lambda(i, j)$ is detailed in section 5.6.

2.10 Marriage Decisions and Value of Singlehood

Upon a meeting, a man and a woman observe each other's type and draw a vector $\boldsymbol{\eta}$. As in equation (2.14), the logit framework yields the following probability of getting married:

$$\begin{aligned} \alpha_0(x, y) &\equiv \Pr \left\{ \max_{l_f \in \mathcal{L}} (S(l_f; i, j) + \eta_{l_f}) > 0 \right\} \\ &= 1 - \frac{1}{1 + \exp(\sigma_\ell \tilde{S}(i, j))} \end{aligned} \quad (2.24)$$

¹³In addition, at the aggregate level, the total number of meetings must not exceed $\min\{N_m, N_f\}$. This additional restriction is implied by (2.21) and (2.22) as long as there is an equal number of male and female singles on the market.

¹⁴The specification (2.23) generalizes $\Lambda(i, j) = \lambda(i, j) ((n_{m,+}(i))^{-\chi} + (n_{f,+}(j))^{-\chi})^{-1/\chi}$, widely used in demography (Pollak, 1990). When $\chi = 1$, Λ boils down to (2.23).

where α_0 differ from α because of the absence of the sunk cost κ . In other words, if an agent is not interested in pursuing a relationship with his/her date, he/she needs to wait until the next period, but can walk away without having to pay any additional cost. As a consequence, it is easy to show that $\alpha(i, j) > \alpha_0(i, j)$ as long as $\kappa > 0$.

It is now possible to derive the value of singlehood, named V_m^0 and V_f^0 for men and women respectively. The per-period utility flow a single agent gets can easily be derived from a much simplified version of the household problem discussed for married couples. The only consumption choice a single agent needs to make is how to spend his total wage on goods q and Q : since he/she lives alone, both goods are private. The presented discounted value of being single also incorporates the expectations about his/her marriage market prospects. The Bellman equations can be written as follows:

$$\begin{aligned}
 V_m^0(i) = & v_m^0(i) + \beta \psi_m(i) \sum_{i'} V_m^0(i') \pi_m(i, i') di' + \\
 & + \underbrace{\psi_m(i) \frac{\beta}{2} \sum_{i', j'} [\gamma_e + \log(1 + \exp(\bar{S}(i', j')))] \Lambda_m(i', j') \pi_m(i, i')}_{\text{Expected marriage prospects}} \quad (2.25)
 \end{aligned}$$

$$\begin{aligned}
 V_f^0(j) = & v_f^0(j) + \beta \psi_f(j) \sum_{j'} V_f^0(j') \pi_f(j, j') + \\
 & + \underbrace{\psi_f(j) \frac{\beta}{2} \sum_{i', j'} [\gamma_e + \log(1 + \exp(\bar{S}(i', j')))] \Lambda_f(i', j') \pi_f(j, j')}_{\text{Expected marriage prospects}}. \quad (2.26)
 \end{aligned}$$

2.11 Aggregate Stocks

After outlining the behavior of individual agents, it is useful to define aggregate measures to keep track of the number of individuals by type and marital status in the population. First, consider the overall population dynamics: define p_m over \mathcal{I} , p_f over \mathcal{J} the marginal PDF of the male and female population characteristics. As detailed in section 2.1, agents may exit the marriage market in any period: e.g., the per-period aggregate outflow of men of type i is given by $(1 - \psi_m(i))p_m(i)$. Stationarity demands that the outflow of agents is counterbalanced by an inflow of new agents so that the size and composition of the population do not change. In t_+ in each period, an inflow $\omega_m(i)$ of unmarried men i and $\omega_f(j)$ of unmarried women j enter the market so that p_m and p_f do not change over time.¹⁵

¹⁵Relaxing this assumption introduces insightful long-run dynamics. For instance, younger cohorts may enter the market with better initial wages: in a competitive environment, this may have sizable implications for older cohorts' matching behavior. While such framework does not seem compatible with a notion of deterministic

I introduce measures n_m over \mathcal{I} , n_f over \mathcal{J} and m over $\mathcal{I} \times \mathcal{J}$ that count male singles, female singles and couples *at the end of the period*, i.e., after the matching phase took place (or, analogously, in t on time-lines 1 and 2, just before uncertainty is resolved). As in any matching model, the *matching outcome* (n_m, n_f, m) must respect the accounting restrictions:

$$p_m(i) = n_m(i) + \sum_j m(i, j) \quad (2.27)$$

$$p_f(j) = n_f(j) + \sum_i m(i, j). \quad (2.28)$$

In t_+ , when agents update their types, it is also necessary to update the aggregate distributions. Singles draw their new wages before the “market opening”, and they are joined by the inflows of new agents ω_m and ω_f . Hence, the measure of singles of a given type in t_+ is given by:

$$n_{m,+}(i') \equiv \begin{cases} \omega_m(i') + \sum_{i'} \psi_m(i) n_m(i) \pi_m(i, i') & \text{if } a_{i'} > \underline{a}_m \\ \omega_m(i') & \text{if } a_{i'} = \underline{a}_m \end{cases} \quad (2.29)$$

$$n_{f,+}(j') \equiv \begin{cases} \omega_f(j') + \sum_{j'} \psi_f(j) n_m(j) \pi_f(j, j') & \text{if } a_{j'} > \underline{a}_f \\ \omega_f(j') & \text{if } a_{j'} = \underline{a}_f \end{cases} \quad (2.30)$$

Similarly, it is useful to define a measure m_+ that counts married couples of a given type in t_+ , right after uncertainty is resolved, but before spouses could make decisions about the continuation of the match. In other words, the measure m_+ is the distribution of characteristics of the population at risk of divorce in t_+ :

$$m_+(i', j') = \sum_{i,j} \psi_m(i) \psi_f(j) m(i, j) \pi_m(i, i') \pi_f(j, j') di dj. \quad (2.31)$$

2.12 Law of Motion and Search Equilibrium

The matching outcome (m, n_m, n_f) results from individual matching strategies (α, α_0) . The number $m(i, j)$ of couples (i, j) at the end of the period is given by the sum of newlyweds (i, j) and those couples (i, j) that did not divorce after drawing new wages and home productivity shocks. This results in the following law of motion:

$$m(i, j) = \underbrace{\alpha_0(i, j) \Lambda(i, j)}_{MF(i,j)} + \underbrace{\alpha(i, j) m_+(i, j)}_{m_+(i,j)-DF(i,j)}. \quad (2.32)$$

steady-state equilibrium, it may be helpful to study the relationship between business cycles and marriage markets.

where the first term on the rhs provides a formula for the marriage flow $MF(i, j)$, while the second term implicitly provides a formula for the divorce flow $DF(i, j)$. Introducing the notation $NF(i, j) \equiv MF(i, j) - DF(i, j)$ to define the *net flow* of agents (i, j) , the evolution of stocks can also be described concisely as follows:

$$m(i, j) = m_+(i, j) + NF(i, j). \quad (2.33)$$

At the steady-state search equilibrium, agents' matching strategies (α, α_0) must be consistent with the equilibrium payoff structure S . The gains from marriage at equilibrium, described by S depend on both the household technology and the agents' reservation utilities (V_m^0, V_f^0) . The latter are endogenous equilibrium objects, in that they depend on the supplies (n_m, n_f) of singles on the market. Given these premises, the steady-state search equilibrium can be defined by combining the key equations outlined in this section.

Definition 2.1. *Consider the search-and-matching model described in this section. A **steady-state search equilibrium** is given by time-invariant measures of couples and singles (m, n_m, n_f) , payoffs (V_m^0, V_f^0, S) and strategies (α_0, α) so that:*

- *optimal marriage and divorce strategies (α_0, α) are linked with surplus S through the divorce rule (2.14) and the marriage rule (2.24).*
- *the Bellman equation of marital surplus (2.17) yields S for given reservation utilities (V_m^0, V_f^0) ;*
- *the Bellman equations of reservation utilities (2.25) and (2.26) yield (V_m^0, V_f^0) for given supplies of singles (n_m, n_f) ;*
- *if the accounting constraints (2.27) and (2.28) are enforced, the law of motion (2.32) yields the equilibrium aggregate measures (m, n_m, n_f) for given matching strategies (α_0, α) .*

These equilibrium conditions can be combined to derive a fixed-point operator of type $n = T_{ext}n$ over the support $\mathcal{I} \cup \mathcal{J}$. This fixed-point operator is described in appendix A.3. Recently, Manea (2017) generalized the original proof of existence by Shimer and Smith (2000). It may be possible to extend this proof to a framework with random match quality, although this has not been done in the literature yet. In practice, iteration of the fixed-point operator seems to converge to the same distribution n .¹⁶

¹⁶The only caveat is that the introduction of a “relaxation parameter” is needed: details are provided in appendix A.3.

2.13 Welfare Measures

Solving for the steady-state search equilibrium yields the distribution of welfare across types. Following [Fernández and Wong \(2017\)](#), I focus on the welfare of individuals entering the marriage market at age \underline{a} . This corresponds to their reservation utility at age \underline{a} plus the expected surplus from participating to the marriage market for the first time (after drawing their first wage). In the case of young men, the *ex-ante welfare* can be computed as follows:

$$V_m^{ex}(i) = V_m^0(i) + \frac{1}{2} \sum_j [\gamma_e + \log(1 + \exp(\bar{S}(i, j)))] \Lambda_m(i, j). \quad (2.34)$$

The ex-ante welfare (2.34) accounts for both the *human wealth* of individuals and their expected gains from marriage over the life-cycle. It can be decomposed into two terms:

$$V_m^{ex}(i) = V_m^{hw}(i) + V_m^{mg}(i) \quad (2.35)$$

$$V_m^{hw}(i) = \mathbb{E}_{\mathbf{w}} \left[\sum_{a=\underline{a}}^{\bar{a}} \beta^{a-\underline{a}} v_m^0(h, a, w) \right]. \quad (2.36)$$

The term $V_m^{hw}(i)$ accounts for the expected present discounted utility generated outside of the marriage market. In other words, if the agent were to stay single for his whole life, his expected present discounted utility would correspond to $V_m^{hw}(i)$. This term only depends on the agent's human wealth, i.e., on the expected stream of labor market earnings obtained during his life-cycle. The term $V_m^{mg}(i)$ is defined as a residual in (2.35) and accounts for the additional expected present discounted utility generated through the marriage market. The term $V_m^{mg}(i)$ depends on the agent's expectations about the timing and duration of his matches and about the characteristics of the partner(s).

The distribution of V_m^{ex} and V_f^{ex} provides insights on the equality of opportunities among young individuals and on the role of marriage markets in explaining welfare differences across groups and over time. [Fernández and Wong \(2017\)](#) use analogous measures to understand the implications of different divorce regimes across gender and wage groups. [Chiappori et al. \(2017\)](#) and [Reynoso \(2017\)](#) measure the *marriage market returns to education* by computing the difference in expected gains from marriage between those with a college degree and those without.

These measures are used later in section 6.9 in order to understand how the intertemporal welfare of young individuals reacts to changes in the primitive parameters of the model. In particular, changes in the wage structure affect agents' human wealth and may increase or decrease the term $V_m^{hw}(i)$. However, they also affect the incentives to get married and the expected gains from marriage over the life-cycle. Changes in $V_m^{mg}(i)$ do not need to go in the

same direction: they may either offset or amplify those welfare changes that occur outside of the marriage market.

As a final remark, the intertemporal measures of welfare used in the present draft do not allow me to assess the monetary costs incurred by households due to changes in the gains from marriage. One way to circumvent this problem is to employ a money metric measure of individual utility that is able to capture the monetary value of the gains from marriage (Chiappori and Meghir, 2014). The key idea behind their approach is that it is possible to provide married agents with a monetary compensation paid in case of divorce that makes them indifferent between keeping the current match and leaving: the said amount represents the monetary value of marriage. I plan to extend their methodology to the current dynamic framework in future work.

3 Identification

In this section, I discuss the identification of three key objects in the model, the meeting function Λ , the divorce cost κ , and the per-period match surplus h . I informally refer to the “full identification” of the model as the desirable situation where the observed data patterns can only be generated by a unique choice of (Λ, κ, h) , and where the primitive parameters of the model can thus be inferred with appropriate data. I show that full identification can be obtained starting from a dataset $(\hat{n}_m, \hat{n}_f, \hat{m}, \hat{\ell}, \widehat{MF}, \widehat{DF})$, where $(\hat{n}_m, \hat{n}_f, \hat{m})$ is the observed marriage market outcome (the “stocks”), $\hat{\ell}$ is the observed vector of labor supply choices, $(\widehat{MF}, \widehat{DF})$ is the observed marital turnover (the gross “flows”).

3.1 Matching Strategies

The identification of the match surplus starting from matched data has been exhaustively discussed by Choo and Siow (2006) and Galichon and Salanié (2015). Choo (2015) extends the seminal model by Choo and Siow (2006) to a dynamic framework where people age¹⁷: also in this case, identification of the gains from marriage relies on the observation of repeated cross-sections of matched data.

Similar identification principles apply to search-and-matching models: information on “stocks”,

¹⁷While the frictionless model of Choo (2015) presents interesting similarities with the model outlined in this paper, one of the main differences is that in Choo’s paper marriage contracts are characterized by full commitment and the risk of divorce is fully exogenous.

i.e., the number of married and single individuals by type, are still key to achieve the full identification of the model. However, the econometrician needs to address an additional question: are matches between two specific types i and j common (rare) because of a high (low) match surplus or because these types meet with high (low) frequency?

In this section, start by assuming that the meeting function Λ and the divorce cost κ are known to the econometrician. If this is the case, then it is possible to pin down matching strategies (α, α_0) using matched data $(\hat{n}_m, \hat{n}_f, \hat{m})$, starting from the law of motion (2.32) and the following relationship between α and α_0 :

$$\alpha_0(i, j) = \frac{\alpha(i, j)}{\tilde{\kappa} + (1 - \tilde{\kappa})\alpha(i, j)}. \quad (3.1)$$

where $\tilde{\kappa} = \exp(\kappa)$. The following identification result for $(\alpha(i, j), \alpha_0(i, j))$ applies.

Lemma 3.1. *Denote θ the set of search parameters of the model (Λ, κ) and assume the econometrician observes $(\hat{n}_m, \hat{n}_f, \hat{m})$, where the empirical measures of singles \hat{n}_m and \hat{n}_f respect the empirical counterparts of the accounting constraints (2.27) and (2.28). Assume that, for a choice of θ and for each pair (i, j) , the following condition holds:*

$$\hat{m}(i, j) < \Lambda(i, j, \hat{n}_{m,+}(i), \hat{n}_{f,+}(j)) + \hat{m}_+(i, j). \quad (3.2)$$

Then there exist two unique mappings from the empirical distribution of spouses characteristics \hat{m} defined over $\mathbb{R}_+^{|\mathcal{I}| \times |\mathcal{J}|}$ to the matching strategies $\hat{\alpha}^\theta$ and $\hat{\alpha}_0^\theta$, both in $[0, 1]^{|\mathcal{I}| \times |\mathcal{J}|}$.

Proof. Start from the law of motion (2.32), and substitute out $\alpha_0(i, j)$ with (3.1). For each (i, j) , $\hat{\alpha}^\theta$ is the one and only solution in the interval $[0, 1]$ to the quadratic equation:

$$\begin{aligned} & -(\tilde{\kappa} - 1)\hat{m}_+(i, j)\alpha(i, j)^2 + \\ & + [(\tilde{\kappa} - 1)\hat{m}(i, j) + \Lambda(i, j, \hat{n}_{m,+}(i), \hat{n}_{f,+}(j)) + \tilde{\kappa}\hat{m}_+(i, j)]\alpha(i, j) + \\ & - \hat{m}(i, j)\tilde{\kappa} = 0. \end{aligned} \quad (3.3)$$

Consider the generic notation for the quadratic equation $ax^2 + bx + c = 0$. Note that: $a < 0$ and $c < 0$ as $\tilde{\kappa} > 1$ by assumption; $\Delta \equiv b^2 - 4ac > 0$; the axis of symmetry is given by $x = -b/2a > 1$. It follows that both solutions take positive values, and that there is at most one solution between $[0, 1]$. The latter is between $[0, 1]$ if $2a < -b + \sqrt{\Delta}$: squaring both sides of the inequality yields $a + b + c > 0$, which holds by assumption (3.2). As long as $\hat{\alpha}^\theta(i, j) \in [0, 1]$, it is easy to see from the relationship (3.1) that also $\hat{\alpha}_0^\theta(i, j) \in [0, 1]$ regardless of the value of $\tilde{\kappa}$. \square

Condition (3.2) implies that, if Λ is misspecified, then there may not exist a set of individual strategies (α, α_0) that rationalize the observed matching outcome $(\hat{n}_m, \hat{n}_f, \hat{m})$. The rhs of

condition (3.2) stands for the total number of pairs (i, j) that, in t_+ , are considering whether they should spend the next period together. If the number of meetings (i, j) is too low, there may not be a sufficient number of potential matches to rationalize the net flow $NF(i, j)$. In other words, underrating the number of meetings (i, j) will lead $(\hat{\alpha}, \hat{\alpha}_0)$ to exceed their upper bounds.¹⁸ The set of conditions (3.2) can thus be used to test whether the prior on the specification chosen for Λ is to reject.

However, we are now left with a major question to address. While conditions (3.2) imply some restrictions on the meeting structure, there may still exist several functions Λ that satisfy them. All of these meeting functions would be able to rationalize the observed matching outcome $(\hat{n}_m, \hat{n}_f, \hat{m})$, with the econometrician being unable to distinguish among them. The intuition behind this identification puzzle is the following: a cross-section (or a series of cross-sections) of matched data are only consistent with a unique set of net flows \widehat{NF} , as it is clear from the law of motion (2.33). However, there may be several sets of gross flows $(\widehat{MF}, \widehat{DF})$ consistent with the same dataset. This identification issue is addressed in the next section.

