Understanding the Evolutions of Labor and Marriage Markets from 1968 to 2018

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Abstract

From 1968 to 2018, the U.S. has been experiencing significant changes in the wage structure, including the rising college premium, the shrinking gender wage gap, and the increasing wage volatility. Concurrently, many U.S. states have transitioned from a mutual consent divorce regime to a unilateral divorce regime. This paper provides a novel framework to understand how these exogenous changes drive the interrelated evolutions of the labor and marriage market outcomes. To account for the fact that the wage structure changes and the divorce law reform are two independent shocks to the agents, we fit the data time series using connected equilibrium transition paths driven by sequential shocks. Using the estimated model, we conduct a decomposition analysis and find that the increasing college premium plays the most important role in delaying marriage, and the divorce law reform also discourages early marriage rather than encouraging it.

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1 Introduction

Household decisions, such as marriage, divorce, and remarriage decisions, are very important for human beings, as they all make large impacts on long-term livings. Tracing back to the seminal work Becker (1973, 1974), reserachers have been seeking to understand how optimal household decisions are being made by the singles and the couples. Furthermore, they have probed into the evolving nature of these decision-making processes in response to shifting economic and social determinants.

Among many important determining factors, wage structure stands out to be a dominant factor. Particularly, the college premium, the gender wage gap, and the idiosyncratic wage volatility play important roles in determining the timing of marriage, the assortative mating pattern, and the labor participation rate of married women. Conversely, recent research underscores a reciprocal relationship, highlighting the influence of marriage market perspectives, notably the advantages associated with possessing a college degree and higher income levels, in steering educational and labor force participation decisions especially for women. In either direction, labor market and marriage outcomes exhibit a close interrelationship.

In the United States, labor and marriage market outcomes have experienced substantial transformations over the last five decades. In labor market, one of the key shifts has been observed in wage differentials. The premium associated with college education has been on the rise since the 1960s, with a temporary decline occurring in the 1970s. Simultaneously, the gender wage gap has significantly decreased. Conditional on crucial demographic characteristics like age, gender, and education, the dispersion of wages within each specific group has expanded, signifying an increase in the idiosyncratic wage volatility. The labor market composition has also been changing over time. There has been a growing fraction of highly educated workers among younger generations, and the labor force participation rate of married women is comparatively higher today. During the same period, a particularly notable trend in the marriage market is the significant delay in marriage. Younger generations of both men and women are opting to remain single for longer periods in their twenties, and the divorce rate experienced a substantial increase during the 1970s and 1980s, persisting at a high level ever since.

The transformations in labor and marriage markets are intricately interconnected. Changes in wage structures and individuals' choices regarding marriage and education are mutually influential. In this paper, we delve into certain exogenous changes in the wage structure and understand how they set in motion the trends in labor and marriage market outcomes.

First, we investigate the effects of shifters in the relative demand for highly educated workers and female workers, which in turn lead to changes in the relative prices of these specific types of labor over time. As the firms value the high education workers and female workers more, this immediately results in higher rates of college attendance and female labor participation. Consequently, this shift affects marriage matching outcomes by altering the relative appeal of marriage versus being single, as the wage structures and the population's educational composition evolve. In turn, the evolving perspectives in the marriage market enhance the perceived value of pursuing higher education. The second exogenous shifter of interest that changes wage structure is the idiosyncratic working efficiency volatility. When the volatility increases, it increases the risk that an invidual is exposed to wage uncertainty. As a result, the relative value of marriage as an insurace device increases, and vice versa.

Another significant exogenous driving factor that cannot be overlooked in the United States is the reform of divorce laws. Traditionally, the U.S. operated under a mutual consent divorce regime, which required both parties to agree to the divorce. However, this shifted to a unilateral divorce regime in the 1960s and 1970s, with the majority of states implementing this change before the year 2000. This reform, which is regarded unexpected by the agents, led to a surge in the divorce rate, seen as a result of the release from unhappy marriages where one spouse had previously held the other in a marriage they wished to exit. However, even for the more recent generations born into an era of unilateral divorce laws, marriages formed during this period still experience a higher rate of dissolution.

To dismysify the convolutions of the endogenous labor and marriage market outcomes, we build a model to quantitatively assess

steady state comparison

single transition

connected transition path

decomposition

The rest of the paper is organized as follows. Section 2 describes the data source and discusses the stylized data patterns that motivate this paper. Section 3 discusses the model details and formalize the connected equilibrium transition paths that we will take to the data. Section 4 discusses the estimation details. Section 5 shows the fitting of the model, and conducts the decomposition analysis. Section 6 concludes.

2 Data

This section describes the data sources and the stylized patterns to be explained using the structural model. We mainly rely on the Current Population Survey (CPS) March files (1968-2018) which provides informative transitional dynamics in the past five decades over a set of family outcomes of interest. Our sample comprises both married and single households whose ages are between 20 and 59 years old.

