Unilateral Divorce and the Rise of Informal Cohabitation *

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Abstract

Does unilateral divorce eroded the gains of marriage with respect to cohabitation? Exploiting the staggered introduction of unilateral divorce across U.S. states, we show that newly formed relationships after the reform are more likely to be cohabitations instead of marriages, and that cohabitation spells last longer. To understand the mechanisms underlying the law changes, we build and estimate a structural life cycle model with partnership choice, where the gains from marriage with respect to cohabitation comes from a better cooperation within the household, enforced through a costly divorce, which acts as a commitment technology. Unilateral divorces increases the risk of separation, making cohabitation preferred to couples that would have had the highest risk of divorce. Since the couples switching relationship are on average better matched than the average cohabitants, the average length of cohabitations increases.

Keywords: Marriage, Cohabitation, Unilateral Divorce, Structural Estimation

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1 Introduction

Cohabitation is on the rise: according to Manning (2013) the share of women that ever cohabited moved from 33% in 1987 to 60% in 2010. Why did this happen? Since the seminal work of Becker (Becker (1981)), economists studied the incentives behind the decision to marry, among which the sharing of public goods, the division of labor to exploit comparative advantages (Chiappori (1997)), and risk sharing (Voena (2015) and Oikonomou and Siegel (2015)). These reasons tell us why couples live together, while they are actually silent about the choice between marriage and informal cohabitation, two partnership contracts subject to different rules. While the literature often simplifies, avoiding the distinction between these two, they display a different labor supply, wealth accumulation and educational composition. It is not surprising that households, the smallest economic unit, can behave differently when the contract ruling them is different, but it can be the key to understand important economic phenomena. For example, cohabitation display a much higher separation rate than marriages, which might be a cause of the high share of single mothers living in the US nowadays, which is the single strongest predictor for upward mobility[1] according to Chetty and Hendren (2018). If we want to understand the behavior of cohabiting households, we first need to understand their formation and why they are growing in number.

In this paper we address the question of the rise of cohabitation, focusing on the role of unilateral divorce on the share of people that decides to cohabit. Our main contribution is to show that the rate of cohabitation increased after the changes in US law and that the underlying mechanism is that the increased risk of divorce makes marriage less attractive. As a consequence, cohabitation becomes the preferred choice to couples that would have experienced the highest risk of divorce.

[1] While the share of single mothers is the strongest predictor of differences in upward mobility across counties on top of segregation, residential segregation, income inequality, social capital, school quality, and racial shares, Chetty and Hendren (2018) points out that half of this effect is due to self selection.

We first use data from the National Survey of Family and the Household and of the National Survey of Family Growth to build a sample of first and second relationships[2]. Then, exploiting the exogenous variation coming from the staggered introduction of unilateral divorce over time across US states, we show that cohabitation becomes around 5% more likely to be chosen as result of the reform. Interestingly, the effect is heterogeneous across property rights regimes within marriage, being insignificant in title based states and the strongest in community property states. This result suggest that cannot be entirely to a deterioration in its commitment technology[3]. Moreover, we analyze how unilateral divorced affected the length of newly formed cohabitation spells, showing that they last longer both because of a reduced risk of marriage and separation. To understand the mechanisms that lead to these changes we build a dynamic model of intra household decision making, where cohabitation and marriage differs in the cost of separation and divorce as well as in law governing property rights upon divorce, which can vary for marriage while it is always title based for cohabitation. Moreover, separation can be initiated unilaterally, as opposed to divorce, that would need the consensus of both partner under a mutual divorce regime. Individuals are initially single, and with some probability in each period they meet a potential partner, which they can decide to marry or start cohabiting with. Couples make decisions about consumption, savings and female labor supply and they are subject to idiosyncratic income shocks. We model the decision making in the couple building on the literature of limited commitment (see for example Kocherlakota (1996), Ligon et al. (2002), Marcet and Marimon (2019) and Pavoni et al. (2018)), which has been applied to dynamic collective models in the household by Voena (2015), Mazzocco (2007), Foerster (2019) and Lise and Yamada (2018) among others. Couples also receive time varying match quality shocks, which might drive the couple to change their partnership status (i.e. from cohabitation to

[2] A relationship is defined as an interruption of the state of singleness, which can either be marriage or cohabitation.