3.2 Meeting and Marriage Cost Function

GJR formally discuss this identification problem in a search-and-matching framework without aging and wage shocks. They suggest the use of additional data on gross flows in order to disentangle the structure of meetings from the structure of the surplus. Assume now that the econometrician observes a new layer of data $(\widehat{MF}, \widehat{DF})$. Recall from the law of motion (2.32) that the equations that yield marriage and divorce rates are:

$$\alpha_0(i, j) = \frac{MF(i, j)}{\Lambda(i, j)} \quad (3.4)$$

$$1 - \alpha(i, j) = \frac{DF(i, j)}{m_+(i, j)}. \quad (3.5)$$

Relationships (3.4) and (3.5) imply $2 \times |\mathcal{I}| \times |\mathcal{J}|$ restrictions that can be used to achieve full identification of the model. Hence, the number of unknowns in the system implied by (3.4) and (3.5) cannot exceed $2 \times |\mathcal{I}| \times |\mathcal{J}|$. The first $|\mathcal{I}| \times |\mathcal{J}|$ parameters to estimate are the matching probabilities α for each pair (i, j) . The only additional unknown parameter needed to obtain

¹⁸Interestingly, condition (3.2) does not imply any restriction on the cost structure, apart from $\kappa > 0$. The proof can be easily extended to the case where the covariance structure of the initial shock differs from the covariance of the following shocks: also in this case condition (3.2) does not depend on either κ or the covariance of the first shock. However, a proper generalization of this result would require to relax the GEV assumption on the home productivity shocks, which would result in a generalization of relationship (3.1). Once relaxed the distributional assumption, one may end up facing restrictions on both Λ and κ .

the marriage probabilities α_0 through relationship (3.1) is the cost of divorce κ . Hence, it is necessary to impose a restriction on Λ as it is only possible to identify up to $|\mathcal{I}| \times |\mathcal{J}| - 1$ additional parameters.

The key intuition behind this identification strategy is that both marriage and divorce flows contain information about marital surplus. The structural approach helps establish an explicit relationship between the data and the parameter of interest. Similar empirical strategies have already been used in the matching literature. In the case of marriage markets, Wong (2003), Goussé (2014) and GJR target the rate of arrival of meetings and divorce shocks: the first two papers rely on data on the duration of marriage and singlehood, while the third relies on marriage and divorce rates. In this paper, I use an approach analogous to GJR, although I also exploit the variation in marriage and divorce rates across types to estimate a more general meeting function. Interestingly, Bruze et al. (2015) use a similar strategy to estimate a frictionless model of the marriage market with heterogeneous cost of divorce in terms of both individual types and duration: they exploit the variation in the hazard of divorce with respect to marriage duration. Finally, both Greenwood et al. (2016) and Shephard (2018) assume that the unobserved match-quality is autocorrelated over time: information on marriage duration and divorce can also help with the identification of the parameters of the match-quality distribution.

3.3 Surplus and Household Production Function

Using the identification result from last section, it is possible to infer the cost of divorce and the meeting function: their estimates are named $\hat{\theta} \equiv (\hat{\Lambda}, \hat{\theta})$. Hence, it is possible to back out the matching strategies α and α_0 from the law of motion (2.32), as long as the conditions required by lemma 3.1 are respected. The average surplus \bar{S} can be obtained through the bijection (2.14). Data on labor supply - and in particular knowing the proportion $\hat{\ell}(l_f; i, j)$ of couples (i, j) with l_f hours worked in the data - leads to the identification of the surplus function S over the support $|\mathcal{I}| \times |\mathcal{J}| \times |\mathcal{L}|$ through equation (2.12). The identification of the reservation utilities V_m^0 and V_f^0 follows, provided a normalization of the utility flows for singles, $v_m^0(i)$ and $v_f^0(j)$.¹⁹

Another important remark is that, as long as the wage process (π_m, π_f) and the survival rates (ψ_m, ψ_f) are independent of the marital status, they can be estimated outside of the model. This greatly simplifies the estimation, but overcoming this limitation is a necessary

¹⁹In the literature on the econometrics of matching models, a normalization of the agents' reservation utilities is usually required as matched data only identify the match gains, i.e., the differential utility produced by the match (Galichon and Salanié, 2015). In search models, an analogous normalization applies to the per-period utility flows of singles.

step to fully understand the relationship between the changing wage distribution and marriage market outcomes. At the moment, only [Shephard \(2018\)](#) and [Beauchamp et al. \(2018\)](#) have been successful in estimating a model of marriage market equilibrium with human capital accumulation during the life-cycle, while several papers have explored these issues outside of the marriage market equilibrium (e.g. [Mazzocco, 2007](#); [Blundell et al., 2016](#)).

Under these assumptions, it is possible to pin down the per-period match surplus h from the Bellman equation for surplus (2.17), as by now both the surplus and the reservation values are known for given search parameters $\hat{\theta}$. In practice, h is obtained as the residual after subtracting both the current reservation values and the dynamic component (i.e., the continuation value) from the surplus function S .

4 Data

The estimation closely relies on the identification results derived in the previous section. Hence, in order to identify the key primitives of the model - the meeting and the per-period match surplus - two types of data are needed: (i) the standard *matched data*, i.e., cross-sectional data on who is matched with whom, and (ii) panel data to measure the *hazard of marriage* (among singles) and the *hazard of divorce* (among married). In this paper, I use two separate data sources to obtain all the necessary information: the Annual Social and Economic Supplement (ASEC) from the Current Population Survey (CPS) is used as a source of information on the number of singles and married couples by observable characteristics, while the Panel Study of Income Dynamics (PSID) as a source of information on the hazard of marriage and divorce. In this section, I introduce the sample used for estimation and the definition of the main variables; I clarify how I use the two datasets and describe their salient characteristics.

4.1 Sample Selection

The CPS is composed of a series of yearly cross-sections, and observations are assigned individual cross-sectional weights so that the sample is representative of the American population in a given year. From the main CPS dataset, I build two separate samples: in the first, I pool all individuals aged between 20 and 60 observed between 1971 and 1981 (about 409,000 men and 445,000 women); in the second, I pool all individuals in the same age range observed between 2001 and 2011 (about 613,000 men and 664,000 women).

From the main PSID dataset, I only keep observations from the SEO (Survey of Economic

Opportunity) and the SRC (Survey Research Center) samples, thus excluding the Immigrant and Latino samples. Since 1997, the survey has been conducted every two years: since in this analysis the PSID is only used to exploit its panel dimension, I only keep odd years in the sample and focus on changes that occur over a two-year period. Also in the case of the PSID, I build two separate samples: the first contains all individuals aged between 20 and 60 between 1971 and 1981 (about 9,800 observations for men and 11,100 for women), and the second all individuals in the same range between 2001 and 2011 (about 12,200 observations for men and 13,300 for women). In the PSID, attrition is low for sampled individuals: this yields a fairly balanced panel. However, temporary non-sample individuals living with the sampled are not followed once they quit the household: this matters when looking at the distribution of divorcees, as it is not always possible to follow the trajectory of one of the two partners after the breakup.

In both samples, I rely on the “relationship-to-head” variable in order to identify married couples. An important remark is in order: the CPS only surveys the civilian noninstitutional population, thus excluding people on duty in the Armed Forces or living in correctional institutions or long-term care facilities. This may explain why the number of observations is higher for women; once statistical weights are implemented, the women-to-men gender ratio is about 0.51, both in the 1970s and in the 2000s.

4.2 Main Variables

- *Conjugal status*: both PSID and CPS respondents are associated with a household identifier and a “relationship-to-head” variable. I identify couples through the presence of an individual who claims to be the head’s legal spouse. If a person is head of household and not living with a spouse, I consider him/her to be single. In addition, if he or she is living in a household and is not the head, nor partner of the head, I also consider him/her to be single. As anticipated, members of secondary families (e.g., a child of the head living with his/her partner) are excluded from the sample. In the CPS, information about unmarried cohabiting partners are only available starting from 1995: hence, the empirical analysis focuses on married couples only, and individuals in cohabiting couples are counted as singles.²⁰
- *Education*: I divide respondents into two categories, those with a college degree and those

²⁰Since information on unmarried partners has been available since the earliest wave of the PSID, I plan to conduct robustness checks with a sample taken for the 2000s period where I consider all couples - married and cohabiting - as equal. [Lundberg and Pollak \(2014\)](#) stress that, once cohabitation is taken into account, the gap between college and non-college graduates in the odds of being in a two-adult household is reduced.

without. Given the cross-sectional nature of the CPS, education is taken to be the highest diploma achieved at the moment of the survey. Because of this, On the contrary, this problem can be avoided in the PSID: I define education as the highest level achieved along the longitudinal dimension.

- *Hours worked*: in both the CPS and the PSID, the average number of hours worked per week is defined as the total number of hours worked in a year divided by the number of weeks worked in a year. I then build a discrete labor supply variable as follows: agents working less than 7 hours per week on average are considered to be out of the labor force (NW); if they work between 7 and 34 hours, I define them as working part-time (PT); if they work 35 hours or more, I define them as working full-time (FT). The upper bound for part-time workers (34 hours) is consistent with the definition of the Bureau of Labor Statistics.²¹
- *Hourly wage*: in both the CPS and the PSID, hourly wages are obtained by dividing the (deflated) total yearly labor income by the total yearly number of hours worked. It is initially set to zero for those individuals who are out of the labor force. A drawback of the PSID dataset is that information on earnings and labor supply is only available for surveyed heads and partners, but is not available for other members of the household: hence, for some sampled individual-year observations, labor market information is missing, particularly in earlier waves when sampled individuals are young and more likely to live with their parents. The problem of selection due to labor force participation choices is addressed in the estimation phase.
- *Newlyweds*: changes in household composition are only observed in the PSID thanks to its longitudinal panel dimension. Changes in conjugal status occurring between two PSID waves help identify the formation of new couples. When a respondent is single in year $y - 2$ and living with a legal spouse in year y , he or she is defined as a “newlywed” in year y . Note that incoming spouses are typically not included in the PSID sample before the marriage occurs.
- *Divorcees*: in a similar way, it is possible to identify divorces in the PSID. If a married couple is observed living together in year y and at least one of the two partners (typically the sampled individual) is observed living alone or with a different spouse in $y + 2$, then the couple is flagged as “about to divorce”. I do not make a difference between divorce and separation as the legal duties of divorcees are not taken into account in the analysis. This way of identifying dissolving couples allows me to gather information on both spouses’

²¹I have not tried to use a different definition of part-time yet, although I intend to do so in the future to check whether current findings are consistent.

characteristics: as a comparison, datasets containing retrospective information on marital history do not provide detailed information about former partners. In spite of this, since in some cases couples are composed of one followable and one non-followable spouse, it is not always possible to track the trajectories of both after a divorce.²²

5 Empirical Specification and Estimation

In this section, I provide details about the estimation method, which is composed of multiple steps. First, I estimate the age and education profiles of hourly wages and the parameters of the $AR(1)$ process for both the CPS and the PSID. The estimation of the wage distribution is performed out of the model. Second, I estimate the marriage surplus jointly with the search parameters (the meeting function and the cost of divorce). Last, starting from estimates obtained at the previous step, I recover the parameters of the production function of the public good (see function (2.2)).

5.1 Wage Levels

In both the CPS and PSID, selection into the labor force prevents me from observing the wage distribution of the entire population. In order to address this issue, I take a control function approach and estimate a standard selection model à la Heckman (1974) for each gender and broad educational group (college graduates and non-college graduates). In the selection equation, I include the number of children, and the ages of the youngest and eldest child as instruments. I subsequently replace missing wages with predicted wages: these are used to assign individuals to wage quantiles, conditionally on their age and education group.

I use the wage distribution obtained with CPS data after estimating the selection model to compute the wage levels used in the following estimation steps. Each individual is assigned the median wage computed within his/her wage quantile, conditionally on his/her age and education. For instance, observations that rank in the top quintile of their age and education group are assigned a wage rate corresponding to the 90th percentile of the group.

It is important to remark that, to be consistent with the model of marriage market and labor

²²Note that all individuals belonging to the original 1967 PSID sample are followable: hence, in the early waves of the PSID, the majority of couples is made of two followable individuals. However, couples that formed later (i.e., where an incoming spouse joined a sampled individual) are made of one followable and one non-followable individual.

supply outlined in previous sections, the wage distribution should be estimated jointly with the other parameters of the model. In this sense, the present work should only be regarded as a first step to extend GJR to include labor force participation choices. In addition, the instruments used to estimate the selection model are far from being ideal: [Chiappori et al. \(forthcoming\)](#), who also opt for an estimation of the age profile of wages outside of the model, suggest the use of policy variation in out-of-work income as an instrument for participation, an approach that could be explored in this framework. As a final remark, note that, in spite of these limitations, I discretize the wage support and only use a limited number of moments from the wage distribution: this should also limit the implications of misrepresenting such distribution.

5.2 Wage Mobility

I have so far described the cross-sectional distribution of wages without imposing any restriction on wage mobility. In order to characterize the degree of mobility implied by the wage process, I follow [Bonhomme and Robin \(2009\)](#) and map the marginal distributions of w_i and $w_{i'}$ into the joint distribution of $(w_i, w_{i'})$ by using a copula. This convenient representation of the $AR(1)$ wage process leaves complete freedom on the way of specifying the marginal distribution of wages, described in the previous paragraph. Call $r_i(h_i, a_i)$ the rank of w_i among agents with human capital h_i and age a_i . The joint CDF of the current wage rank $r_i(h_i, a_i)$ and the future wage rank $r_{i'}(h_{i'}, a_{i'})$ is given by a Plackett's copula $C_m(r_i(h_i, a_i), r_{i'}(h_{i'}, a_{i'}) | h_i, a_i)$ (with $C_f(r_j(h_j, a_j), r_{j'}(h_{j'}, a_{j'}) | h_j, a_j)$ for women). A Plackett's copula is characterized by a single parameter that can be interpreted as a measure of mobility: this one parameter is a monotonically increasing function of the Spearman's rank correlation coefficient (details are provided in appendix [A.4](#)). I allow this correlation coefficient to vary with agent's gender, education and age, and denote the vector of coefficients $\rho_m(h_i, a_i)$ and $\rho_f(h_j, a_j)$, for men and women respectively. To estimate these parameters, panel data on wages are needed: hence, after dealing with non-participation as explained in the previous section, I use PSID data to estimate the Spearman's coefficients $\rho_m(h_i, a_i)$ and $\rho_f(h_j, a_j)$ as detailed in [Bonhomme and Robin \(2009\)](#). The results are plotted in figure [5](#).

This setup implies that the degree of wage mobility faced by agents in the model is effectively summarized by $\rho_m(h_i, a_i)$ and $\rho_f(h_j, a_j)$: for a man of type i , the odds of moving up or down the wage distribution when getting older entirely depend on $\rho_m(h_i, a_i)$. In their analysis of earning mobility in the US, [Kopczuk et al. \(2010\)](#) suggest that rank correlation between periods is indeed a direct and effective measure of wage mobility.

5.3 Agents' Types and Marginal Distributions

The time-invariant human capital endowment, h_i for men and h_j for women, is assumed to correspond to education. I consider two levels of education, college graduates vs non-college graduates. Hence, $h_i, h_j \in \{1, 2\}$, where 2 stands for a college degree. All agents enter the marriage market at age 20, a period corresponds to two years, and all agents quit the market when aged 62: the life-cycle stretches across 21 periods, $a_i, a_j \in \{1, 2, \dots, 21\}$. Finally, for each age and education group, I rank agents according to their wage rates and divide them into wage quantiles: men (women) within the same wage quantile are *ex ante* identical, and are all assigned the same wage rate w_i (w_j), which corresponds to the median wage within the quantile, consistently with what explained in section 5.1. I use 3 quantiles in the estimation phase, and 5 in the simulations and counterfactual exercises.

I assume that the cohort size is constant: hence, the marginal distribution with respect to age is uniform for both men and women. I also assume that the gender ratio is perfectly balanced. This assumes away gradual entry and exit into the marriage market, as well as the potential implications of gender ratio imbalances. While these restrictions could easily be relaxed, they allow me to simplify the analysis and to focus on a smaller number of primitive parameters in the empirical analysis. The only parameter left to estimate is the share of college graduates in the male and female population: I measure it as the proportion of college graduates older than 21 in the CPS. The share of adult college graduates per decade is given in table 3.

If the stationarity assumption were verified in the data, the population would be uniformly distributed with respect to age in the age bracket spanning from 20 to 60, once accounted for exogenous entry and exit.²³ This would be consistent with the assumptions stated in the previous paragraph. However, the stationarity assumption implies that both the size of the US population and its educational composition do not change over time. It is easy to see that these conditions are not verified in the data: in both the 2000s and the 1970s sample, younger individuals tend to be more educated than the older, as a consequence of the steady rise in college attendance. On top of that, in the 1970s sample, younger individuals are more numerous than the older: this is due to the exceptional demographic growth in the Post-war period. These demographic patterns would require to study the out-of-steady dynamics spurred by a growing and increasingly educated population: the changing size and composition of the population may have important implications in marital sorting across cohorts. This challenging

²³By tracking a cohort of agents born in the same year across CPS waves, it is possible to verify whether the cohort size is constant or is modified by inflows or outflows of people. For young agents, death rates are low; however, immigration, incarceration and active duty in the armed forces in the army do, among other factors, result in non-negligible variation in cohort size across years in the CPS.

issue is beyond the scope of the current paper, and is left for future search.