2.1 Wage Structure

Figure

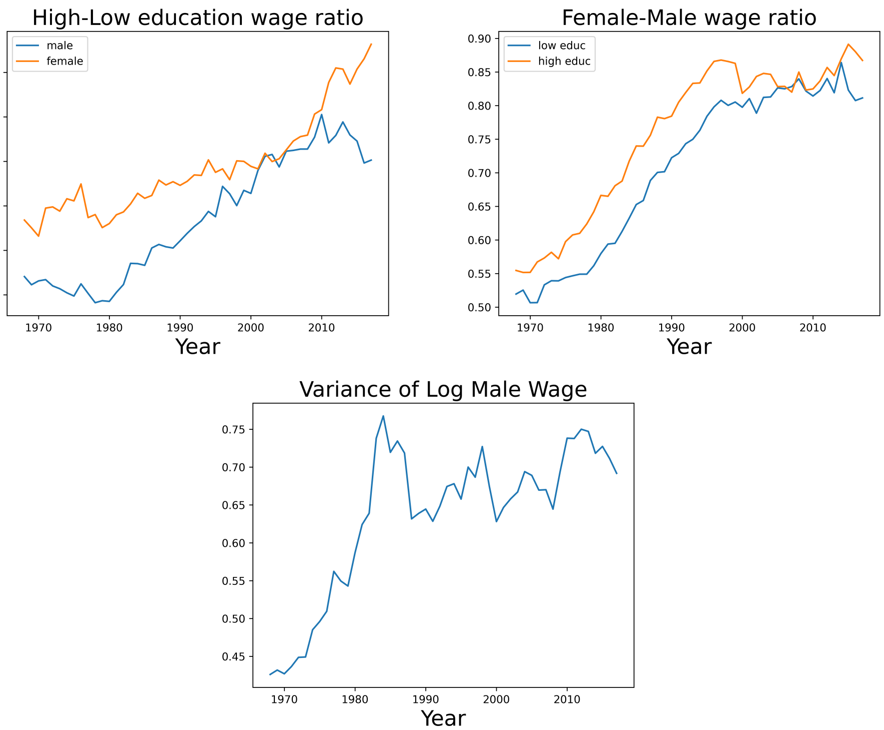

Figure 1: Wage structure: Cross-sectional wage structure time series. Source: CPS 1968-2018. Sample: Pooled single and marrid households. The high education is defined to be some college and above.

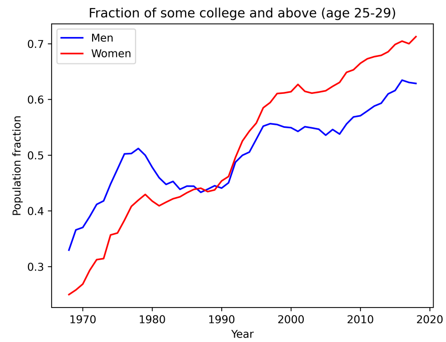

Figure 2: Education: Population fraction of high education over time. Source: CPS 1968-2018. Sample: Pooled single and marrid individuals with age between 25 and 29. The high education is defined to be some college and above.

2.2 Education

2.3 Marriage

2.4 Female Labor Supply

2.5 Divorce

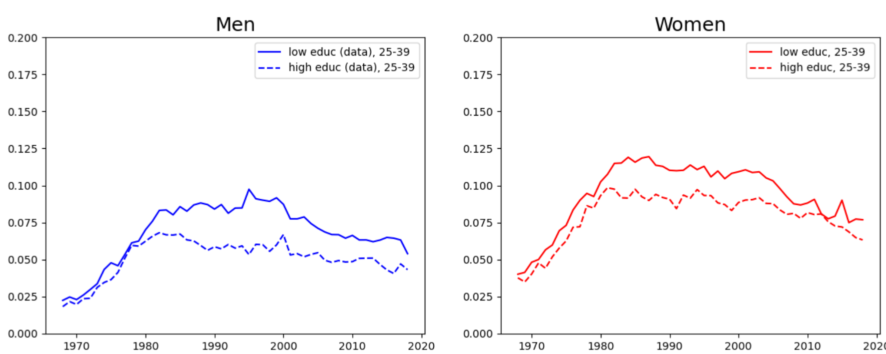

Figure 6: Divorce: Divorcee ratios over time. Source: CPS 1968-2018. Sample: Pooled single and marrid households. The high education is defined to be some college and above.

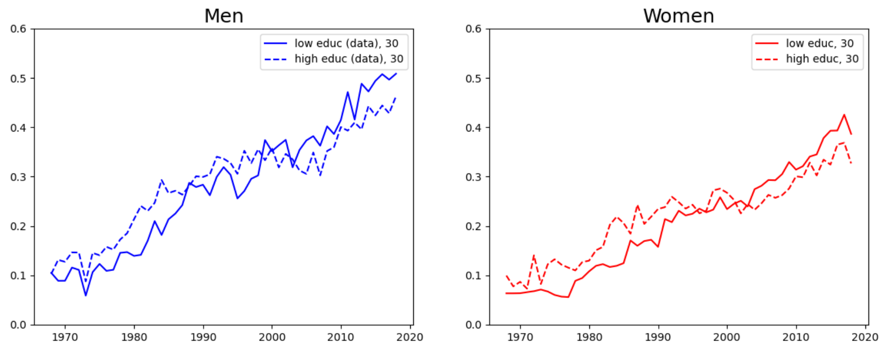

Figure 3: Never married ratio: Never married ratios over time. Source: CPS 1968-2018. Sample: Pooled single and marrid households. The high education is defined to be some college and above.

3 Model

We construct a life cycle model with a limited-size endogenous marriage market and endogenous search behavior. Periods are divided by age. We assume people enter the marriage market at age 18 and leave at age 50. People die at age 70. In the following, we present more details about the model with two separate stages.

In the first stage from age 18 to 50, singles search in the marriage market. At the beginning of each period, singles meet one potential partner with meeting probabilities determined by the search efforts and the availability of singles measured by effective market size. The probability of each meeting pair is determined by the search behaviors and the distribution of singles. Upon one meeting, a match-specific utility is realized and people decide whether to marry or not after observing the match quality. For couples, the match quality will be updated at the beginning of each period irregularly, and they give birth with an exogenous fertility rate. After the realizations of match quality and fertility shocks, they decide whether to continue the marriage or not. We consider unilateral divorce in our model, which means that divorce can be triggered as long as one spouse prefers being single. The population distribution by marital status and ability at each age will be the result of individuals' optimal search, marriage, and divorce decisions last period, and it will evolve gradually over time. On the other hand, people have rational expectations and

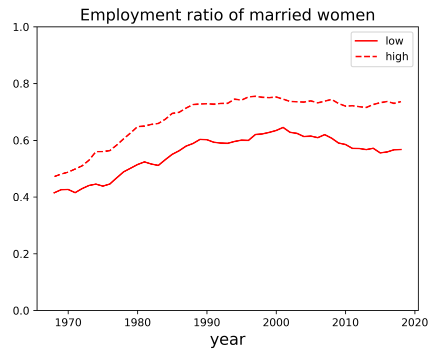

Figure 4: Married women employment: Employment ratio of married women over time. Source: CPS 1968-2018. Sample: Marrid households. The high education is defined to be some college and above.

make optimal marriage and divorce decisions based on their expectations of the population distribution of available singles in the future. In the equilibrium, the optimal marriage and divorce decisions, as well as the search efforts, are determined along with the population distribution in the marriage market endogenously. The tradeoff between labor and marriage markets is mostly concerned. The wage growth rates are dependent on the working hours and there is an i.i.d. wage shock across periods. Singles need to find the optimal time allocation among labor and marriage markets to maximize the total expected values.