[3] This mechanism is highlighted by Lafortune and Low (2019), where the equal division of assets within marriage makes possible to efficiently invest in children even after the rise of unilateral divorce.

marriage) or to separate. When one member of the couple wishes to split, the bargaining powers are rebargained such that the binding member is made indifferent between separation and staying in a couple[4]. The gains of marriage with respect to cohabitation derive from a better risk sharing and a more efficient specialization in the production of a public good[5], which arise from a better commitment within the couple, enforced by the treat of a costly divorce, which acts as a commitment device. On the other hand, couples that would face a high risk of divorce if married (i.e. because of a low match quality draw) are more likely to choose cohabitation instead, since it implies a lower cost of separation while allowing to enjoy the gains from being in a couple. In the model, a switch from mutual consent to unilateral divorce causes couples to start cohabiting more, since the higher risk of divorce makes the expected value of marriage with respect to cohabitation lower. The effect would be particularly pronounced under community property division of assets upon divorce, since the richest part of the couple would risk to lose most of its wealth. This mechanism implies that couples that would have married under the old regime, are cohabiting instead. Since those have a higher match quality than the average cohabiting couples, this selection drives down the risk of separation for cohabiting couples, as observed in the data.

We then estimate the model using the simulated method of moments to learn about the size of our main mechanism. We use as targets an array of moments regarding the mating market and the differential female labor supply for cohabiting and married couples. We find that the model is able to reproduce the results from our empirical evidence, thus validating our mechanism. We then run a series of counterfactual experiments to gain intuition about forces that might have contributed to the rise of cohabitation in the last decades. [In particular, we quantify the role of shrinking the gender wage gap and technological progress in the household sector, which increases the opportunity cost of home production with female

[4] For particularly bad draws in the match quality or productivity shock this might not be possible and hence the couple would split.

[5] We assume that a public good is produced with money an female time. When females stop working for producing such good their potential productivity in the labor market decreases.

time and decreases the gains coming from labor market specialization.]

The contribution of this paper is threefold. First, we document and explain how divorce laws affected the choice between marriage and cohabitation. This adds to the existing literature that documented the effects of divorce laws on the rate of divorce (Friedberg (1998), Wolfers (2006)), female labor supply (Stevenson (2008), Voena (2015)), savings (Voena (2015)), assortative mating Reynoso (2019) and prostitution (Ciacci (2017)) among the others. As in Reynoso (2019), we study not only the effect of unilateral divorce on married couples, but also on sorting. While her focus is on who marries whom and concludes that unilateral divorced raised the share of singles, we abstract from modeling the mating market and we focus on partnership choice, which allow us to conclude that the rate of singleness declined less than previously thought, since some people that were believed not to be in a couple were actually cohabiting. Our paper build on Voena (2015), that studies how unilateral divorce interacted with property rights upon divorce affected household behavior of married couples. We extend her work both considering cohabitation as an alternative relationship and in analyzing the effects of these laws on sorting. Second, our paper expands the literature on cohabitation, showing how the risk of splitting and its interaction with divorce laws is essential for understanding partnership choices. Different papers in the literature highlighted various gains of marriage with respect cohabitation: commitment (Matouschek and Rasul (2008)), labor specialization within the couple Gemici and Laufer (2014), learning about match quality Brien et al. (2006), the interaction between the cost of divorce and learning Blasutto (2020) and investment in children Lafortune and Low (2019). A paper close to ours is Lafortune and Low (2019), who highlights the role of assets as a collateral that enforces commitment and hence allows for optimal investment in children. In their model, a switch from mutual consent to unilateral divorce causes people without wealth to start cohabiting because they are left without a commitment technology. While we think that their mechanism is important, it cannot be the whole story since we observe that the switch toward cohabitation was the weakest in title based state, while their model would predict the opposite. In this paper we will quantify how much of the shift is due to this mechanism versus the role of the increased risk of divorce. We extend the work of Gemici and Laufer (2014) and Blasutto (2020), who develop collective dynamic models with limited commitment, introducing saving decisions, which are shown to play an important for commitment and hence for partnership choice, especially when interacted with property rights upon divorce.