5.4 Marital Patterns and Hazard Rates

The estimation of the model relies on the observation of the empirical frequencies of couples by type (i, j) , male singles by type i and female singles by type j . Hence, as a first step, I compute the raw empirical frequencies from the CPS sample, using the repartition into wage quantiles explained in section 5.1. These can be read as a contingency table - men's types on one axis and women's type on the other - and automatically imply some marginal frequencies through the accounting constraints (2.27) and (2.28). However, recall that, in section 5.3, I have already produced estimates of the marginal distributions \hat{p}_m and \hat{p}_f that are consistent with the stationarity assumption. To reconcile marital patterns and marginal distributions, I follow Greenwood et al. (2014) and apply an iterative procedure to obtain what they define as "standardized contingency tables", i.e., standardized empirical frequencies that are, at once, consistent with the required marginals \hat{p}_m and \hat{p}_f and with the matching behavior observed in the data.²⁴ The joint distribution of characteristics and marital status $(\hat{m}, \hat{n}_m, \hat{n}_f)$ obtained through this standardization technique is used to estimate the model in the next step.

The estimation also requires information on the hazard of marriage and divorce for different groups of the population. These are calculated from the PSID sample.

- Divorce rates for men of type i (women of type j) are calculated as the ratio of men i (women j) divorcing between t and $t + 1$ to the number of married men i (women j) in t . Similarly, for couples (i, j) , the rate corresponds to the ratio of the number of divorcing couples (i, j) between t and $t + 1$ to the number of married couples (i, j) in t .
- Marriage rates for men of type i (women of type j) are calculated as the ratio of men i (women j) getting married between t and $t + 1$ to the number of single men i (women j) in t . For couples (i, j) , the rate corresponds to the ratio of the number of couples (i, j) getting married between t and $t + 1$ to the geometric mean between the number of male singles i and female singles j in t .

In practice, I do not compute the full distribution but only some selected moments (e.g., the rate of divorce for men with a college degree). This allows me to avoid dealing with empty cells

²⁴More explicitly, this technique suggested by Mosteller (1968) consists in transforming a contingency table into a second one that respects the desired marginals while leaving the odds ratio unchanged. In the case of marriage, the transformation does not affect the odds of marrying a type i versus a type i' , for each woman j (and vice versa). Details on the computation are provided in appendix A.5.

due to the small size of the PSID.

5.5 Search Parameters and Marriage Surplus.

The unobserved parameters of the meeting function Λ and the cost of divorce κ are estimated jointly with the vector of matching strategies α . The estimation procedure relies on matching a vector $\hat{\mu}$ of empirical moments calculated from the empirical distribution $(\hat{M}F, \hat{D}F)$ to their theoretical counterparts $\mu(\theta, \alpha^\theta)$. The vector $\hat{\mu}$ includes both rates of marriage and divorce conditionally on the spouses' education and age.

In practice, I use an estimator of the GMM class and exploit the restrictions implied by the model on the size of the gross flows into and out of marriage. These correspond to equations (3.4) and (3.5), where the matching strategies α and α_0 are replaced by their nonparametric estimators, whose existence is guaranteed by Lemma 3.1. The GMM estimator is given by:

$$\hat{\theta} \equiv \arg \min_{\theta} \sum_k \omega_k (\mu_k(\theta, \alpha^\theta) - \hat{\mu}_k)^2 \quad \text{subject to (3.2) for any } (i, j) \quad (5.1)$$

where ω is a vector of weights.²⁵ The presence of the constraint (3.2) is required by Lemma 3.1 to ensure that α^θ belongs to the set $[0, 1]$ and is indeed a probability. Since the number of constraints is large and corresponds to $|\mathcal{I}| \times |\mathcal{J}|$, I add a penalty function to the standard quadratic loss function used as objective. If the penalty function is given enough weight, this results in only small violations of the constraints.²⁶ Standard errors are computed following the guidance of Lise and Robin (2017).

Once obtained the estimates of the search parameters $\hat{\theta}$, I compute the corresponding matching strategies $\hat{\alpha}$ and the surplus function $\hat{\hat{S}}$ from the matching rule (2.24). Inverting equation (2.12), I then recover the surplus function \hat{S} - i.e., the match surplus specific to a given labor supply choice l_f - using the odds of choosing l_f for a married couple (i, j) observed in the data. Then, I derive the function h - which implicitly characterizes the Pareto frontier - from (2.17), the Bellman equation of surplus: this requires subtracting the continuation value and the reservation values terms, which are by now known terms, from the nonparametric estimate \hat{S} of the surplus function. The intuition is that, once taken into account the dynamic nature of surplus, the per-period match surplus $h(l_f; i, j)$ represents the residual component of the gains from marriage.

²⁵In the application, $\omega_k = 1$ for each k .

²⁶This means that α^θ may be slightly larger than 1. If the weight of the penalty function is high enough, violations are small. Once obtained $\hat{\alpha}$, for those types (i, j) for which the constraint is binding $\hat{\alpha}(i, j)$ is rounded down to 0.999.

A remark is in order concerning the role of the parameter σ_ℓ - i.e., the degree of independence between domestic productivity shocks $\boldsymbol{\eta}$. This parameter weighs the importance of the economic component of the marital surplus, which ultimately depends on the labor supply choice of the wife, as opposed to that part of the marital surplus that only depends on the agents' traits (γ_3 in the per-period match surplus (2.18)). The parameter σ_ℓ is identified through the variation in labor supply behavior conditional on the agents' observable traits and sorting patterns along the same observables: its identification has been widely discussed in the nested logit literature (Train, 2009). However, I have not attempted to estimate σ_ℓ : so far, I have set $\sigma_\ell = 0.7$ to allow for some positive correlation between the shocks $\boldsymbol{\eta}$. There is little if no benchmark in the literature in this regard, although Train (2009) discusses its lower and upper bound ($0 < \sigma_\ell \leq 1$).²⁷

Finally, note that this estimation method exploits a set of restrictions produced by the model and has the advantage of being relatively quick to implement, as it is not necessary to solve for the market equilibrium. Moreover, the estimator is of the GMM class and has well-known properties. In Ciscato (2018), I employ a parallel Markov Chain Monte Carlo method to estimate the model in one step and without having to rely on the full distribution ($\hat{m}, \hat{n}_m, \hat{n}_f$) but only using some of its moments. This approach is far more time-consuming as it requires to iteratively solve for the equilibrium model. However, it would allow me to estimate the parameters of the domestic production function, of the meeting function, the cost of divorce in one step. In addition, this kind of moment-matching approach does not require the *i.i.d.* assumption on the match-quality shocks.

5.6 Empirical Specification: Meeting Function

The general specification (2.23) chosen for the meeting function Λ contains the unobserved parameters $\lambda(i, j)$, estimated jointly with the cost of divorce κ through the procedure described in section 5.5. I consider the following specification for the shifter $\lambda(i, j)$, which captures homophily in meetings:

$$\tilde{\lambda}(i, j) = \begin{cases} \frac{\exp(\lambda_1 \{h_i = h_j\} + \lambda_2 d^2 + \lambda_3 a_m a_f^2 + \lambda_4 a_m^2 a_f)}{1 + \exp(\lambda_1 \{h_i = h_j\} + \lambda_2 d^2 + \lambda_3 a_m a_f^2 + \lambda_4 a_m^2 a_f)} & \text{if } \underline{d} \leq d \leq \bar{d} \\ 0 & \text{otherwise.} \end{cases} \quad (5.2)$$

with $d \equiv a_m - a_f$. The terms of λ have the role of shifting the odds of meetings across types: the first term of (5.2) determines the degree of homophily with respect to education, while the

²⁷While so far my findings have not proved to be particularly sensitive to changes in this parameter, I plan to conduct a more systematic analysis to show that they are indeed robust in this regard. Ultimately, I also plan to estimate σ_ℓ with the other unobserved parameters of the model.

last three let the odds of meeting depend on the age distance. On top of this, I impose that meetings do not occur at all if the age distance is too large: in the empirical analysis, I set $\underline{d} = -3$ and $\bar{d} = 7$, i.e., I do not allow for meetings between men that are more than 6 years younger than women or more than 14 years older than women (as one period corresponds to two years in the data). This restriction still allows me to consider about 96% of all marriages in the CPS for both the 1970s and the 2000s. The specification is close to the one suggested by [Shephard \(2018\)](#).

5.7 Empirical Specification: Household Production Function

With data on matching behavior and the labor supply of married couples, I have shown how to compute h on each point of its support $\mathcal{I} \times \mathcal{J} \times \mathcal{L}$. We have seen in section 2.8 that the specification of h depends on the agents' utility functions and the production function (2.2): equation (2.18) allows me to establish a connection between the parameters $(\gamma_1, \gamma_2, \gamma_3)$ and the per-period surplus h . Hence, through OLS, I compute estimates $(\hat{\gamma}_1, \hat{\gamma}_2, \hat{\gamma}_3)$ that best fit the vector of residuals \hat{h} .

I impose the following restriction on the parameter functions γ_1 , $\gamma_2(l_f)$ and γ_3 , which characterize the production of the public good Q through function (2.2).

- γ_1 , which represents the elasticity of Q with respect to the total joint expenditure $t_m + t_f$, only depends on the spouses' time-invariant human capital (h_i, h_j) . In particular, I estimate γ_1 for each combination (h_i, h_j) .
- $\gamma_2(l_f)$, which represents the productivity shifter associated with labor supply choice l_f , only depends on the wife's age a_j and human capital h_j . Hence, I estimate γ_2 for each combination (h_j, a_j) and each level l_f , after normalizing $\gamma_2(1) = 0$, where $l_f = 1$ corresponds to the wife working full-time.
- γ_3 , which is an additional productivity shifter, only depends on the wife's age a_j and human capital h_j and on the husband's a_i and h_i , as well as interactions between these inputs. In particular, γ_3 contains dummies for each combination (h_i, a_i, h_j, a_j) . Hence, while γ_3 can change with age, its trajectory is fully predictable at the moment of the match, since it is not affected by wage shocks.

6 Results

In this section, I start by briefly discussing the estimates of the parameters of the domestic production function of the public good and the meeting function. I subsequently present the fit of the model for the two samples, the 1970s and the 2000s. I then conduct a counterfactual analysis to understand the main forces behind the decline of marriage that occurred between these two periods and discuss the changes in welfare. I conclude with a summary of the main findings and a concise description of the economic mechanisms at play.

6.1 Estimation Results: Public Good

Estimates of the parameter γ_1 are collected in table 1, and suggest that not all families enjoy increasing returns to scale from the joint expenditure $t_m + t_f$ used to produce the public good Q . In the 1970s, the estimate of γ_1 for couples where both spouses are college graduates is not significantly different than 1; however, in the 2000s, these same couples enjoy significant increasing returns to scale. Conversely, couple where no spouse holds a college degree have experienced a drastic decrease: γ_1 used to be significantly greater than 1 in the 1970s, while it is not in the 2000s.

Estimates of the parameter γ_2 suggest that the gains from marriage for couples where the wife does not work are lower in the 2000s than in the 1970s, particularly for non-college graduates. For women aged between 40 and 50 in the 2000s, the benefits of staying at home are not significantly different than zero, regardless of the educational level. Part-time does not seem to produce public benefits, and, on the contrary, it may decrease the match surplus. It is possible to conclude that women have higher incentives to spend time on the labor market in the 2000s than they used to in the 1970s: the production of public good Q has become less labor-intensive.

6.2 Estimation Results: Meetings and Cost of Divorce

Estimates of the parameters of the meeting function Λ suggest that the marriage market in the 1970s is characterized by a higher segregation with respect to education than in the 2000s. The odds of meetings across educational levels have increased between the two periods, all else constant: this is captured by the decrease in the parameter λ_1 reported in table 2.

The cost of divorce κ has increased by 0.4 standard between the two periods, although it is

already high in the 1970s. Marriage is associated with strong commitment in both periods.²⁸ Recall that, in the model, it is assumed that spouses have the option to renegotiate the household allocation in every period: this assumption may cause the estimate of κ to be inflated. If the spouses were able to reduce consumption volatility by sticking to an agreed sharing rule, then they could achieve higher level of surplus as the continuation value of marriage would be higher. If this is the case, the source of commitment is misinterpreted and attributed to high costs of divorce.

6.3 Fit of the Model

The estimated model is able to reproduce some of the key facts observed in the data, and does a good job at reproducing the changes in marital patterns that have occurred between the 1970s and the 2000s. Tables 4 and 5 compare simulated and empirical moments from the distribution of singles' and spouses' characteristics in the cross-section. Table 5 also contains the simulated and empirical hazard rates of marriage and divorce. For the 1970s sample, the predicted share of married men aged between 20 and 60 is 74.59%, as opposed to 69.74% in the data; for the 2000 sample, the predicted share is 58.64%, as opposed to 52.14% in the data. The distance between simulated and empirical moments is slightly larger for women. Most importantly, the estimated model replicates the decline of marriage between the 1970s and the 2000s accurately (see last column of table 4). The differences in the share of married adults between college graduates vs non-college graduates is also understated. However, the estimated model accurately replicates the differential in the decline of marriage across educational groups that has emerged between the 1970s and the 2000s. A graphical representation of how well the model is able to replicate the changes on the extensive margins is provided in figure ??.

The estimated model is able to approximate the age profile of married individuals: the simulated stock of married agents progressively increases during their 20s and 30s and stabilizes around age 40. The share of married women decreases when they enter their 50s: those who divorce or become widows outnumber those who get married, as women tend to marry older men. Note that, in the model, agents die when they turn 62, so this artificially inflates the number of widows. From figures 7 and 8, we can also see that the stock of married agents grows rapidly in the 1970s and more slowly in the 2000s.

The predicted correlation rates between spouses' ages and wages are only slightly below

²⁸Consider a potential couple (i, j) with the systematic part of surplus, $\bar{S}(i, j)$, equal to zero: their odds of getting married are one out of two. However, with $\kappa = 4.6$, if the man i and the woman j were already married, the probability that they will file divorce is only equal to about 1%.

those computed from the data. The predicted educational homogamy is instead stronger. The predicted changes between the 1970s and the 2000s are in line with what observed in the data. Finally, the aggregate labor force participation of women is well replicated by the model.

The predicted marriage and divorce rates are lower than those observed in the data (see table 5). This also affects the evolution of the stocks along the life-cycle (see 7 and 8): (i) agents are very selective, thus marriage rates are lower than in the data and the stocks of married agents grow slower; (ii) divorce is rare and the stocks of married agents keep increasing, albeit more slowly, instead of stabilizing. Low marriage and divorce rates are induced by the high point-estimates for the cost of divorce κ jointly with the relatively low R^2 obtained at the second stage of the estimation procedure (0.15 with the 1970s sample and 0.23 with the 2000s sample). In the future, estimating all parameters in one step - and thus fitting both the stocks and the flows at the same step - may address this issue.

6.4 Explaining the Decline of Marriage: Full Decomposition

In order to address the key question of this paper, i.e., to what extent the decline of marriage is accounted for by changes in the wage structure, I perform the following decomposition. The columns of tables 6 and 7 are labeled after the names of the experiments and provide an extensive overview of the decomposition.

- a In the first experiment, I simulate a counterfactual equilibrium where all parameters are fixed to their estimated 1970s levels except for the wage distribution, which is assigned its 2000s shape. More precisely, both the wage levels w_i and w_j and the transition matrices π_m and π_f are allowed to take on their 2000s values: in the next section, I will further decompose this step to understand how each of these components matters.
- b In the second experiment, I simulate a counterfactual equilibrium where all parameters are fixed to their estimated 1970s levels except for the shares of college graduates, which are assigned their 2000s values.
- c In the third experiment, I let both the wage distribution and the shares of college graduates correspond to what we observe in the 2000s. Both the production function of the public good, the meeting function and the cost of divorce are still fixed to their 1970s levels.
- d In the last experiment, I let the meeting function Λ and the cost of divorce κ take on the values indicated by their 2000s point-estimates in table 2. Only the parameters of the

production function of the public good, γ_1 , γ_2 and γ_3 , are still fixed to their 1970s levels: these parameters can account for the residual change.

Different elements of the wage distribution may impact on the marriage market outcome differently. Hence, I run four additional simulations to explore the economic mechanism that establishes the relationship between changes in the structure of labor market earnings and changes in marital patterns. Experiments are once again labeled by letters, consistent with the notation used in tables 8 and 9.

- e In experiment (e), I simulate a counterfactual equilibrium where all parameters are fixed to their estimated 1970s levels except for men's wage levels, which are set to their 2000s values.
- f In experiment (f), I simulate a counterfactual equilibrium where all parameters are fixed to their estimated 1970s levels except for women's wage levels, which are set to their 2000s values. Changes in men's and women's wage levels are plotted in figure 3 and 4.
- g In experiment (g), I simulate a counterfactual equilibrium where all parameters are fixed to their estimated 1970s levels except for the transition matrix π_m , which is allowed to take on its 2000s values. The elements of π_m determine the odds of changing wage quantile for men. Recall from section 5.1 that π_m is generated from an $AR(1)$ process and that the degree of wage mobility is monotonically decreasing in the wage rank correlation between an agent's wage w in period t and w' in $t + 1$. Hence, looking at plot 5, it is easy to see that wage mobility among men has unequivocally increased between the 1970s and the 2000s.
- h In experiment (h), I simulate a counterfactual equilibrium where all parameters are fixed to their estimated 1970s levels except for the transition matrix π_f , which is allowed to take on its 2000s values. The elements of π_f determine the odds of changing wage quantile for women. Figure 5 indicates that wage mobility has decreased for women.