The second stage is from age 51 to 70 when individuals all quit search and marriages become stable. In other words, we assume that there are neither new marriages nor divorces during the second stage, and match qualities stay constant. Both singles and married couples make optimal time allocation decisions to maximize the utilities from consumption and leisure. This stage is mainly used for computing the continuation values for the last period of the first stage.

3.1 Enviornment

Time is discrete and denoted by t, representing each calendar year. Denote j as individual's age, each agents live from $j = 1$ to J[1]. We do not model mortality risk, and each individual dies at J with certainty. Gender is denoted as $g \in \{m, f\}$. Denote Ω_{mt} as the

[1] We set $J = 50$. Therefore, j from 1 to 50 corresponds to age 20 to 70.

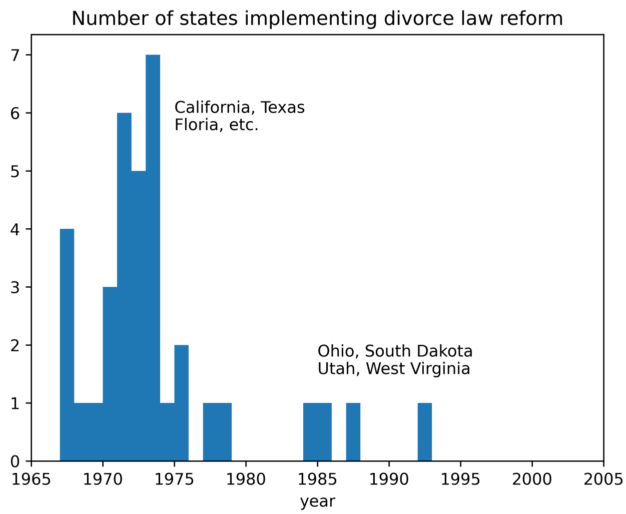

Figure 5: Timing of divorce regime change

vector of states for a single male at time t,

$$\Omega_{mt} = \left\{j_m, e_m, a_{mt}, \eta_{mt}\right\},$$

where $e_m \in \{l, h\}$ indicates the education level[2], and a_{mt} is current saving[3]. Note that the education level e_m is time-invariant once it's chosen by the individual at the first period of life cycle. The last state variable η_{mt} is the persistent individual-specific efficiency level that determines one's labor productivity and consequently the wage income. Conditional on the same age and education background, the higher η_{mt} is, the higher wage income is.

Similarly, we denote the state vector for a single female as Ω_{ft},

$$\Omega_{ft} = \left\{j_f, e_f, a_{ft}, \eta_{ft}, n_{ft}\right\},$$

which has one more state variable n_{ft} compared to the one of single male. $n_{ft} \in \{0, 1\}$ indicates whether there is a child in the household. By excluding this state variable in

[2]Education level is divided into two groups, low education versus high education, depending on whether the individual attended some college or not.

[3]Let's set the timing such that a_{mt} is the saving level at the beginning of time period t.

Ω_{mt}, we assume that there are no single fathers in the economy, as single fathers account for a relatively small fraction of population. [4]

For a married household, the state vector $\bar{\Omega}_t$ is simply combining the states of the husband and the wife,

$$\bar{\Omega}_t = \{j_m, j_f, e_m, e_f, a_t, \eta_{mt}, \eta_{ft}, n_t, \theta_t\},$$

with one additional state variable θ_t capturing the match quality for each couple at time t, and it evolves over time as a random walk process. Notably, in this paper we allow marriage age gaps $j_m - j_f$ to be nonzero, which makes the model more realistic at a computational cost.

The state variables of a married couple consist of state variables of spouses i and j, the match quality $q_{i,j,t}$, and the indicator of child living in the intact family $intact_{i,j,t}$,

$$\Omega_{i,j,t} = \{w_{i,t}, e_i, k_{i,t}, w_{j,t}, e_j, k_{j,t}, q_{i,j,t}, intact_{i,j,t}\}.$$

The density functions of the distribution for singles and marrieds at time t are denoted by $ns_t(\Omega_{gt})$ and $nm_t(\bar{\Omega}_t)$.

3.2 Preference

At time t, the flow utility for each individual consists of both the economic part and the noneconomic part. Given a particular consumption level c_t, the utility from consumption is assumed to take CRRA functional form and σ captures the level of risk aversion. We use a constant ψ_h for both male and female workers to denote the disutility from working, independent of the working hours. The additional disutility from working ψ_n enters the flow utility if there are children present in a household and the mother is working.

Given this, the (dis)utility from consumption and working for a male single with states Ω_{mt} at time t is

$$u^{S,m}(c_t;\Omega_{mt}) = \frac{c_t^{1-\sigma}}{1-\sigma} - \psi_h,$$

[4] Population of single fathers...

and the counterpart (dis)utility for a female worker with states Ω_{ft} is given by

$$u^{S,f}\left(c_t;\Omega_{ft}\right)=\frac{\left(c_t\cdot E^s\left(n_{ft}\right)\right)^{1-\sigma}}{1-\sigma}-\psi_h-\psi_n I\left(n_{ft}>0\right),$$

where $I\left(n_{ft}>0\right)$ is the indicator function, and equals one if there are children in the household[5]. We adjust the consumption level for the single female depending on whether there are children in the household, and use $E^s\left(n_{ft}\right)$ as the equivalence scale function.[6]

Similarly, the (dis)utility from consumption and working for each spouse in a married household is given by

$$u^{M,m}\left(c_t,h_t;\bar{\Omega}_t\right)=\frac{\left(c_t\cdot E^m\left(n_t\right)\right)^{1-\sigma}}{1-\sigma}-\psi_h-I\left(n_t>0\right)\psi_n h_t,$$

$$u^{M,f}\left(c_t,h_t;\bar{\Omega}_t\right)=\frac{\left(c_t\cdot E^m\left(n_t\right)\right)^{1-\sigma}}{1-\sigma}-\left(\psi_h+I\left(n_t>0\right)\psi_n\right)h_t,$$

where $E^m\left(n_t\right)$ is the equivalence scale function with two adults in the household, in contrast to $E^s\left(n_{ft}\right)$ which only considers one single mother. Note that the disutility ψ_n enter both $u^{M,m}$ and $u^{M,f}$ when the mother is working. Unlike single mothers, whether the wife goes to work or not $h_t=0,1$ is a joint decision by the husband and the wife, and therefore ψ_n is multiplied by h_t.

There are three additional noneconomic parts that enter the flow utility additively for married spouses, which are the match quality θ_t, the tastes for wife's working decision $\boldsymbol{\varepsilon}_t^h$, and the one-time penalty if the spouses are experiencing divorce at time t. The initial match quality for a newly met pair is randomly drawn from the distribution $N\left(\mu^\theta,\lambda^\theta\right)$, and the match quality gets updated each period following a random walk process,

$$\theta_{t+1}=\theta_t+\varepsilon_t^\theta,$$

$$\varepsilon_t^\theta\sim N\left(0,\lambda^{\varepsilon,\theta}\right).$$

The taste shocks $\boldsymbol{\varepsilon}_t^h=\left[\varepsilon_t^0,\varepsilon_t^1\right]'\sim G^{\varepsilon,h}$ follow Type I Extreme Value distribution and are

[5] In this paper, we assume singles are always working, so that we don't need a indicator function of working status for the single mothers in the utility function

[6] We use the OECD equivalence scale...

i.i.d. across couples and over time t. The term $\varepsilon_t^0 \cdot (1-h_t) + \varepsilon_t^1 \cdot h_t$ enters the flow utility additively given the joint decision of female labor supply decision h_t.

The disutility ζ enters the flow utility if a couple jointly decides to divorce at the beginning of each time period t. ζ does not vary across couples or over time.

3.3 Wage Process

Wage process is taken given by the agents, and it plays an important role in determining individual's educational and marrital decisions. The annual wage wage for an individual of age j, gender g, and education level e at time t is given by

$$w_t^{g,e} = p_t^{g,e} \times \exp\left[L(j) + \eta_t\right].$$

The annual wage $w_t^{g,e}$ is a product of two parts, where the second term $\exp\left[L(j) + \eta_t\right]$ is the individual-specific working efficiency units of labor type (g, e) at time t, and the first term $p_t^{g,e}$ is the price per efficiency unit of each specific labor type. The individual-specific working efficiency units takes exponential functional form, where $L(j)$ is a deterministic function of age that captures the wage profile over age, and η_t enters additively such that individuals with higher working efficiency η_t earns more wage income. When newborns enter the economy at time t, they draw their initial η_t from a stationary distribution $N(\mu^\eta, \lambda^\eta)$, and η_t evolves over time following an AR(1) process,

$$\eta_t = \rho\eta_{t-1} + \omega_t,$$

$$\omega_t \sim N\left(0, \lambda_t^\omega\right).$$

Here the λ_t^ω is one of the three important wage structure parameters of interest. It captures the individual wage volatility, and a sequence of $\{\lambda_t^\omega\}_{t=t_0}^\infty$ depicts how individual wage volatility changes over time starting from t_0. When λ_t^ω increases over time, the individuals face a higher risk from wage volatility.

The price $p_t^{g,e}$ equals the marginal productivity of efficiency unit from labor type of gender g and education background e. We model a representative firm in the economy that maximize profits, with a production function

$$Y_t = Z_t K_t^{\alpha} H_t^{1-\alpha},$$

where K_t and H_t are the aggregate capital and labor inputs respectively, and α is the capital's share of output. Z_t is a time-varying scaling factor.

Following Katz and Murphy (1992), Heckman, Lochner, and Taber (1998), and Heathcote, Storesletten, and Violante (2010), we model the aggregate labor H_t as a constant elasticity of substitution aggregator of four types of labor input,

$$\begin{aligned} H_t = \Big[& \lambda_t^E \left(\left(1-\lambda_t^E\right) H_t^{m,h} + \lambda_t^G H_t^{f,h} \right)^{\frac{\theta-1}{\theta}} \\ & + \left(1-\lambda_t^E\right) \left(\left(1-\lambda_t^G\right) H_t^{m,l} + \lambda_t^G H_t^{f,l} \right)^{\frac{\theta-1}{\theta}} \Big]^{\frac{\theta}{\theta-1}}, \end{aligned}$$

where $H_t^{g,e}$ are the aggregate inputs from specific types of labor given the gender g and education e. Under this specification, the labor supply from female and male workers with same educational background are perfect substitutes, while the elasticity of substitution between the two educational groups is θ, which is constant over time. The two important wage structure parameters λ_t^E and λ_t^G, which can also be interpreted as demand shifters, capture the extent about how the production side demands for highly educated workers and for female workers relatively.

3.4 Life Cycle

Given the preferences and the wage process, each single or married individual chooses their optimal educational, marital, and consumption decisions over the life cycle, and the married households make wife's labor supply decisions jointly.

At the beginning of each time period t, a new generation of age $j = 1$ is born to the economy with equal population sizes for males and females. The newborns all enter the economy as singles, and they randomly draw their initial individual-specific working efficiency levels $\eta_{gt} \sim N\left(\mu^{\eta}, \lambda^{\eta}\right)$ and initial savings $a_{gt} \sim lnN\left(\mu^{a,s}, \lambda^{a,s}\right)$.[7] Upon observ-

[7]The distribution of initial savings are assumed to be state-specific, in order to capture the difference in

ing their drawn states (η_{gt}, a_{gt}), each individual chooses their optimal decisions about whether to attend college or not, $e_g = 1, 0$, by forming rational expectation and comparing their lifetime values with high education versus low education. The educational decisions of the newborns are made at the beginning of each time period t.