6.5 Overall Changes in the Wage Distribution

Between the 1970s and 2000s, the share of married agents aged between 20 and 60 has fallen by 15.95 percentage points (i.e., a 21.4% decrease with respect to the initial level). Comparing the marriage market outcomes in the 1970s (column 1) with experiment (a), I conclude that changes in the wage structure can account for about 33.3% of the decline between the two periods (see table 6). Changes in the wage structure induce a larger decline in marriage among

low-educated men (5.97pp) than among high-educated men (2.81pp); the decline is more evenly distributed among women: 5.48pp for those with a college degree and 4.23pp for those without. Marriage rates are lower while divorce rates are higher: the share of married agents grows less rapidly over the life-cycle and it reaches a lower peak with respect to the benchmark economy (see plot 11). The wage correlation among those who get married increases and the fraction of married women working full-time also grows.

Experiments (e) and (f) shed further light on the underlying mechanism: they show how changes in wage levels, for men and women respectively, have affected the marriage market outcome while holding wage mobility fixed. Results are reported in tables 8 and 9. In experiment (e), only male wages change: male population groups that experience the strongest wage decline - the low-educated, the young and the low earners - are also those who experience the strongest decline in the odds of being married. In experiment (f), only female wages change: contrarily to experiment (e), female population groups that experience the strongest wage rise - the high-educated and the top earners - are those who experience the strongest decline in the odds of being married. In both experiments (e) and (f), the overall number of married agents decreases.

The findings from these experiments suggest that, when the gender wage gap shrinks, the economic gains from marriage tend to fade. As they experience wage rises, women can afford being more selective and value noneconomic gains more than in the past. Since the changes in wage have not been uniform across the population, some groups are particularly concerned by the evolution of the wage distribution. Consider the case of men without a college degree: while their wages decline, the gains from household specialization start to disappear. On the other hand, high-wage men are still able to build two kinds of family: as they retain their comparative advantage within the couple over low-wage women, they can form “traditional” households and enjoy the gains from specialization; alternatively, they can form couples of two earners with high-wage women, as the spouses’ pooled labor income is sufficiently large to take full advantage of the economies of scale and make the match convenient.

6.6 Changes in Wage Mobility

The last two columns of tables 8 and 9, (g) and (h), consider changes in wage mobility while holding wage levels fixed. This kind of experiment is, to the best of my knowledge, the first of its kind in the literature. My findings show that both changes in men’s wage mobility and women’s wage mobility have only a very small impact on the marriage market outcome. Men’s wage mobility have increased (see figure 5): column (g) in table 8 suggests that the effect of

this increase has a positive - although very limited - impact on marriage. The explanation is that increased wage mobility makes marriage more relevant due to its insurance motive.

Women’s wage mobility is considered in experiment (h): this decrease has nearly no impact on the marriage market outcome. This can be explained as follows: at the 1970s equilibrium, changes in women’s wages almost never cause couples to break up, both because the wife can compensate a wage cut by increasing her domestic time and because the ratio of the wife’s earnings to the total household labor income is low.

6.7 Changes in Schooling

Column (b) in table 6 suggests that the increase in the share of college graduates from the 1970s to the 2000s, which is particularly strong for women, has contributed to both a decline in marriage and changes in assortativeness. In experiment (b), the share of couples where both spouses are college graduates doubles, and high-educated women start “marrying down”; in spite of this, their odds of being married decrease with respect to the 1970s benchmark. In experiment (c), changes in wages are considered jointly with changes in schooling. The interaction between the two changes leads to a further decrease in the share of married adults: these two factors can jointly account for about 49% of the decrease between the 1970s and the 2000s. With respect to experiment (a), changes in schooling partly offset the decrease in marriage for high-educated men.

Changes in the educational composition of the population only affect the match surplus through competition on the marriage market. Since the increase in the share of college graduates is weaker for men, high-educated women must be less selective. As a result, it becomes more difficult for them to find a valuable match. On the contrary, low-educated women are fewer, and are ready to match with both high-educated and low-educated men: their odds of being in a marriage relationship increase.

6.8 Changes in Meetings and Household Production

Changes in the structure of meetings also contribute to the evolution of marriage patterns. Changes in the parameters of the search function are reported in table 2 and suggest that meetings are less assortative with respect to education in the 2000s. Experiment (d) shows that this results in a slight decline in the number of marriages (table 6) and in a decrease in the share of homogamous marriages (table 7). If agents are less likely to meet potential partners

with a similar schooling level, they also tend to refuse more matches: this can also be seen by the higher number of singles among the young. However, since search is costly in terms of time, they become more inclined to accept marriages with people that are less alike.

As discussed in section 6.2, the cost of divorce is found to be increasing between the two periods, although it is high in both periods. This implies that, in all other experiments, most of the adjustments in the share of married across the population go through changes in marriage rates rather than in divorce rates. Since commitment is strong, individuals are extremely careful about selecting their partner and the search takes longer.

Changes in the parameters of the domestic production function explain the residual changes in marriage patterns, i.e., the difference between column (d) and column (2) in tables 6 and 7. In particular, they account for a residual 49% decline in the share of married adults. Three elements need to be considered: first, economies of scale have become stronger for couples where the wife holds a college degree, with a positive impact on the economic gains from marriage (see table 1). The opposite has happened for couples where the wife does not hold a college degree. Second, domestic production of public good has become less labor intensive, with a negative impact on the gains from specialization. For this reason, wives have stronger incentives to work and economies of scale play a more important role than in the past: this favors high-wage women. Third, taste for age and educational homogamy has also changed. The vector γ_3 of structural parameters estimated in the current framework aims to capture additional motives for marriage not explicitly considered. Changes in these parameters are particularly relevant in explaining the changing age profile of marriage: the young have become comparatively less likely to be in a marital relationship.

6.9 Welfare Analysis

In table 10, I report changes in the *ex-ante* welfare of individuals aged 20 for each gender group, before and after conditioning on education (see details on welfare measurement in section 2.13). Experiment (a) shows that changes in the wage distribution induce an average 9.5% welfare loss for men with respect to the 1970s benchmark economy. This welfare loss can be further decomposed: declining real wages at the middle and bottom of the distribution have a negative direct impact on human wealth and induce an average welfare loss of 8.2%; on top of that, worsened marriage prospects result in a 1.3% welfare loss due to reduced expected gains from marriage enjoyed over the life-cycle. As for women, experiment (a) shows that improved labor market conditions result in an average 1.3% welfare gain; however, this is offset by a 1.8% welfare loss due to worsened marriage prospects.

The bottom half of table 10 allows me to discuss the distributional effects of changes in the wage distribution across different educational groups. In experiment (a), welfare losses are far larger for men without a college degree (11.5%) than for college graduates (2.7%), although for both groups the losses are amplified through the marriage market. Female college graduates enjoy a sufficiently large increase in human wealth to offset the welfare loss due to lower expected gains from marriage and experience an overall welfare gain (4.3%). On the contrary, women without a college degree experience only minor improvements in labor market conditions: the gains associated with these improvements are offset by worsened marriage prospect and result in an overall welfare loss (1.4%). Finally, figure 12 documents changes in the distribution of ex-ante welfare for individuals with different initial wages.

In the last column of table 10, I report the welfare levels for the 2000s. On average, men have experienced welfare losses (8.6%): a considerable part of the losses is due to worsened marriage prospects (2.4%). Women have experienced net welfare gains (2.7%) and have partly caught up with men due to improved labor market conditions and increased schooling. However, lower expected marriage surplus has a negative impact on welfare (3.3%) and partly offsets the welfare increase realized outside of the marriage market (6%). As seen in experiment (a), the increase in human wealth for low-educated women is not sufficiently high to compensate the welfare losses due to worsened marriage prospects. On the contrary, female college graduates experience only a limited decrease in expected marriage surplus. Figure 13 provides a graphical representation of this situation.

Between the 1970s and the 2000s, not only wage inequality has increased, but the marriage market has shifted from an equilibrium where the low and the high educated enjoy, on average, the same level of gains from marriage to an equilibrium where the high educated enjoy substantially more gains. The quantitative results presented in this section suggest that the marriage market amplifies economic inequality. One missing step is left for future work: in the current analysis, I suggest that the marriage market amplifies welfare differences across education and age groups, but the measure of welfare that I employ does not allow me to compare the finding with commonly used measures of economic inequality. A more satisfying measure requires to compute the monetary value of marriage surplus enjoyed by individuals on top of their human wealth. As anticipated in section 2.13, Chiappori and Meghir (2014) provide guidelines to compute measures of this kind in the case of static household models: their methodology can be extended to dynamic model in order to overcome these limitations.

7 Conclusion

In this paper, I build and estimate an equilibrium model of the marriage markets with search frictions, endogenous divorce, wage mobility and aging. This structural approach allows me to provide a quantitative assessment of the role of changes in the wage structure in explaining changes in the marriage market outcome. The empirical analysis is composed of the following steps: I first estimate the unobserved parameters of the model - the domestic production function, the meeting function and the cost of divorce - for both the 1970s and the 2000s. The estimated model is able to approximate the cross-sectional marital patterns - who is married and with whom - and the divorce and marriage rates observed in the data. I then proceed with a series of experiments where I analyze the role of changes in one primitive parameter of the model holding all other factors constant. I find that changes in the wage structure can explain about 33.3% of the decline in marriage that occurred between the 1970s and the 2000s, and that they have a stronger impact on the low educated. I also find that changes in positional inequality play a much more important role than changes in wage mobility. In particular, changes in men's wage inequality and the shrinking gender wage gap are the most important driving forces behind the decline of marriage. Finally, I show that in the 2000s, on top of the increased wage inequality, individuals with a college degree enjoy, on average, substantially more gains than those without: this gap in gains from marriage was instead absent in the 1970s. This result suggests that, as for the 2000s, the marriage market amplifies economic inequality.

The paper presents several innovative aspects, both in the modeling part and in the empirical analysis. It extends the search-and-matching framework of GJR by introducing aging and wage mobility, and represents a first attempt to provide an empirically tractable framework to study marriage along the life-cycle and across cohorts.²⁹ The setup is potentially suitable for the analysis of a great variety of topics: the determinants of the age of first marriage, gender asymmetries in matching with respect to age and in remarriage trends, and the relationship between marriage and health. In the empirical analysis, I complement existing findings on marriage and economic inequality by providing a rich set of results, some of which are new to the literature. The analysis is the first to consider the joint impact of changes in wage inequality, wage mobility and the life-cycle dynamics of labor market earnings on the marriage market outcome. I show that changes in wage inequality between and within gender groups play a bigger role than changes in wage mobility. In section ??, I also briefly discuss the implications of changes in the way people meet each other on the marriage market outcome: while more work is needed in this direction, these first findings show that changes in the degree of segregation across educational groups matter in explaining the decline of marriage and the

²⁹To the best of my knowledge, only [Shephard \(2018\)](#) is, at this date, working on this kind of models.

changing sorting patterns.

The paper represents a starting point for further research in this direction. In particular, the analysis abstracts away from human capital investment. Introducing choices such as schooling or dynamic labor supply decisions linked with human capital accumulation is key to understand how agents adjust to changes in labor market conditions. Previous works have stressed the importance of studying the interplay between human capital investment and competitive matching on the marriage market (e.g. [Chiappori et al., 2017](#)); other works have extensively discussed the schooling and life-cycle career choices of women outside of an equilibrium framework (e.g. [Sheran, 2007](#); [Bronson, 2014](#)). Although this will add an additional layer of complexity, particularly in the estimation phase, the theoretical setup outlined in this paper can bridge these two literatures and provide new insights in this direction.

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A Technical Appendix

A.1 Linearizing the Pareto Frontier

The TU property implies that there exist a cardinal representation of the spouses' preferences so that the Pareto frontier can be characterized as a straight line with slope -1 (see [Chiappori and Gugl, 2014](#)). This property is also used in the proof of lemma 2.1. Given the ordinal representation of spouses' utilities given by equation (2.1) and the demand for public good (2.5), it is possible to recover $\Gamma(l_f; i, j)$, i.e., the constant characterizing the linearized Pareto frontier associated with l_f .

$$\begin{aligned}\Gamma(l_f; i, j) &= \exp(\log(w_i - t_m) - \log Q^*(l_f; i, j)) + \exp(\log(l_f w_j - t_f) - \log Q^*(l_f; i, j)) = \\ &= (w_i + l_f w_j - t_m - t_f) Q^*(l_f; i, j) = \\ &= \frac{\gamma_1(i, j)^{\gamma_1(i, j)}}{(1 + \gamma_1(i, j))^{1 + \gamma_1(i, j)}} (w_i + l_f w_j)^{1 + \gamma_1(i, j)} \exp(\gamma_2(l_f; j) + \gamma_3(i, j) + \eta_{l_f}).\end{aligned}\tag{A.1}$$

Note from the expression above how η_{l_f} tilts the Pareto frontier. Moreover, $\Gamma(l_f; i, j)$ is closely related to what is defined in section as the “per-period marital surplus” $h(l_f; i, j)$ corresponds to $\log(\Gamma(l_f; i, j))$.

A.2 Private Consumption and Sharing Rule

The amount of private consumption is jointly determined by the amount of surplus produced by a match and the way it is shared between the spouses. Consider the wife's Bellman equation (2.16): the splitting rule (2.10) tells us that her share of surplus must be exactly one half of the total. This restriction implied by the splitting rule allows me to back out the wife's amount of private consumption. Interestingly, it is possible to write the ratio of the wife's to the private husband's consumption as follows:

$$\frac{w_j - t_f^*(l_f; i, j)}{w_i - t_m^*(l_f; i, j)} = \frac{\exp(V_f^0(j) - \beta \psi_f(j) \sum_{j'} V_f^0(j') \pi_f(j, j'))^2}{\exp(V_m^0(i) - \beta \psi_m(i) \sum_{i'} V_m^0(i') \pi_m(i, i'))^2}.\tag{A.2}$$

A.3 Steady-State Equilibrium as a Fixed Point

The steady-state search equilibrium can be thought of as a fixed-point of an operator $n \rightarrow T_{ext}n$, with $n = (n_m, n_f)$. First, it is necessary to discretize the sets of types $|\mathcal{I}|$ and $|\mathcal{J}|$, as wage

rates are continuous variables in the data. Hence, n is a vector of length $|\mathcal{I}| + |\mathcal{J}|$.

1. Start the iteration with $k = 0$ and a guess for n^k .
2. For given n^k , solve a fixed-point problem T_{int} given by equations (2.17), (2.25) and (2.26), in order to find $V^0 = (V_m^0, V_f^0)$ so that $V^0 = T_{int}V^0$.
3. Update α using (2.24).
4. Substitute the matrix α into the law of motion (2.32) and solve forwards for m .
5. Use the accounting equations (2.27) and (2.28) to compute n^{k+1} .
6. If $\Delta(n^k, n^{k+1}) < \epsilon$, keep n^{k+1} , otherwise set $n^k = \delta n^{k+1} + (1 - \delta)n^k$ and restart from step 2.

As anticipated in section 2.12, while there is no theoretical result ensuring existence and uniqueness of the equilibrium, iteration of the fixed-point operator leads to convergence to a vector n^* . Many simulations have brought me to conclude that convergence to n^* is obtained regardless of the initial points chosen to start the algorithm and for a very broad choice of the numerous primitive parameters. The only caveat is that, at the last step of the algorithm described above, I update the distribution n by taking a convex combination of the last two obtained vectors in the sequence: experience suggests that setting $0 < \delta < 1$ and in particular sufficiently close to 0 (I set it equal to 0.2) allows the algorithm to converge for almost any choice of the primitive parameters.

More theoretical guidance and a proof of existence and, possibly, uniqueness of the equilibrium would help understand the property of the fixed-point operator and could possibly help to design faster solution methods. This is left for future research.

A.4 Plackett's Copula and Transition Matrix

In order to obtain the transition matrices π_m and π_f , I characterize the $AR(1)$ wage process through a copula that links the wage rank of an individual across two consecutive periods. Consider the case of a man i : the joint CDF of his current wage rank $r_i(h_i, a_i)$ and his future wage rank $r_{i'}(h_{i'}, a_{i'})$ is given by the Plackett's copula:

$$C_m(u, v | h_i, a_i) = \frac{1 + \theta(h_i, a_i)(u + v) - [1 + \theta(h_i, a_i)(u + v)^2 - 4\theta(h_i, a_i)(\theta(h_i, a_i) + 1)uv]^{1/2}}{2\theta(h_i, a_i)} \quad (\text{A.3})$$

where the parameter $\theta(h_i, a_i)$ is such that the higher $\theta(h_i, a_i)$, the lower the mobility. In particular, [Nelsen \(2007, Chapter 5\)](#) shows that θ is a monotonically increasing function of the Spearman's rank correlation coefficient. Dropping the arguments (h_i, a_i) for the sake of clarity, the two are related as follows,

$$\rho = \frac{2\theta + \theta^2 - 2(1 + \theta) \log(\theta + 1)}{\theta^2}. \quad (\text{A.4})$$

A.5 Standardization of Empirical Frequencies

In order to produce a joint distribution of spouses characteristics that is consistent with the stationarity assumption and with the observed matching behavior, I apply the following transformation to the raw empirical frequencies of married and single agents by type. This appendix closely follows [Greenwood et al. \(2016\)](#), which in turns draws from [Mosteller \(1968\)](#) and relies on the solution algorithm of [Sinkhorn and Knopp \(1967\)](#) outlined below.

Call $(m_{raw}, n_{m,raw}, n_{f,raw})$ the empirical frequencies as measured straight from the data: these are associated with the marginals $p_{m,raw}$ and $p_{f,raw}$ through accounting constraints (2.27) and (2.28). However, for my empirical analysis, I choose to work with marginals \hat{p}_m and \hat{p}_f , whose estimation is detailed in section 5.3. Starting from $(m_{raw}, n_{m,raw}, n_{f,raw})$, I compute empirical frequencies $(\hat{m}, \hat{n}_m, \hat{n}_f)$ - the “standardized contingency table” - as follows.