Starting from age $j = 1$ to J, individuals make marital, wife's labor supply decision, consumption and saving decisions in order within each period. Within each time period t, we divide decision making into two substages. In the first substage, individuals update their marital status. Singles search in the marriage market and randomly meet potential partners. Upon each meeting, the two parties observe states of each other, Ω_{mt} and Ω_{ft}, and randomly draw the initial match quality θ_t. With both parties being better off with the marriage, a new married household will be formed with mutual consent, $m_t = 1$, and otherwise they will stay single and search again next period. Note that we consider an endogenous frictional marriage market, such that both the probability of meeting someone at time t, $\delta(M_t)$, as well as the conditional probability of a particular meeting pair, $\gamma_t(\Omega_{mt}, \Omega_{ft})$, will be dependent on the current population distribution of available singles at time t. We will discuss the meeting technology in detail in section 3.9.

On the other hand, couples will make divorce decisions during the first substage of time t. The divorce will be either triggered by shocks to the individuals specific efficiency η_{gt} that change the wage income composition within a household, or a negative shock to the match quality that makes marriage no longer attractive. Note that we model the divorce decision closely following the divorce law in each state. Recall that the divorce law reform timing of state s is denoted by $t_{1,s}$. Before $t_{1,s}$, a married household will dissolve $d_t = 1$ under the mutual consent divorce regime only if both parties prefer to returning single, even though they must take one-time divorce penalty ζ. However, after the divorce law reform, a divorce will happen as long as one party is better off returning single. We do not distinguish divorcees from never married individuals, so that spouses choosing to divorce will return and search again in the marriage market just as never married singles.

After marital status is updated, individuals enter the second substage of decision marking. Singles will supply one unit of labor inelastistically, and choose their optimal consumption c_{gt} and saving a_{gt+1} given their budget constraint. Couples will first draw a

wealth distributions among states.

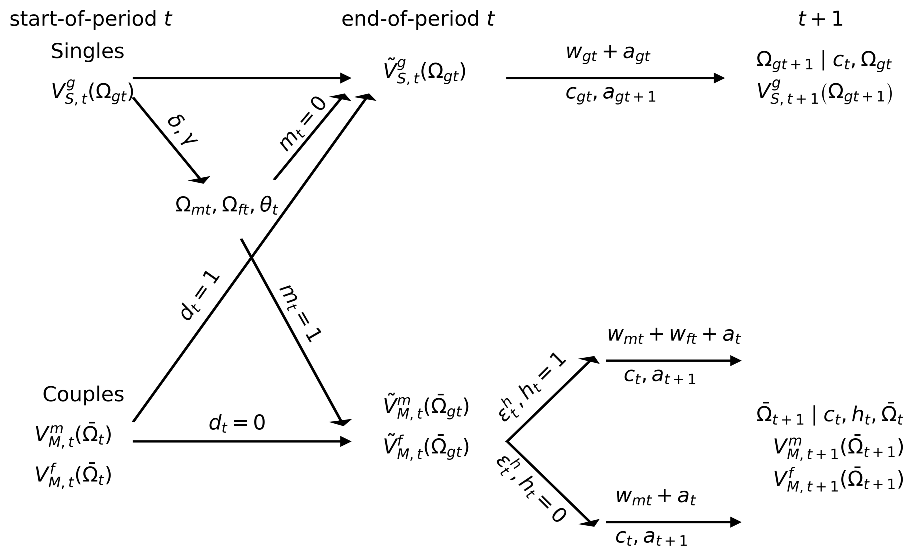

Figure 7: Decision substages within t

random vector of their tastes for wife's labor supply decision $\boldsymbol{\varepsilon}^h_t$, and choose optimal female labor supply decision h_t, consumption c_t, and saving a_{t+1} all jointly by maximizing the total household values which is weighted by the intra-household bargaining power ρ, subject to the budget constraint which depends on whether the wife works or not. Given the optimal decisions, states will be updated across periods, including the individual labor efficiency η_{gt} and the match quality θ_t as we described in the previous sections. Both single and married women will give a new birth following exogenous fertility processes, $\Pr\left(n_{ft}=1 \mid n_{ft}=0, \Omega_{ft}\right)$ and $\Pr\left(n_t = 1 \mid n_t = 0, \bar{\Omega}_t\right)$, that will be directly estimated from data.

To formalize the decision making problems, we denote in total value functions and characterize the Bellman equations. We let $V^m_{S,t}\left(\Omega_{gt}\right)$, $V^f_{S,t}\left(\Omega_{gt}\right)$, $V^m_{M,t}\left(\bar{\Omega}_t\right)$, $V^f_{M,t}\left(\bar{\Omega}_t\right)$ to be the *start-of-period* value functions, and $\tilde{V}^m_{S,t}\left(\Omega_{gt}\right), \tilde{V}^f_{S,t}\left(\Omega_{gt}\right), \tilde{V}^m_{M,t}\left(\bar{\Omega}_t\right), \tilde{V}^f_{M,t}\left(\bar{\Omega}_t\right)$ to be the *end-of-period* value functions for each time period t. We will discuss the Bellman equations in detail and show how these value functions are interrelated in sections 3.5 and 3.6.

Figure 7 demonstrates the two substages of decision marking within each time period t.

All agents die at age J, and the terminal value is dependent on the marital status and the bequests,

$$V_{S,t}^{g}\left(\Omega_{gt}\right)=\phi_{S,1}\left(1+\frac{a_{gt}}{\phi_{S,2}}\right)^{1-\sigma}$$

$$V_{M,t}^{g}\left(\bar{\Omega}_{t}\right)=\phi_{M,0}+\phi_{M,1}\left(1+\frac{\frac{1}{2}a_{gt}}{\phi_{M,2}}\right)^{1-\sigma}$$

3.5 Problem of Singles

At each time t, the *start-of-period* value function $V_{S,t}^{g}\left(\Omega_{gt}\right)$ for a single agent of gender g and with state vector Ω_{gt} is characterized by

$$\begin{aligned}V_{S,t}^{g}\left(\Omega_{gt}\right)=&\delta\left(M_{t}\right)\times E_{t}\left[m_{t}\left(\bar{\Omega}_{t}\right)\tilde{V}_{M,t}^{g}\left(\bar{\Omega}_{t}\right)+\left(1-m_{t}\left(\bar{\Omega}_{t}\right)\right)\tilde{V}_{S,t}^{g}\left(\Omega_{gt}\right)\right]\\&+\left(1-\delta\left(M_{t}\right)\right)\tilde{V}_{S,t}^{g}\left(\Omega_{gt}\right)\end{aligned}$$

which takes into account the marriage market perspectives. The marriage market search is frictional, and $\delta\left(M_{t}\right)$ denotes the probability of meeting a potential partner of the opposite gender, where M_t is the population measure of the available singles at time t and $\delta\left(M_{t}\right)$ is increasing return to scale. Conditional on a successful meeting with probability $\delta\left(M_{t}\right)$, the meeting pair distribution is governed by $\gamma_{t}\left(\Omega_{mt},\Omega_{ft}\right)$, which is dependent on the whole population distribution of singles, as we will discuss in more detail in section 3.9. The first term takes expectation over all the possible meeting pairs, such that

$$\begin{aligned}&E_{t}\left[m_{t}\left(\bar{\Omega}_{t}\right)\tilde{V}_{M,t}^{g}\left(\bar{\Omega}_{t}\right)+\left(1-m_{t}\left(\bar{\Omega}_{t}\right)\right)\tilde{V}_{S,t}^{g}\left(\Omega_{gt}\right)\right.\\=&\int_{\Omega_{g't}}\int_{\theta_{t}}\left[m_{t}\tilde{V}_{M,t}^{g}+\left(1-m_{t}\right)\tilde{V}_{S,t}^{g}\right]f\left(\theta_{t}\right)\gamma_{t}\left(\Omega_{mt},\Omega_{ft}\right)d\theta_{t}d\Omega_{g't},\end{aligned}$$

where $\tilde{V}_{M,t}^{g}$ and $\tilde{V}_{S,t}^{g}$ are the *end-of-period* value functions, and $m_{t}\left(\bar{\Omega}_{t}\right)$ is the indicator function of a successful marriage for the meeting pair with combined states $\bar{\Omega}_{t}$. We always assume that marriage requires mutual consent, so that

$$m_{t}\left(\bar{\Omega}_{t}\right)=1\text{ iff }\tilde{V}_{M,t}^{g}\left(\bar{\Omega}_{t}\right)>\tilde{V}_{S,t}^{g}\left(\Omega_{gt}\right)\text{ for }g=m,f.$$

Intuitively, the newly met two parties compare their *end-of-period* value functions of agreeing on a marriage versus staying single in the second substage of time period t, and choose to form a married household only if both parties are better off with the new marriage. The *end-of-period* value function for a married spouse $\tilde{V}^{g}_{M,t}\left(\bar{\Omega}_t\right)$ will be discussed in section 3.6. If a newly met pair fails to transform into marriage, the two individuals will stay single and make optimal consumption and saving decisions in the second substage. For each individual of gender g with states Ω_{gt}, the *end-of-period* value function $\tilde{V}^{g}_{S,t}\left(\Omega_{gt}\right)$ is given by

$$\tilde{V}^{g}_{S,t}\left(\Omega_{gt}\right) = \max_{c_t, a_{t+1}} u^{S,g}\left(c_t; \Omega_{gt}\right) + \beta E_t\left[V^{g}_{S,t+1}\left(\Omega_{gt+1}\right) \mid c_t, \Omega_{gt}\right], \tag{1}$$

subject to

$$c_t + \frac{a_{t+1}}{1 + r_{t+1}} = a_t + w^{g,e}_t.$$
$$a_{t+1} \geq \underline{a}, \quad c_t \geq \underline{c}$$

3.6 Problem of Couples

Married households will decide whether to divorce or not at the beginning of each period t, particularly by observing their new individual specific labor efficiency units η_{mt}, η_{ft}, and the match quality θ_t updated from last period. If they choose to go through a divorce, both spouses will receive one-time penalty ζ of divorce. The *start-of-period* value function $V^{g}_{M,t}\left(\bar{\Omega}_t\right)$ for each spouse g in the household characterized by $\bar{\Omega}_t$ is therefore

$$V^{g}_{M,t}\left(\bar{\Omega}_t\right) = \begin{cases} \tilde{V}^{g}_{M,t}\left(\bar{\Omega}_t\right) & \text{if } d_t\left(\bar{\Omega}_t\right) = 0 \\ \tilde{V}^{g}_{S,t}\left(\Omega_{gt}\right) - \zeta & \text{if } d_t\left(\bar{\Omega}_t\right) = 1 \end{cases}$$

where $d_t\left(\bar{\Omega}_t\right)$ is the indicator function of divorce. Unlike marriage decisions which always require mutual consent, we model the interesting transition from mutual consent divorce regime to unilater divorce regime in the U.S., which happens at time $t_{1,s}$ that varies among states. We make divorce a joint decision when $t < t_{1,s}$, and a divorce will happen if and only if for both spouses, the value of returning single in the second substage $\tilde{V}^{g}_{S,t}\left(\Omega_{gt}\right)$ exceeds the value of staying married $\tilde{V}^g_{M,t}\left(\bar{\Omega}_t\right)$ by ζ,

$$d_t\left(\bar{\Omega}_t\right) = 1 \text{ if } \tilde{V}^g_{M,t}\left(\bar{\Omega}_t\right) < \tilde{V}^g_{S,t}\left(\Omega_{gt}\right) - \zeta \quad \forall g \in \{m, f\}.$$

And when $t \geq t_{1,s}$, agents under the unilateral divorce regime can make divorce happen as long as one spouse prefers it,

$$d_t\left(\bar{\Omega}_t\right) = 1 \text{ if } \tilde{V}^g_{M,t}\left(\bar{\Omega}_t\right) < \tilde{V}^g_{S,t}\left(\Omega_{gt}\right) - \zeta \quad \exists g \in \{m, f\}.$$

As we discussed in the previous section, the *end-of-period* value function of being single is characterized by solving the optimal consumption and saving problem. Similarly, the *end-of-period* value function of staying married also maximizes over consumption, but the spouses are choosing one additional choice, which is whether the wife goes to work or not h_t.