1. Start the iteration with $k = 0$ and set $m^k = m_{raw}$, $n_m^k = n_{m,raw}$, $n_f^{k+1} = n_{f,raw}$.
2. Compute the marginal distribution p_m^k using m^k and n_m^k and accounting restriction (2.27).
3. For each man's type i , rescale each element of the contingency table as follows: $m^{k+1}(i, j) = m^k(i, j)(\hat{p}_m(i)/p_m^k(i))$ and $n^{k+1}(i) = n^k(i)(\hat{p}_m(i)/p_m^k(i))$, where \hat{p}_m is the men's marginal distribution that has been imposed.
4. Compute the marginal distribution p_f^{k+1} using m^{k+1} and n_f^{k+1} and accounting restriction (2.28).
5. For each woman's type j , rescale each element of the contingency table as follows: $m^{k+2}(i, j) = m^{k+1}(i, j)(\hat{p}_f(j)/p_f^{k+1}(j))$ and $n^{k+2}(j) = n^{k+1}(j)(\hat{p}_f(j)/p_f^{k+1}(j))$, where \hat{p}_f is the women's marginal distribution that has been imposed.
6. Compute p_m^{k+2} using m^{k+2} and n_m^k : if p_m^{k+2} and \hat{p}_m are close, stop; otherwise repeat from step 2 until convergence.

B Tables

Table 1: Estimates of γ_1 by spouses' education

Parameter (λ_1)	1971-1981 (a)	2001-2011 (b)	Change (b)-(a)
Husband L, wife L	1.286 (0.098)	0.949 (0.080)	-0.336
Husband L, wife H	1.302 (0.143)	1.552 (0.095)	0.250
Husband H, wife L	1.546 (0.129)	1.157 (0.103)	-0.390
Husband H, wife H	1.002 (0.130)	1.559 (0.101)	0.557

Notes: the table contains estimates of γ_1 , the elasticity of public good Q with respect to the joint expenditure $t_m + t_f$, for different types of couples; L (Low) indicates that the agent does not hold a college degree, while H (High) indicates that he/she does hold a college degree. The first column contains results for the 1970s sample, the second for the 2000s sample, and the third the difference between the two. Standard errors are in parentheses.

Table 2: Estimates of the search parameters

Parameter	1971-1981 (a)	2001-2011 (b)	Change (b)-(a)
Educational homophily (λ_1)	0.645 (0.003)	0.361 (0.006)	-0.284
Age distance squared (λ_2)	-0.044 (0.001)	-0.005 (0.002)	0.039
Age term of degree 3 $a_m a_f^2$ (λ_3)	-0.004 (0.000)	-0.010 (0.000)	-0.006
Age term of degree 3 $a_m^2 a_f$ (λ_4)	-0.001 (0.000)	0.007 (0.000)	0.008
CES parameter (χ)	100.000 -	100.000 -	0.000
Cost of divorce (κ)	4.221 (0.001)	4.623 (0.001)	0.402

Notes: the table contains estimates of the parameters of the meeting function Λ and the cost of divorce κ . The elasticity of substitution of inputs ($n_{m,+}(i), n_{f,+}(j)$) in the meeting function χ is set to 100 after that early findings suggested that the meeting function is well approximated by a Leontief function. The empirical specification of the meeting function is detailed in section 5.6.

Table 3: Summary of parameters estimated or calibrated outside of the model

Parameter	1971-1981	2001-2011	Notes
β	0.9604	0.9604	Calibrated (Voena, 2015; Chiappori et al., 2017)
π	0.7	0.7	Calibrated (see section 5.5)
Share of college graduates (men)	20.84%	30.54%	Estimated (CPS data, see section 5.3)
Share of college graduates (women)	13.03%	31.31%	Estimated (CPS data, see section 5.3)
Wage levels (men and women)	See figure 3		Estimated (CPS data, see section 5.1)
Wage mobility (men and women)	See figure 3		Estimated (PSID data, see section 5.1)

Notes: the table summarizes the parameters that are calibrated or estimated outside of the model. Wage levels and wage mobility are described in separate figures.

Table 4: Fit of the model (1)

Moment	1971-1981		2001-2011		Change	
	(a)		(b)		(b) - (a)	
	Sim.	Data	Sim.	Data	Sim.	Data
<i>% of married</i>						
Men	74.59	69.74	58.64	52.14	-15.95	-17.60
Women	74.59	67.69	58.64	52.45	-15.95	-15.24
<i>% of married by education</i>						
Men (L)	76.03	68.78	57.26	47.18	-18.77	-21.60
Women (L)	75.39	67.84	56.83	48.93	-18.56	-18.91
Men (H)	69.09	73.79	61.77	65.03	-7.32	-8.75
Women (H)	69.23	66.65	62.60	60.99	-6.63	-5.67
<i>% of married by wage quintile</i>						
Men (1st quintile)	61.63	49.31	43.35	29.50	-18.27	-19.81
Women (1st quintile)	73.11	60.50	49.36	38.98	-23.75	-21.52
Men (3rd quintile)	75.01	72.44	53.43	48.39	-21.58	-24.05
Women (3rd quintile)	74.29	73.02	52.26	52.39	-22.03	-20.64
Men (5th quintile)	86.80	87.48	74.57	76.60	-12.23	-10.88
Women (5th quintile)	79.43	65.97	68.67	62.43	-10.76	-3.54
<i>% of married by age</i>						
Men (20-30)	41.44	45.59	20.65	20.36	-20.79	-25.23
Women (20-30)	59.19	57.10	30.17	30.02	-29.02	-27.09
Men (30-40)	80.34	78.69	60.43	56.83	-19.91	-21.86
Women (30-40)	85.51	76.70	67.78	61.00	-17.72	-15.70
Men (40-50)	87.17	82.47	72.87	63.27	-14.30	-19.20
Women (40-50)	88.47	77.09	74.98	62.50	-13.49	-14.59
Men (50-60)	88.73	82.96	78.61	67.33	-10.12	-15.62
Women (50-60)	74.69	67.50	67.35	57.62	-7.35	-9.88

Notes: the table contains moments from the empirical distribution of agents' marital status conditional on their characteristics for both the 1970s and the 2000s. These are compared to the moments obtained by simulating the estimated model. In the last two columns, it is possible to assess the changes observed in the data and those implied by the two simulations. Labels: (L) means non-college graduate; (H) means college graduate; (xx-yy) means from age xx to age yy; (PT) means part-time; (FT) means full-time.

Table 5: Fit of the model (2)

Moment	1971-1981		2001-2011		Change	
	(a)		(b)		(b) - (a)	
	Sim.	Data	Sim.	Data	Sim.	Data
<i>% of couples by education</i>						
L husband, L wife	79.55	76.12	61.15	54.92	-18.40	-21.20
L husband, H wife	1.15	3.58	6.68	10.42	5.53	6.84
H husband, L wife	8.36	11.39	5.43	11.12	-2.93	-0.27
H husband, H wife	10.95	8.91	26.75	23.53	15.80	14.62
<i>Correlation between spouses' traits</i>						
Wage	20.05	25.87	26.19	33.57	6.14	7.70
Wage (rank)	13.96	27.12	23.88	34.87	9.92	7.75
Age	69.51	75.41	65.69	67.66	-3.83	-7.75
<i>% of couples by wife's l_f</i>						
Not working (L)	41.71	49.25	26.34	29.28	-15.37	-19.97
Working PT (L)	20.73	16.37	22.06	17.82	1.33	1.44
Working FT (L)	37.56	34.38	51.60	52.91	14.04	18.53
Not working (H)	34.74	35.10	22.31	20.77	-12.43	-14.33
Working PT (H)	18.24	17.53	17.69	17.25	-0.55	-0.28
Working FT (H)	47.02	47.37	60.00	61.98	12.98	14.61
<i>Marriage rates</i>						
Men	18.78	26.81	11.30	10.95	-7.48	-15.86
Women	20.48	20.94	11.78	10.39	-8.70	-10.55
Men (L)	20.24	27.67	10.92	10.35	-9.31	-17.32
Women (L)	21.30	21.09	11.25	9.37	-10.05	-11.71
Men (H)	14.39	25.22	12.22	12.09	-2.17	-13.13
Women (H)	16.06	20.56	13.09	12.08	-2.96	-8.48
<i>Divorce rates</i>						
Overall	1.82	5.09	2.25	4.91	0.43	-0.18
Men (L)	1.88	5.45	2.60	6.24	0.72	0.79
Women (L)	1.81	5.21	2.45	6.01	0.64	0.80
Men (H)	1.56	4.20	1.50	3.21	-0.07	-0.98
Women (H)	1.91	4.64	1.84	3.50	-0.07	-1.14

Notes: the table contains moments from the joint empirical frequency of spouses' characteristics, married women's empirical probabilities of choosing a certain level l_f of labor supply and the distribution of empirical probabilities of getting married (for singles) or divorced (for married) for both the 1970s and the 2000s. These are compared to the moments obtained by simulating the estimated model. In the last two columns, it is possible to assess the changes observed in the data and those implied by the two simulations. Labels: (L) means non-college graduate; (H) means college graduate; (xx-yy) means from age xx to age yy; (PT) means part-time; (FT) means full-time.

Table 6: Decomposition of the changes in marriage market outcome (1)

	1970s	Experiments				2000s
		Wages	Schooling	Wages Schooling	Wages Schooling Meetings	
	(1)	(a)	(b)	(c)	(d)	(2)
<i>% of married</i>						
Overall	74.59	69.27	72.16	66.73	66.51	58.64
<i>% of married by education</i>						
Men (L)	76.03	70.06	73.63	66.45	66.30	57.26
Women (L)	75.39	69.91	76.01	69.58	70.18	56.83
Men (H)	69.09	66.28	68.82	67.37	67.01	61.77
Women (H)	69.23	65.00	63.72	60.48	58.48	62.60
<i>% of married by wage quintile</i>						
Men (1st quintile)	61.63	56.75	56.03	50.72	50.59	43.35
Women (1st quintile)	73.11	70.14	69.42	65.24	65.02	49.36
Men (3rd quintile)	75.01	70.82	69.83	63.42	63.03	53.43
Women (3rd quintile)	74.29	72.59	73.44	63.75	64.01	52.26
Men (5th quintile)	86.80	82.25	86.64	81.26	81.38	74.57
Women (5th quintile)	79.43	70.80	74.24	68.70	68.39	68.67
<i>% of married by age</i>						
Men (20-30)	41.44	36.84	37.77	33.14	30.67	20.65
Women (20-30)	59.19	55.25	54.70	50.52	49.09	30.17
Men (30-40)	80.34	74.29	78.30	72.07	70.27	60.43
Women (30-40)	85.51	79.90	83.61	77.62	76.42	67.78
Men (40-50)	87.17	81.50	85.24	79.49	80.08	72.87
Women (40-50)	88.47	82.81	86.17	80.45	81.46	74.98
Men (50-60)	88.73	83.70	86.33	81.21	83.24	78.61
Women (50-60)	74.69	68.46	73.35	67.23	68.01	67.35

Notes: the table contains moments from different simulated economies: column (1) aims to match the 1970s equilibrium; the labels of the column in the middle part of the table (“Experiments”) refers to the names of the experiments described in section 6.4; column (2) aims to match the 2000s equilibrium. Each experiment corresponds to a simulated equilibrium where all parameters are fixed to their 1970s levels but those named in the header, which are set to their 2000s levels. The table helps understand which factors contributed the most to changes in the marriage market outcome. Finally, note that the residual difference between column (c) and (2) is only explained by changes in the production function of the public good Q (i.e., due to changes in γ_1 , γ_2 and γ_3).

Table 7: Decomposition of the changes in marriage market outcome (2)

	1970s	Experiments				2000s
		Wages	Schooling	Wages Schooling	Wages Schooling Meetings	
	(1)	(a)	(b)	(c)	(d)	(2)
<i>% of couples by education</i>						
L husband, L wife	79.55	79.30	65.71	65.35	64.28	61.15
L husband, H wife	1.15	0.76	5.16	3.82	4.95	6.68
H husband, L wife	8.36	8.47	6.64	6.28	8.19	5.43
H husband, H wife	10.95	11.47	22.49	24.56	22.58	26.75
<i>Correlation between spouses' traits</i>						
Wage	20.05	21.07	23.58	25.40	23.26	26.19
Wage (rank)	13.96	16.16	18.47	22.25	20.29	23.88
Age	69.51	67.55	70.08	67.88	66.06	65.69
<i>% of couples by wife's l_f</i>						
Not working (L)	41.71	37.52	41.76	37.61	37.69	26.34
Working PT (L)	20.73	21.05	20.70	21.02	21.04	22.06
Working FT (L)	37.56	41.43	37.54	41.37	41.27	51.60
Not working (H)	34.74	31.02	33.96	30.14	29.64	22.31
Working PT (H)	18.24	18.28	18.18	18.22	18.19	17.69
Working FT (H)	47.02	50.70	47.86	51.64	52.17	60.00
<i>Marriage rates</i>						
Men	18.78	16.22	17.51	15.10	13.87	11.30
Women	20.48	17.45	18.96	16.13	14.90	11.78
Men (L)	20.24	17.04	18.35	15.34	13.96	10.92
Women (L)	21.30	18.04	21.77	18.65	17.65	11.25
Men (H)	14.39	13.44	15.76	14.54	13.69	12.22
Women (H)	16.06	14.05	14.26	11.85	10.54	13.09
<i>Divorce rates</i>						
Overall	1.82	2.44	2.12	2.71	1.90	2.25
Men (L)	1.88	2.55	2.22	2.94	2.04	2.60
Women (L)	1.81	2.46	2.07	2.78	1.86	2.45
Men (H)	1.56	1.99	1.89	2.19	1.60	1.50
Women (H)	1.91	2.32	2.28	2.53	2.00	1.84

Notes: the table contains moments from different simulated economies: column (1) aims to match the 1970s equilibrium; the labels of the column in the middle part of the table (“Experiments”) refers to the names of the experiments described in section 6.4; column (2) aims to match the 2000s equilibrium. Each experiment corresponds to a simulated equilibrium where all parameters are fixed to their 1970s levels but those named in the header, which are set to their 2000s levels. The table helps understand which factors contributed the most to changes in the marriage market outcome. Finally, note that the residual difference between column (c) and (2) is only explained by changes in the production function of the public good Q (i.e., due to changes in γ_1 , γ_2 and γ_3).

Table 8: Changes in wage mobility and wage levels (1)

	1970s	Experiments			
		Men's	Women's	Men's	Women's
	(1)	wages	wages	mobility	mobility
		(e)	(f)	(g)	(h)
<i>% of married</i>					
Overall	74.59	70.11	73.70	74.75	74.60
<i>% of married by education</i>					
Men (L)	76.03	70.82	75.25	76.17	76.05
Women (L)	75.39	70.47	74.76	75.55	75.40
Men (H)	69.09	67.42	67.83	69.35	69.10
Women (H)	69.23	67.73	66.64	69.40	69.24
<i>% of married by wage quintile</i>					
Men (1st quintile)	61.63	56.71	60.70	62.29	61.64
Women (1st quintile)	73.11	68.63	73.97	73.26	73.34
Men (3rd quintile)	75.01	71.85	74.17	75.07	75.03
Women (3rd quintile)	74.29	69.54	77.26	74.45	74.32
Men (5th quintile)	86.80	83.88	86.00	86.47	86.81
Women (5th quintile)	79.43	75.21	75.51	79.61	79.19
<i>% of married by age</i>					
Men (20-30)	41.44	36.82	41.23	41.52	41.46
Women (20-30)	59.19	55.21	58.95	59.28	59.21
Men (30-40)	80.34	74.83	79.70	80.45	80.36
Women (30-40)	85.51	80.48	84.85	85.63	85.52
Men (40-50)	87.17	82.65	86.10	87.32	87.19
Women (40-50)	88.47	84.10	87.27	88.65	88.49
Men (50-60)	88.73	85.21	87.28	89.02	88.73
Women (50-60)	74.69	70.01	73.21	74.97	74.70

Notes: the table contains moments from different simulated economies: column (1) aims to match the 1970s equilibrium; the labels of the column in the middle part of the table (“Experiments”) refers to the names of the experiments described in section ???. Each experiment corresponds to a simulated equilibrium where all parameters are fixed to their 1970s levels but those named in the header, which are set to their 2000s levels. The table helps understand the impact of changes in each element of the wage distribution on the changing marriage market outcome.

Table 9: Changes in wage mobility and wage levels (2)

	1970s	Experiments			
		Men's	Women's	Men's	Women's
	(1)	wages	wages	mobility	mobility
		(e)	(f)	(g)	(h)
<i>% of couples by education</i>					
L husband, L wife	79.55	79.23	79.63	79.53	79.55
L husband, H wife	1.15	0.73	1.19	1.14	1.15
H husband, L wife	8.36	8.18	8.59	8.37	8.36
H husband, H wife	10.95	11.86	10.59	10.96	10.95
<i>Correlation between spouses' traits</i>					
Wage	20.05	21.10	19.16	20.03	20.12
Wage (rank)	13.96	15.37	13.60	13.92	14.04
Age	69.51	67.45	69.54	69.50	69.52
<i>% of couples by wife's l_f</i>					
Not working (L)	41.71	38.34	40.87	41.67	41.72
Working PT (L)	20.73	21.02	20.79	20.74	20.73
Working FT (L)	37.56	40.64	38.34	37.60	37.55
Not working (H)	34.74	33.68	32.13	34.70	34.75
Working PT (H)	18.24	18.27	18.26	18.24	18.24
Working FT (H)	47.02	48.06	49.61	47.06	47.01
<i>Marriage rates</i>					
Men	18.78	16.50	18.37	18.88	18.79
Women	20.48	17.81	19.96	20.61	20.49
Men (L)	20.24	17.31	19.83	20.34	20.24
Women (L)	21.30	18.23	20.95	21.44	21.31
Men (H)	14.39	13.75	14.01	14.49	14.40
Women (H)	16.06	15.23	14.86	16.12	16.06
<i>Divorce rates</i>					
Overall	1.82	2.25	1.99	1.80	1.82
Men (L)	1.88	2.37	2.04	1.87	1.88
Women (L)	1.81	2.29	1.96	1.79	1.81
Men (H)	1.56	1.79	1.77	1.52	1.56
Women (H)	1.91	1.97	2.24	1.88	1.91

Notes: the table contains moments from different simulated economies: column (1) aims to match the 1970s equilibrium; the labels of the column in the middle part of the table (“Experiments”) refers to the names of the experiments described in section ???. Each experiment corresponds to a simulated equilibrium where all parameters are fixed to their 1970s levels but those named in the header, which are set to their 2000s levels. The table helps understand the impact of changes in each element of the wage distribution on the changing marriage market outcome.