To understand how the married couples choose optimal c^*_t and h^*_t, let's first denote $\tilde{V}^g_{M,t}\left(c_t, h_t; \bar{\Omega}_t, \boldsymbol{\varepsilon}^h_t\right)$ as the *end-of-period choice-specific* value function for a particular spouse g, given the arbitrarily chosen c_t, h_t, conditional on the states $\bar{\Omega}_t$ and the realized taste shocks for female labor supply decision $\boldsymbol{\varepsilon}^h_t$,

$$\begin{aligned}\tilde{V}^g_{M,t}\left(c_t, h_t; \bar{\Omega}_t, \boldsymbol{\varepsilon}^h_t\right) = & u^{M,g}\left(c_t, h_t; \bar{\Omega}_t\right) + \theta_t \\ & + \varepsilon^0_t\left(1 - h_t\right) + \varepsilon^1_t h_t \\ & + \beta E_t\left[V^g_{M,t}\left(\bar{\Omega}_{t+1}\right) \mid c_t, h_t, \bar{\Omega}_t\right].\end{aligned}$$

We model the intrahousehold bargaining, and assume that the spouses jointly choose the optimal c^*_t and h^*_t to maximize the sum of household values $\tilde{V}_{M,t}\left(\bar{\Omega}_t, \boldsymbol{\varepsilon}^h_t\right)$ which is weighted by a constant bargaining power for the husband, ρ,

$$\tilde{V}_{M,t}\left(\bar{\Omega}_t, \boldsymbol{\varepsilon}^h_t\right) = \max_{c_t, a_{t+1}, h_t} \rho \tilde{V}^m_{M,t}\left(c_t, h_t; \bar{\Omega}_t, \boldsymbol{\varepsilon}^h_t\right) + \left(1 - \rho\right) \tilde{V}^f_{M,t}\left(c_t, h_t; \bar{\Omega}_t, \boldsymbol{\varepsilon}^h_t\right), \tag{2}$$

subject to

$$c_t + \frac{a_{t+1}}{1 + r_{t+1}} = a_t + w^{m,e}_t + w^{f,e}_t h_t,$$

$$a_{t+1} \geq \underline{a}, \quad c_t \geq \underline{c}.$$

The optimal consumption $c_t^*\left(\bar{\Omega}_t,\boldsymbol{\varepsilon}_t^h\right)$, saving $a_{t+1}^*\left(\bar{\Omega}_t,\boldsymbol{\varepsilon}_t^h\right)$, and wife's labor supply decisions $h_t^*\left(\bar{\Omega}_t,\boldsymbol{\varepsilon}_t^h\right)$ are functions of $\left(\bar{\Omega}_t,\boldsymbol{\varepsilon}_t^h\right)$ and are chosen to maximize $\tilde{V}_{M,t}\left(\bar{\Omega}_t,\boldsymbol{\varepsilon}_t^h\right)$. By substituting the optimal choice functions back into the *end-of-period choice-specific* value functions, we obtain the $\boldsymbol{\varepsilon}_t^h$*-specific end-of-period* value function for each spouse g, $\tilde{V}_{M,t}^g\left(c_t^*\left(\bar{\Omega}_t,\varepsilon_t\right),h_t^*\left(\bar{\Omega}_t,\varepsilon\right.\right.$ and the *end-of-period* value function $\tilde{V^g}_{M,t}\left(\bar{\Omega}_t\right)$ is implied by taking expectation over $\boldsymbol{\varepsilon}_t^h$,

$$\tilde{V}_{M,t}^g\left(\bar{\Omega}_t\right)=E_\varepsilon\left[\tilde{V}_{M,t}^g\left(c_t^*\left(\bar{\Omega}_t,\varepsilon_t\right),h_t^*\left(\bar{\Omega}_t,\varepsilon_t\right);\bar{\Omega}_t,\varepsilon_t\right)\right].$$

3.7 Education

Educational choices are made by each generations at age $j=1$. When the newborns enter the economy as singles and observe their intial states η_{gt} and a_{gt}, they form rational expectations about their lifetime values of attending college versus not, $V_{S,t}^g\left(j=1,e_g=h,a_{gt},\eta_{gt}\right)$ and $V_{S,t}^g\left(j=1,e_g=l,a_{gt},\eta_{gt}\right)$. Each individual also draw their utility cost of attending college randomly, $\kappa^g\sim N\left(\mu^{\kappa,g},\lambda^{\kappa,g}\right)$. An individual will choose to go to college if and only if the benefit exceeds the cost,

$$V_{S,t}^g\left(j=1,e_g=h,a_{gt},\eta_{gt}\right)-V_{S,t}^g\left(j=1,e_g=l,a_{gt},\eta_{gt}\right)\geq\kappa^g. \tag{3}$$

3.8 Population Dynamics

The population evolution of singles $ns_t^g\left(\Omega_{gt}\right)$ is implied by the optimal educational and marital decisions by each cohort at each time t. First, the fraction of newborns that choose to attend college at each time t is given by equation 3. For example, conditional on $\left(\eta_t,a_t\right)$, the population fraction of high education newborns is

$$\Phi\left(\frac{\kappa^g-\left(V_{S,t}^g\left(j=1,e_g=h,a_{gt},\eta_{gt}\right)-V_{S,t}^g\left(j=1,e_g=l,a_{gt},\eta_{gt}\right)\right)-\mu^{\kappa,g}}{\left(\lambda^{\kappa,g}\right)^{1/2}}\right),$$

where Φ is the CDF of the standard normal distribution.

In each period, there will be outflows of single population, which are the successful new marriages and deaths of singles at age J. There will also be inflows, which are the divorcees and widowed men or women whose spouses turn J.

The population of married individuals $nm_t\left(\bar{\Omega}_t\right)$ will be considered reversely. In each period, there will be inflows of newly married couples, and outflows of divorcees and families experiencing loss of one or both spouses.

We do not model either population growth nor mortality risk, so that the population sizes of cohorts will be constant, and normalized to be 1.

3.9 Marriage Market

We assume the probability of meeting a potential partner at time t takes the following IRS functional form

$$\delta\left(M_t\right) = \alpha_0 + \alpha_1 M_t + \alpha_2 M_t^2, \tag{4}$$

which sastisfies the conditions

$$\frac{\partial \delta\left(M_t\right)}{\partial M_t} > 0, \quad \frac{\partial^2 \delta\left(M_t\right)}{\partial M_t^2} > 0,$$

and M_t is the effective marriage market size, measured by the population size of available singles remaining in the market,

$$M_t = \sum_{g=m,f} \int_{\Omega_{gt}} ns_t\left(\Omega_{gt}\right) d\Omega_{gt}.$$

Conditional on a successful meeting with probability $\delta\left(M_t\right)$, the probability for a meeting pair $\left(\Omega_{mt}, \Omega_{ft}\right)$ is given by

$$\gamma_t\left(\Omega_{mt}, \Omega_{ft}\right) = \varphi^{ee'} \phi^{jj'} \frac{ns_t\left(\Omega_{mt}\right)}{\int_{\tilde{\Omega}_{ft}} ns_t\left(\tilde{\Omega}_{ft}\right) d\tilde{\Omega}_{ft}}, \tag{5}$$

where $\varphi^{ee'}$ and $\phi^{jj'}$ captures the level of homogamy in education and age.

3.10 Equilibrium

Given sequences $\lambda_t^E, \lambda_t^G, \lambda_t^\omega$ that govern the wage structure and the divorce regime, a *competitive equilibrium* is characterized by sequences of value functions $V_{S,t}^m$, $V_{S,t}^f$, $V_{M,t}^m$, $V_{M,t}^f$,

$\tilde{V}^m_{S,t}$, $\tilde{V}^f_{S,t}$, $\tilde{V}^m_{M,t}$, $\tilde{V}^f_{M,t}$, $\tilde{V}_{M,t}$; sequences of marital, female labor supply, consumption, educational choices m_t, d_t, h_t, $c^S_{m,t}$, $c^S_{f,t}$, c^M_t, $e_{m,t}$, $e_{f,t}$; prices $p^{g,e}_t$; population dynamics ns^m_t, ns^f_t, nm_t; marriage market meeting probabilities δ_t, γ_t, such that for all t, the following conditions hold:

1. The educational choices $e_{g,t}$ solves the individual problem (3).

2. The optimal marital decisions m_t, d_t and the *start-of-period* value functions $V^g_{S,t}$, $V^g_{M,t}$ are consistent. In particular, the divorce decision d_t is consistent with the divorce regime in each state at time t.

3. The optimal consumption decisions $c^S_{g,t}$ solve the individual optimization problem for singles (1). The optimal consumption and female labor supply decisions c^M_t and h_t maximizes the weighted sum of household values (2).

4. Capital and labor inputs are chosen optimally,

$$r = \alpha Z_t \left(\frac{H_t}{K_t}\right)^{1-\alpha}$$

$$p^{m,l}_t = \chi^l_t \left(1-\lambda^G_t\right)\left(1-\lambda^E_t\right), \quad p^{m,h}_t = \chi^h_t \left(1-\lambda^G_t\right)\lambda^E_t$$
$$p^{f,h}_t = \chi^h_t \lambda^G_t \lambda^E_t, \quad p^{f,l}_t = \chi^l_t \lambda^G_t \left(1-\lambda^E_t\right)$$

where

$$\chi^h_t \equiv (1-\alpha) Z_t K^\alpha_t H^{(1/\theta)-\alpha}_t \left[\lambda^G_t H^{f,e}_t + \left(1-\lambda^G_t\right) H^{m,e}_t\right]^{-1/\theta}.$$

5. The domestic labor market clears so that for each (g,e),

$$H^{g,e}_t = \int_{\Omega^g_t} I\left(e_g = e\right) ns^g_t \left(\Omega^g_t\right) d\Omega^g_t.$$

6. The domestic good market clears,

$$C_t + K_{t+1} = Z_t K^\alpha_t H^{1-\alpha}_t,$$

where C_t is the aggregate consumption.

7. The world asset market clears, such that

$$(A_{t+1} - K_{t+1}) - (A_t - K_t) = NX_t + r\,(A_t - K_t)\,,$$

   where A_t is the aggregate domestic wealth.

8. The population dynamics ns_t^m, ns_t^f, nm_t are consistent with the optimal marital and educational choices $m_t, d_t, e_{m,t}, e_{f,t}$.

9. The marriage market meeting probabilities δ_t, γ_t are consistent with population distributions of singles ns_t^m, ns_t^f at each time t.

3.11 Transition

4 Estimation

To answer the question about which exogenous factor is dominant in driving the evolutions of the labor and marriage market outcomes, we take the model to the data and match the time series of interest using the connected equilibrium transition paths. A part of the model parameters will be calibrated, and the rest of them will be estimated using the simulated method of moments, by targeting all the important moments that we discuss in section 2. In particular, we will solve distinct connected equilibrium transition paths for each state, as we allow both the timing of divorce law reform and the distribution of initial saving to differ among the states. We will then weight the outcomes by states using the population sizes, and match the national data moments.

4.1 Calibration

4.2 Matching the Moments

5 Results

6 Conclusion

7 Reference

Appendix