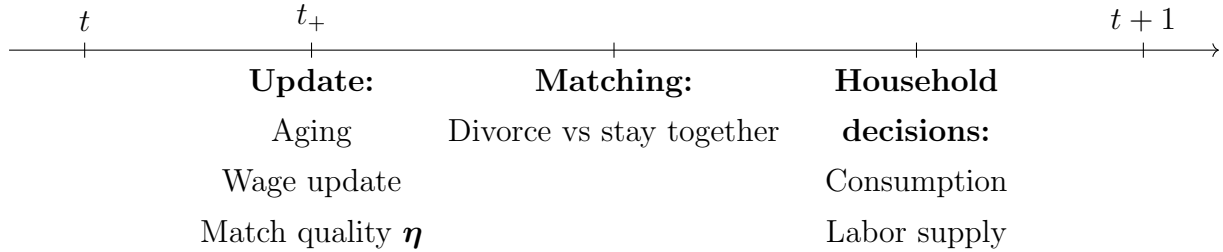
Table 10: Changes in the distribution of intertemporal welfare at the beginning of adulthood

	1970s	Experiments				2000s
		Wages	Schooling	Wages Schooling	Wages Schooling Meetings	
	(1)	(a)	(b)	(c)	(d)	(2)
<i>By gender</i>						
Average welfare (men)	100.00	90.50	101.64	93.15	92.62	91.40
Average welfare without marriage (men)	86.32	78.13	87.56	80.06	80.06	80.06
Average expected marriage gains (men)	13.68	12.37	14.07	13.08	12.56	11.33
Average welfare (women)	81.50	81.09	84.93	85.60	85.18	83.69
Average welfare without marriage (women)	66.30	67.36	69.23	71.20	71.20	71.20
Average expected marriage gains (women)	15.20	13.73	15.69	14.39	13.98	12.49
<i>By gender and education</i>						
Average welfare (men, L)	97.38	86.17	97.02	85.92	85.32	84.00
Average welfare without marriage (men, L)	83.65	73.97	83.65	73.97	73.97	73.97
Average expected marriage gains (men,L)	13.74	12.20	13.37	11.95	11.35	10.03
Average welfare (men, H)	109.93	106.95	112.15	109.59	109.21	108.23
Average welfare without marriage (men, H)	96.47	93.92	96.47	93.92	93.92	93.92
Average expected marriage gains (men,H)	13.47	13.02	15.68	15.67	15.29	14.31
Average welfare (women, L)	79.04	77.94	80.28	79.23	78.89	75.81
Average welfare without marriage (women, L)	64.21	64.62	64.21	64.62	64.62	64.62
Average expected marriage gains (women, L)	14.83	13.32	16.07	14.61	14.27	11.18
Average welfare (women, H)	97.97	102.13	95.12	99.56	98.99	100.98
Average welfare without marriage (women, H)	80.25	85.63	80.25	85.63	85.63	85.63
Average expected marriage gains (women, H)	17.72	16.50	14.87	13.93	13.36	15.35

Notes: the table reports the evolution of the intertemporal welfare of individuals entering the marriage market at age \underline{a} between the two periods and provides a decomposition of the change. The *ex-ante* welfare is decomposed into two terms according to equation (2.35): the first accounts for the welfare generated by the agents' human wealth outside of the marriage market, the second for the expected marriage gains over the life-cycle (see section 2.13 for details). All measures are normalized so that the average welfare for men in the 1970s is equal to 100. A full description of the experiments from (a) to (d) can be found in section 6.4.

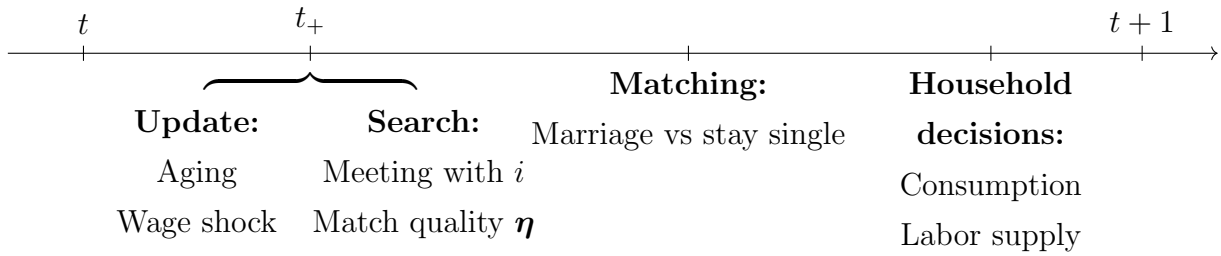
C Figures

Figure 1: Timeline for a man i and a woman j married in t



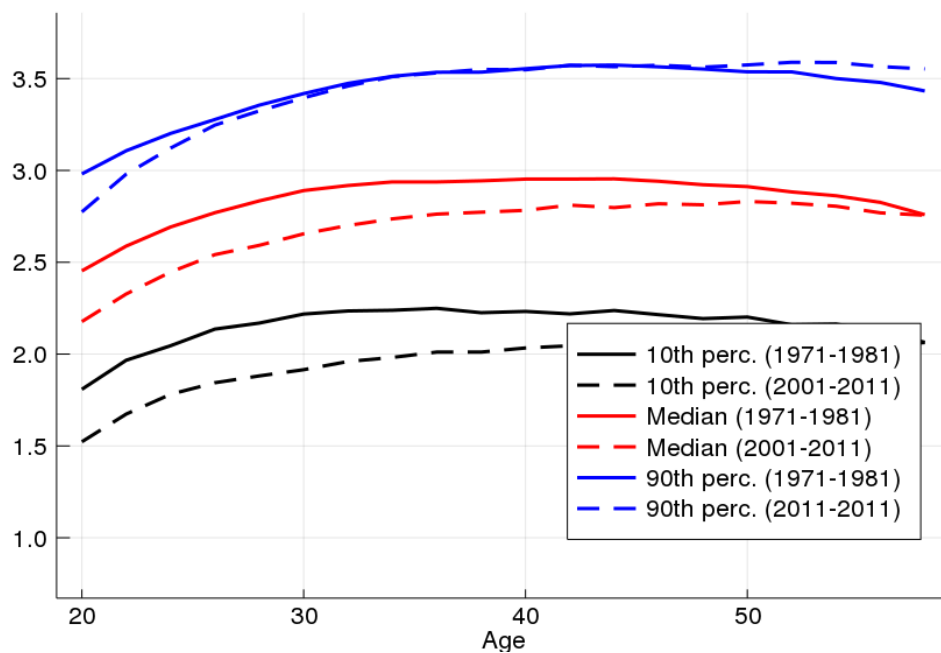
Notes: the figure reproduces the timing of decisions of agents that enter the period as married couples. Uncertainty is resolved at the beginning of the period (t_+): both spouses draw new wages and experience taste shocks η . Immediately after t_+ , couples have sufficient information to decide whether to stay together or divorce. Conditionally on their updated marital status, they make consumption and labor supply decisions.

Figure 2: Timeline for a woman j who is single in t

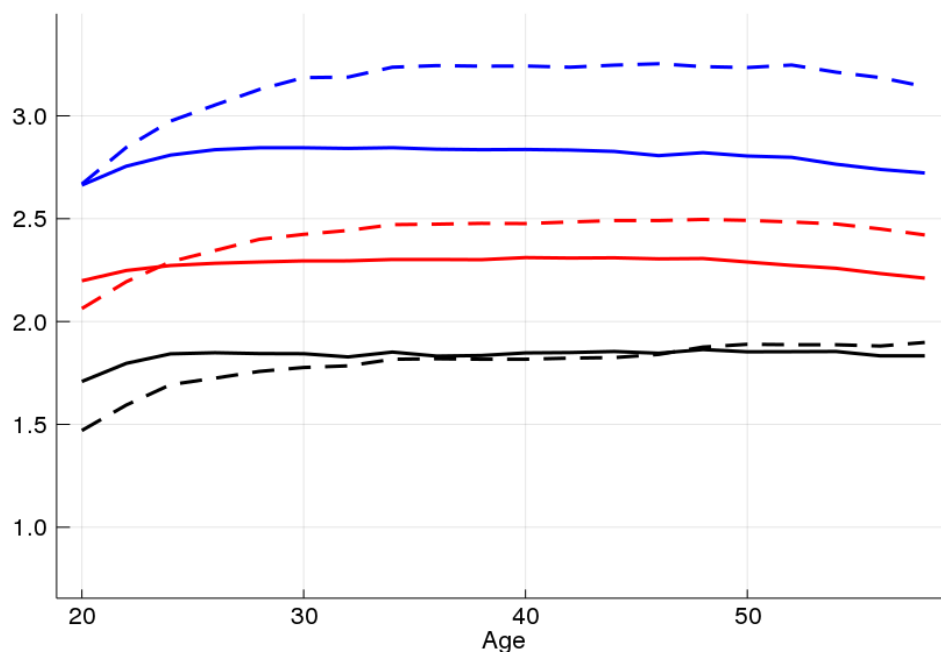


Notes: the figure reproduces the timing of single agents' decisions. Uncertainty is resolved at the beginning of the period (t_+): singles draw a new wage and look for a partner; upon a date, the pair draws a vector η which is indicative of match quality. Immediately after t_+ , single agents have sufficient information to decide whether to get married (if they have met someone). Conditionally on their updated marital status, they make consumption and labor supply decisions.

Figure 3: Wage levels by gender and age



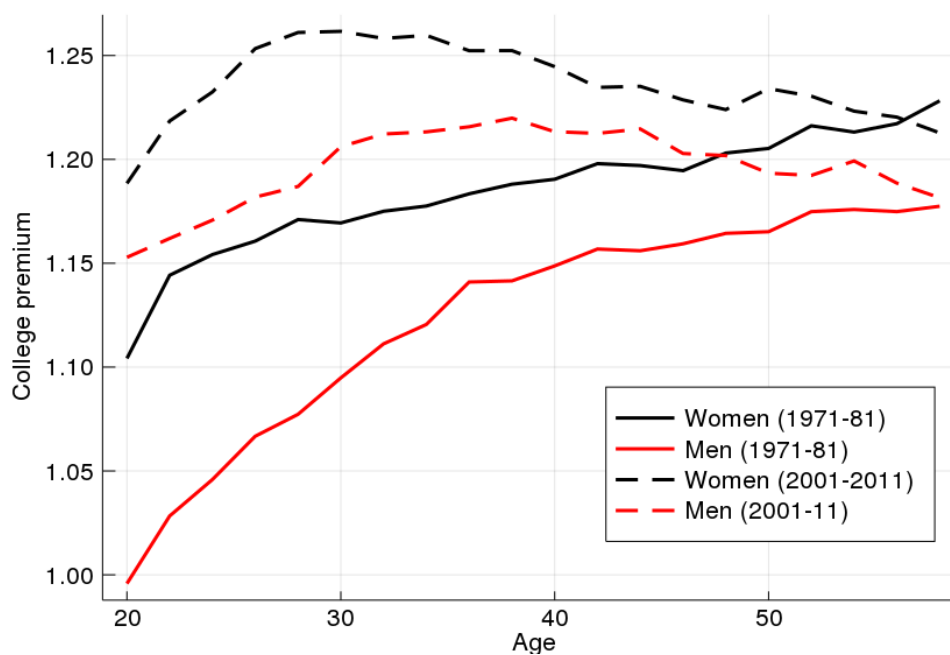
(a) Men



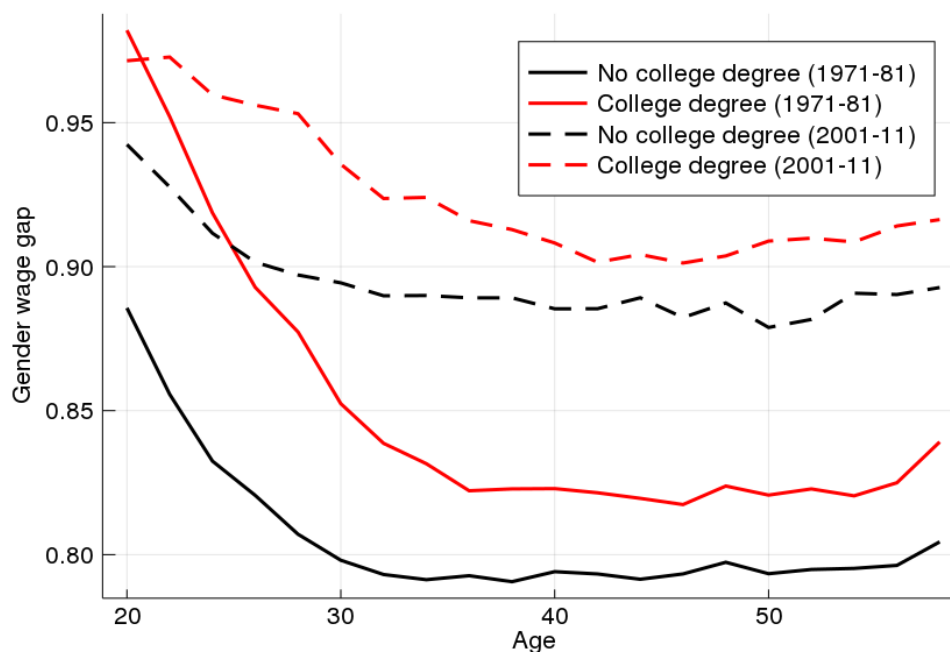
(b) Women

Notes: the plots display wage levels for the 10th (black), 50th (red) and 90th percentile (blue) for both men (on the left) and women (on the right). Solid lines refer to wage levels in the 1970s, while dash lines refer to the 2000s.

Figure 4: College premium and gender wage gap



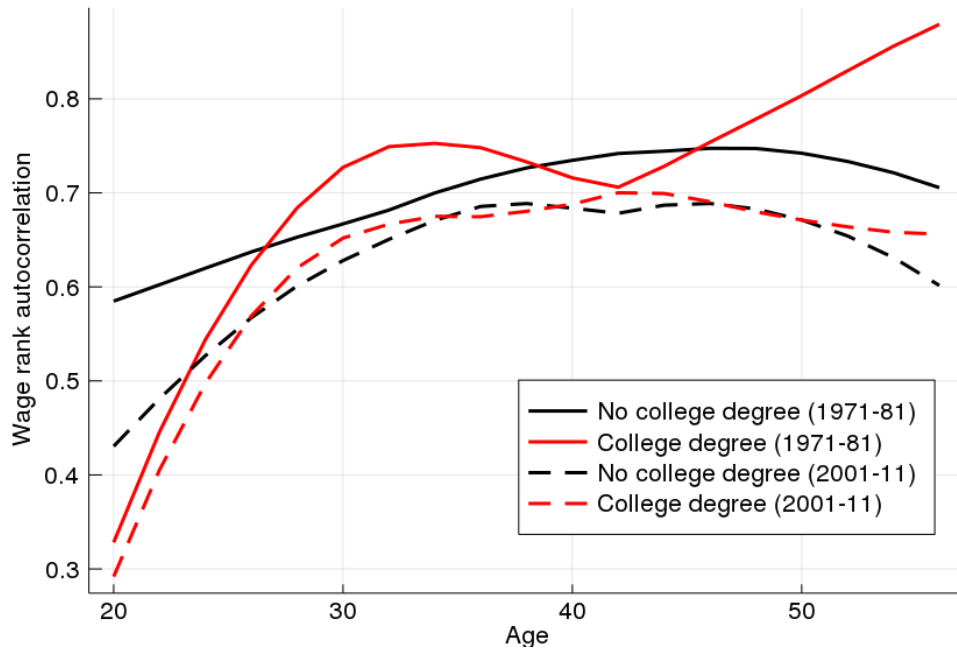
(a) College premium



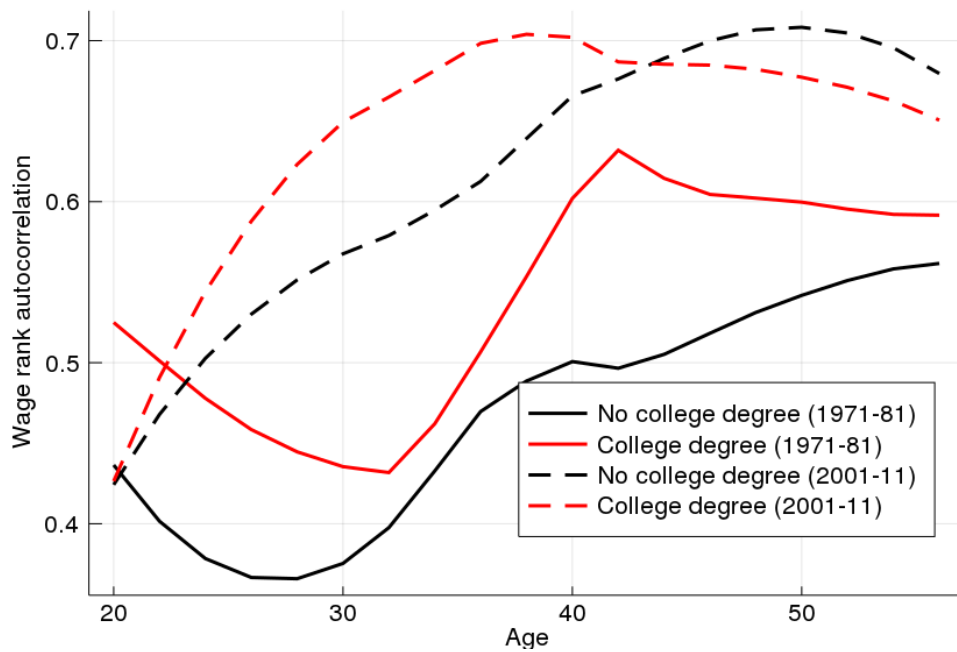
(b) Gender wage gap

Notes: the plots display the college premium (on the right) and the gender wage gap (on the left) measured as ratios between the median wages of each gender and educational group. Solid lines refer to ratios in the 1970s, while dash lines refer to the 2000s.

Figure 5: Changes in wage mobility by gender, age and education

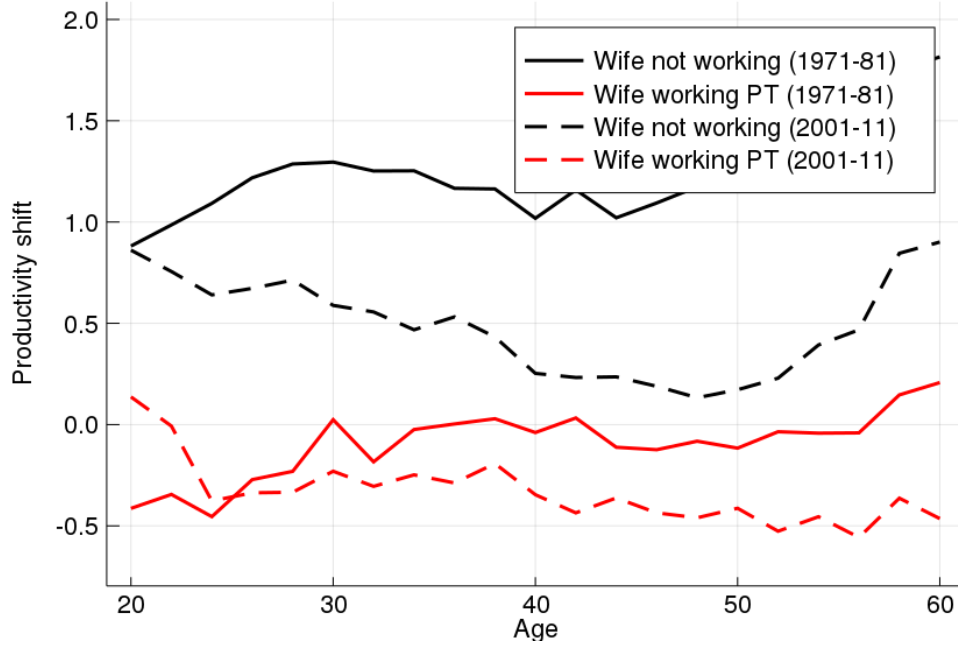


(a) Men



(b) Women

Notes: the plots display the rank correlation between the wage w in period t and the wage w' in period $t + 1$: the higher the rank correlation, the lower wage mobility. Solid lines refer to parameter estimates for the 1970s, while dash lines refer to the 2000s.

Figure 6: Estimates of γ_2 by age and education

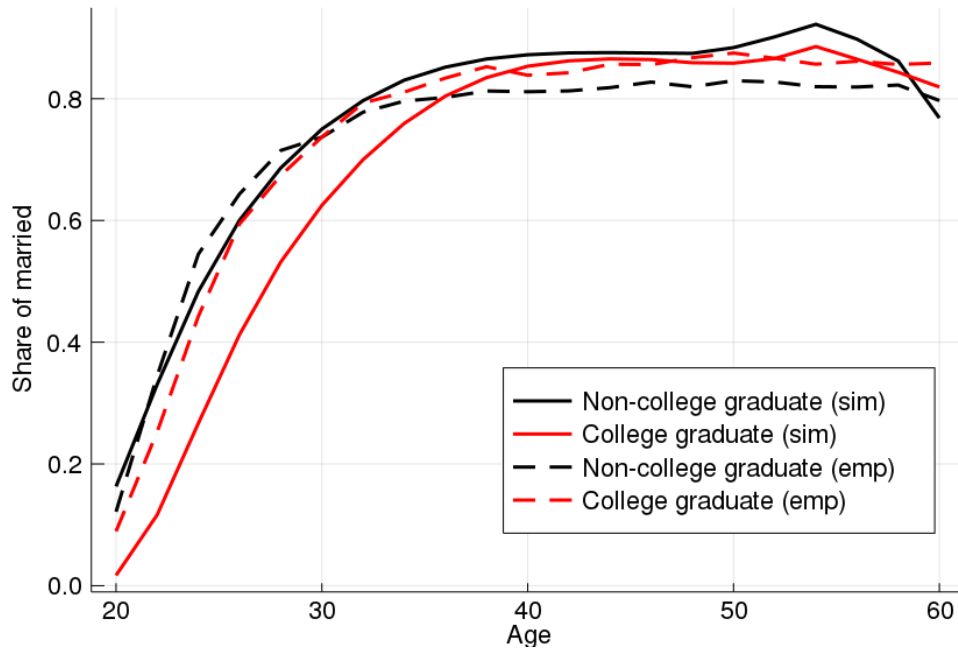
(a) Noncollege graduates



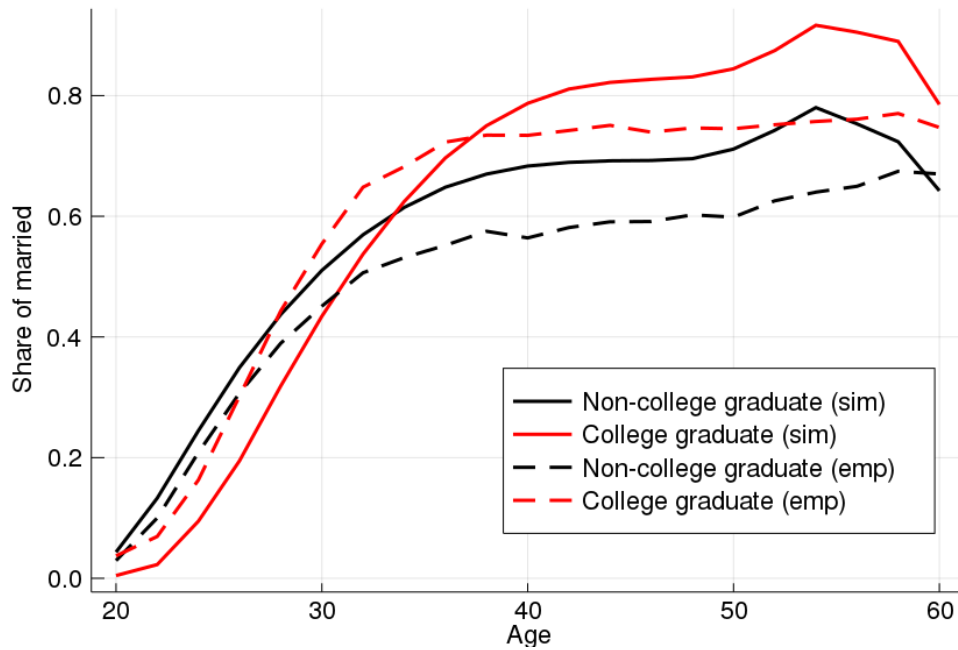
(b) College graduates

Notes: the plots display estimates of $\gamma_2(l_f)$, the productivity shifter associated with labor supply choice l_f , for women without a college degree (on the left) and with a college degree (on the right). Black indicates inactivity and red part-time; solid lines represent 1970s estimates, and dashed lines 2000s estimates. For each level l_f , $\gamma_2(l_f)$ is allowed to vary by age and education; $\gamma_2(l_f)$ is normalized to zero for married women working full-time. If $\gamma_2(l_f) > 0$, the household benefits from an increase in match surplus with respect to the benchmark (wife working full-time) if option l_f is chosen; if $\gamma_2(l_f) < 0$, the household faces a loss in match surplus.

Figure 7: Fit of the model: share of married men by age and education



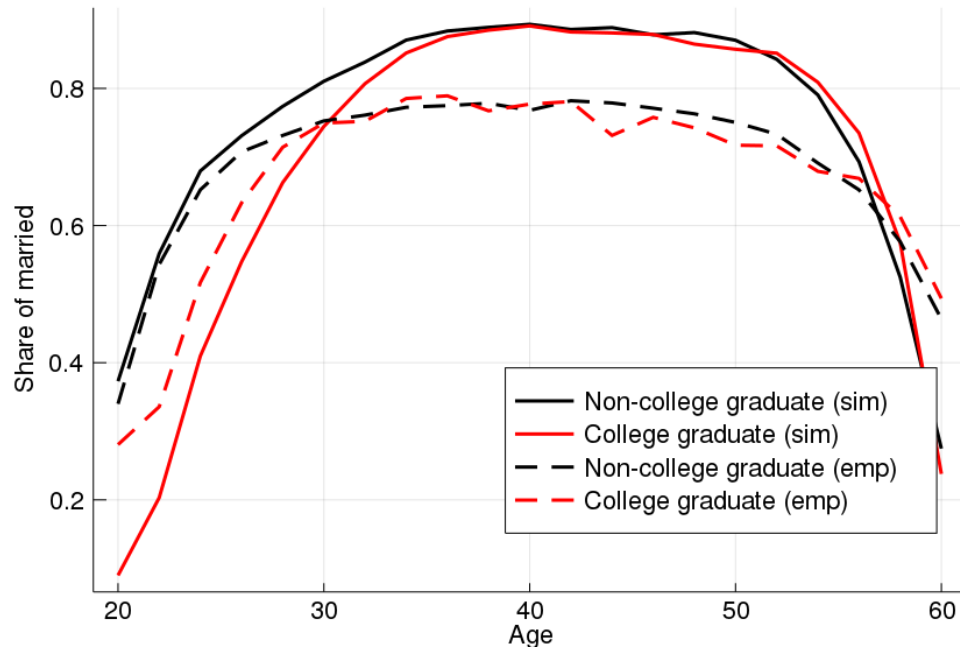
(a) 1970s



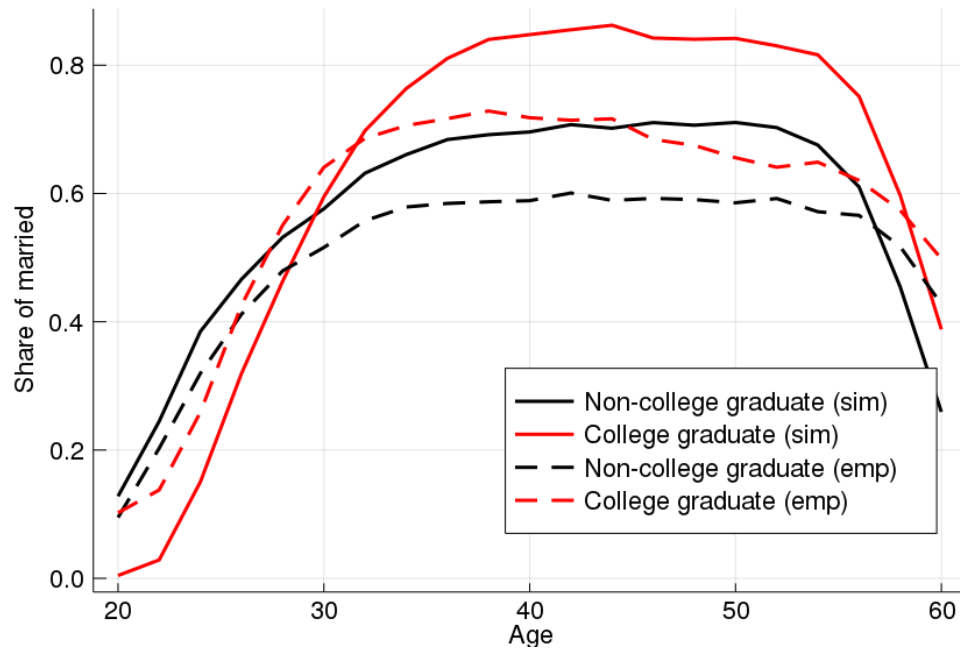
(b) 2000s

Notes: the plots track the life-cycle dynamics of the stocks of married men by educational level. For each plot, black represents non-college graduates, and red college graduates; solid lines correspond to simulated moments, dash lines to empirical moments.

Figure 8: Fit of the model: share of married women by age and education



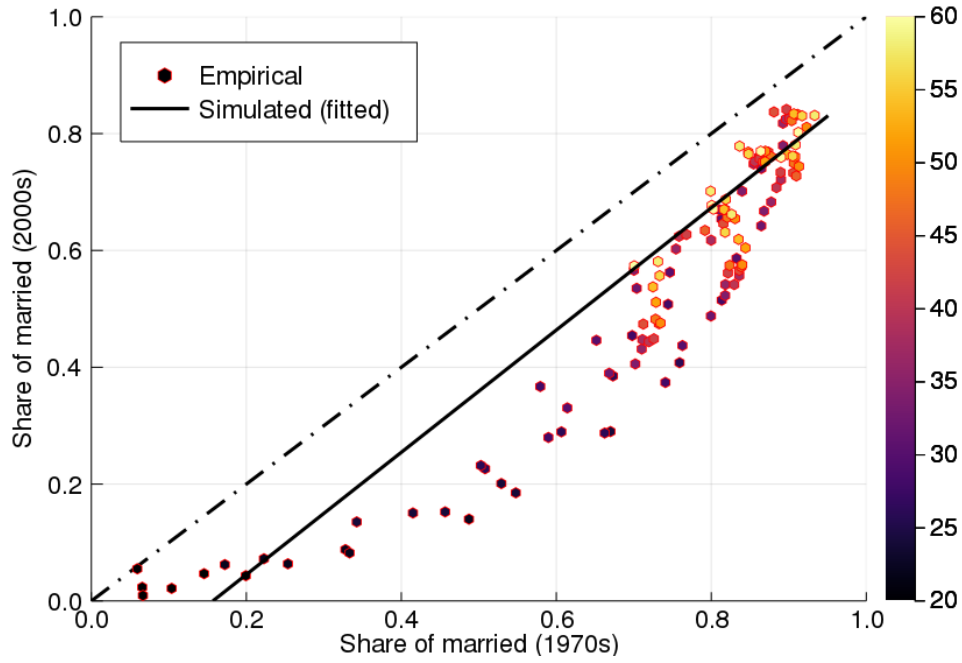
(a) 1970s



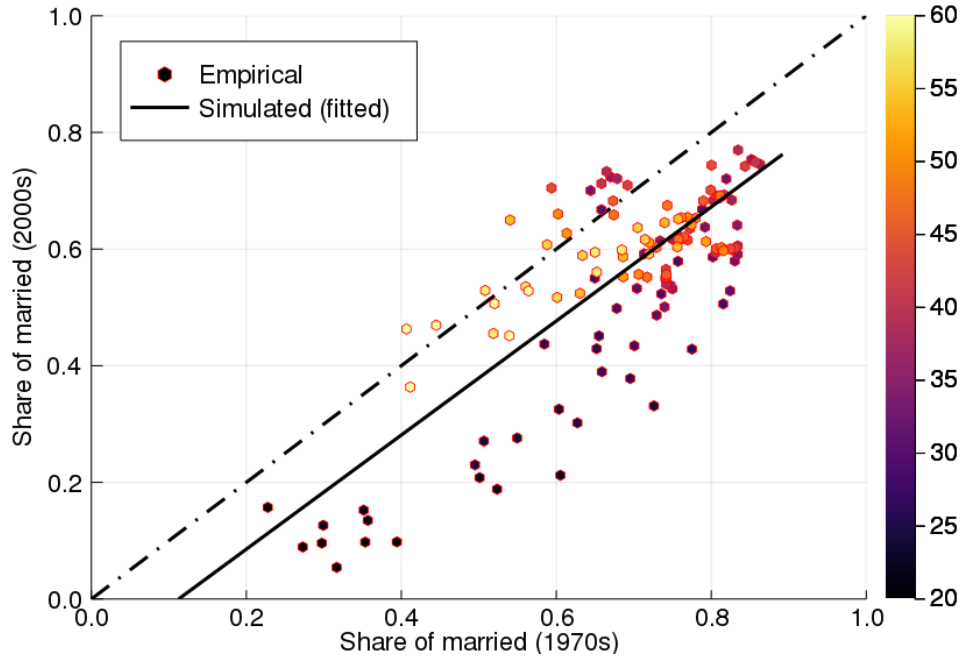
(b) 2000s

Notes: the plots track the life-cycle dynamics of the stocks of married men by educational level. For each plot, black represents non-college graduates, and red college graduates; solid lines correspond to simulated moments, dash lines to empirical moments.

Figure 9: Fit of the model: changes on the extensive margin by gender and age



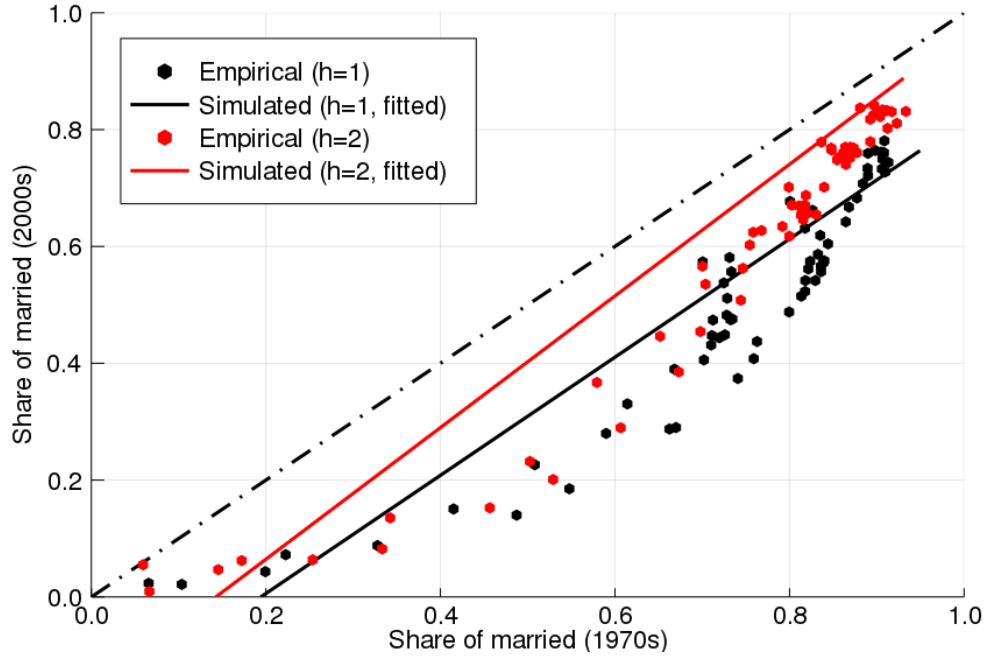
(a) Changes in the share of single men by age



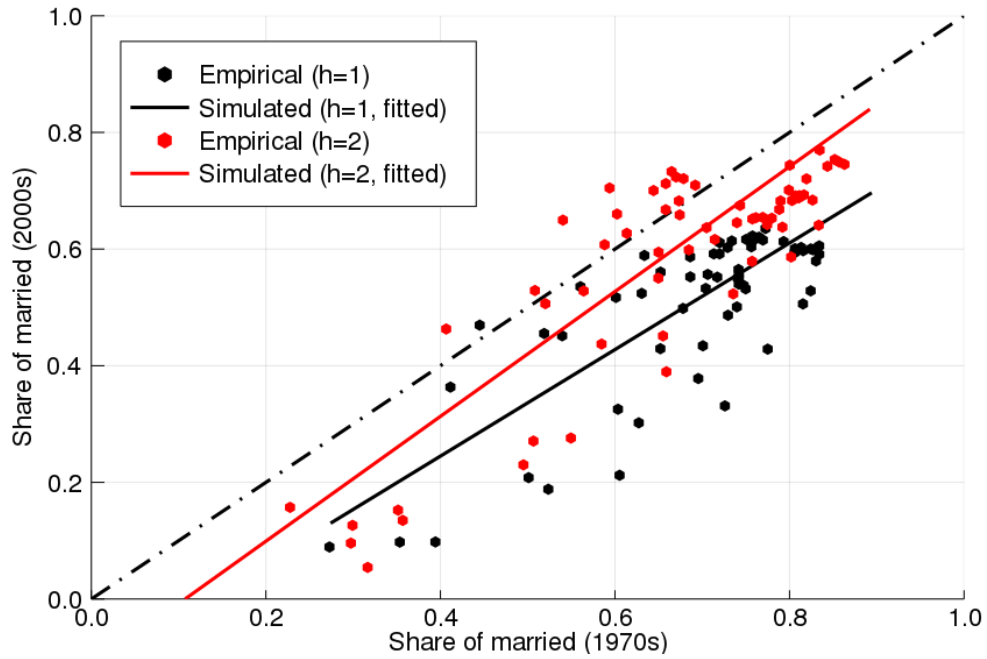
(b) Changes in the share of single women by age

Notes: the scatter plots reports the share of married agents in the 2000s vs the share of married agents in the 1970s as observed in the data for a given type i (i.e., by education, age and wage quantile). Markers are colored according to the age associated with the type (see colorbar on the right). Points below the 45-degree line correspond to a decline of marriage for a given i . The solid black line corresponds to the fitted values obtained by regressing the predicted shares of married agents in the 2000s on the predicted shares of married agents in the 1970s.

Figure 10: Fit of the model: changes on the extensive margin by gender and education



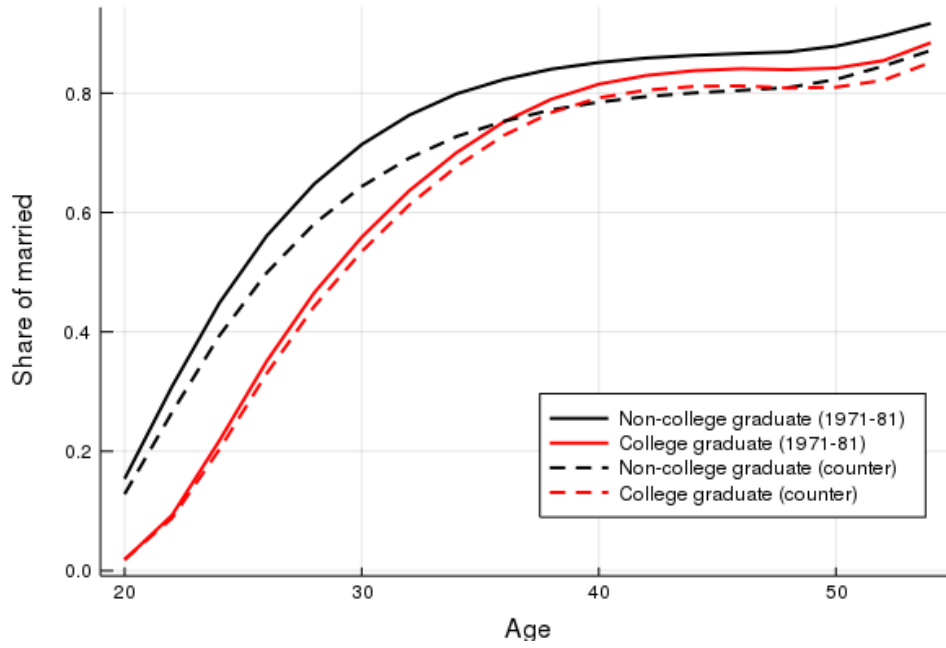
(a) Changes in the share of single men by education



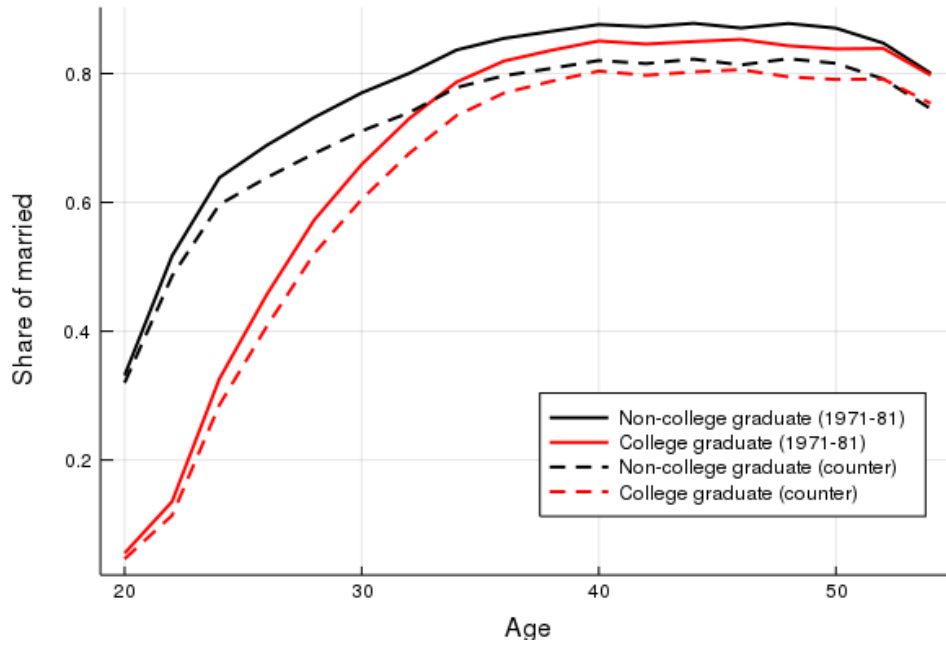
(b) Changes in the share of single women by education

Notes: the scatter plots reports the share of married agents in the 2000s vs the share of married agents in the 1970s as observed in the data for a given type i after separating the population by gender and educational group ($h = 2$ indicates a college degree). Points below the 45-degree line correspond to a decline of marriage for a given i . The solid lines correspond to the fitted values obtained by regressing the predicted shares of married agents in the 2000s on the predicted shares of married agents in the 1970s for a given gender and educational group.

Figure 11: Changes in the share of married men by age and education: experiment (a)



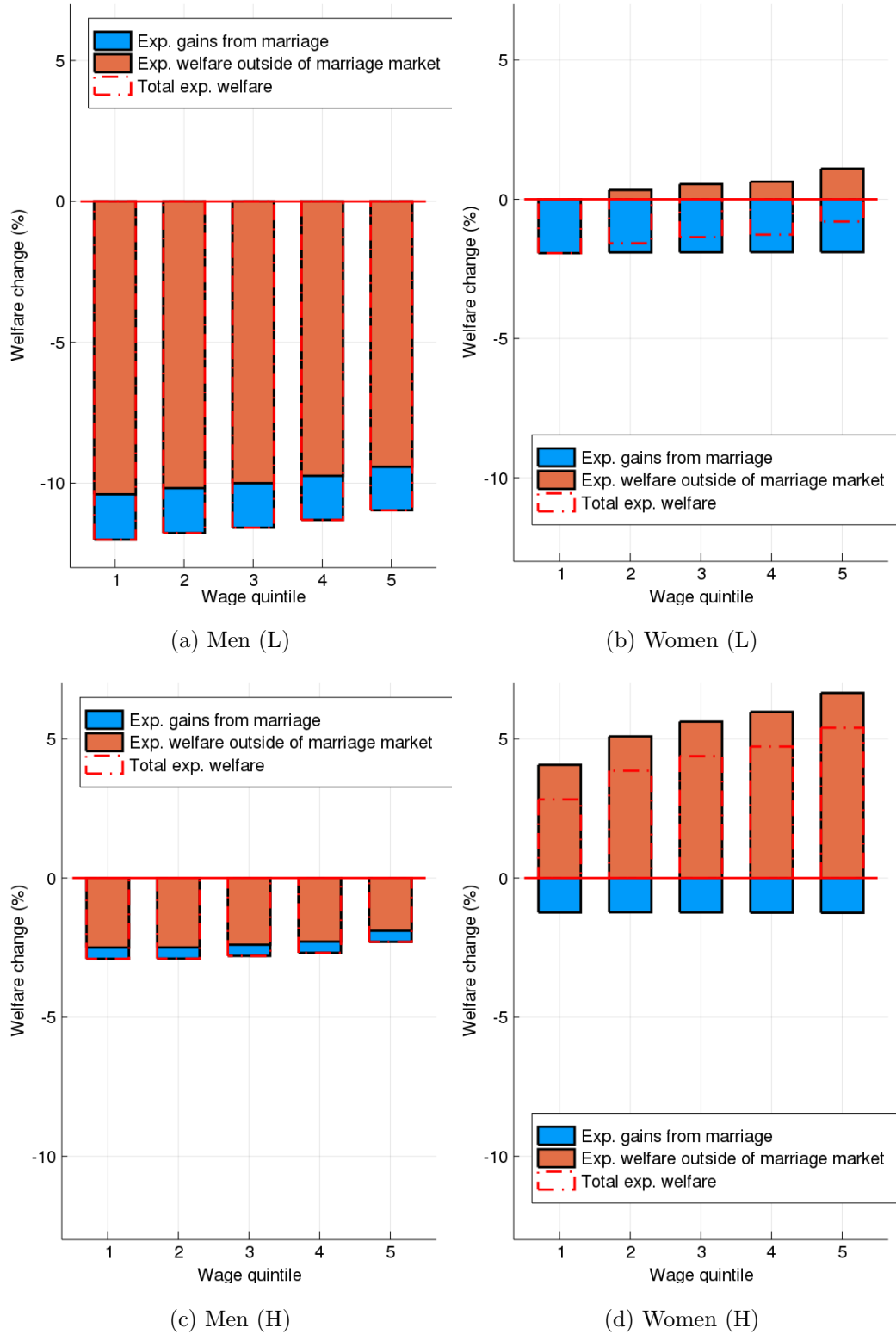
(a) Men



(b) Women

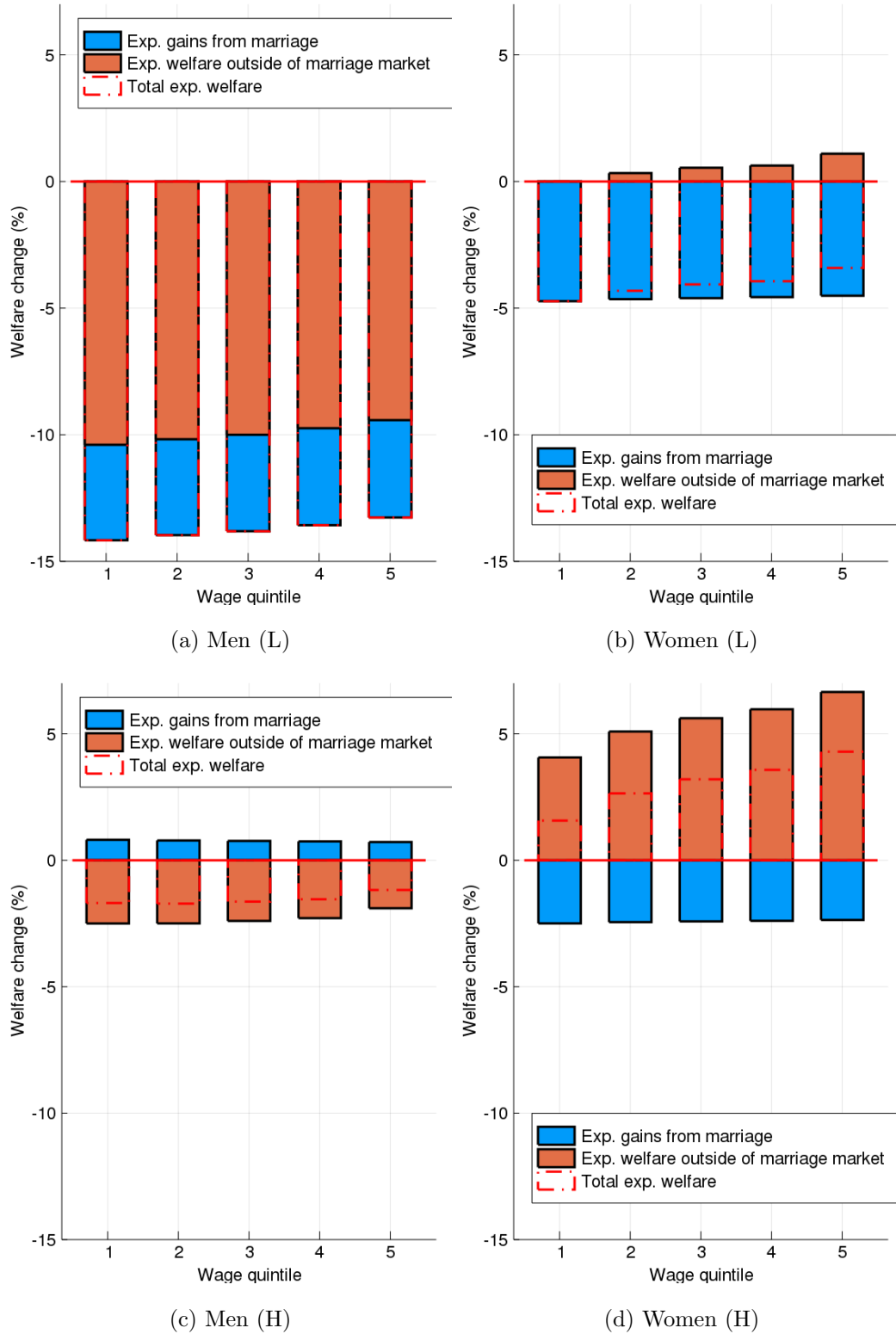
Notes: the plots track the life-cycle dynamics of the stocks of married men by educational level. For each plot, black represents non-college graduates, and red college graduates; solid lines correspond to simulated moments for the 1970s marriage market (column (1) in table 6), while dash lines correspond to simulated moments for a counterfactual equilibrium where all parameters are fixed to the 1970s but the wage distribution, which takes on its 2000s shape (column (a) in table 7).

Figure 12: Changes in intertemporal welfare of young individuals: experiment (a)



Notes: the plots report changes in ex-ante welfare for individuals entering the marriage market at age 20 in the context of experiment (a) (see section 2.13). Blue bars correspond to % change in expected gains from marriage over the life-cycle, while orange bars correspond to changes in the welfare generated outside of the marriage market. The dash red bars correspond to the net change obtained as the sum of the two other terms.

Figure 13: Changes in intertemporal welfare of young individuals: from the 1970s to the 2000s



Notes: the plots report changes in ex-ante welfare for individuals entering the marriage market at age 20 when considering the full transition from the 1970s to the 2000s (see section 2.13). Blue bars correspond to % change in expected gains from marriage over the life-cycle, while orange bars correspond to changes in the welfare generated outside of the marriage market. The dash red bars correspond to the net change obtained as the sum of the two other terms.

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