Third, our paper speaks to the literature studying changes of the family in the last decades. Recent works have investigated various channels through which the structure of families might have changed over time. **?** show the role of improved maternal health on the rise of female labor force participation, Greenwood et al. (2016) instead study the role that technology and the wage structure played in the rise in assortative mating, female labor force participation, the share of divorced and the increase in married people. Our paper extends this work, studying the effect of wage structure, gender wage gap and changes in the home production technology on the rise of cohabitation. Through a series of counterfactual experiments we are able to inspected which were the main forces behind the rise in cohabitation. Intuitively, as wages grow and the price of home appliances decreases, household can buy on the the market goods that were once produced at home. Since one of the gain of marriage with respect to cohabitation lies in the better specialization of production within the household, we might expect that those forces imply a reduction in the share of couples choosing marriage over cohabitation.

The paper is organized as follows: section 2 offers an overview of US divorce laws, section 3 presents the empirical results, while section 4 describes in detail the theoretical model. Section 5 explain the procedure used for the estimation as well as the results. Section 6 report the results from a series of counter-factual experiments , while section 7 performs a welfare analysis. Section 8 draws the conclusions of the paper.

2 US Divorce Laws: an Overview

3 Data and Empirical Evidence

3.1 The Dataset

3.2 Empirical Evidence

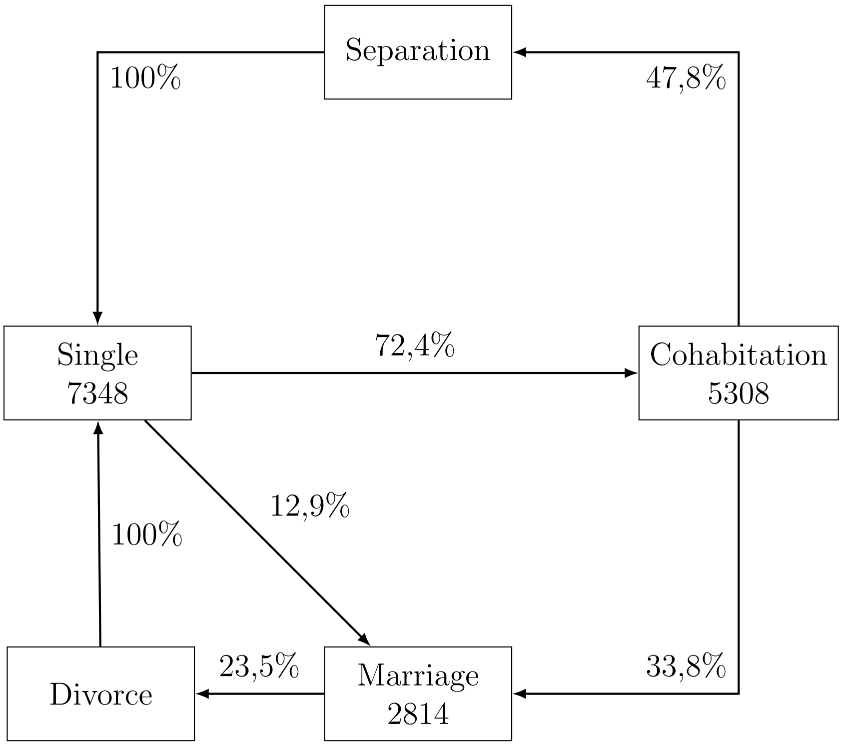
4 The Model

This section describes a dynamic life cycle structural model of partnership formation, savings, female labor supply and home prduction. Couples act cooperatively subject to limited commitment, which means that rebargaining might happen in response of changes in the outside options, which are assumed to be divorce or separation.

In the model time is discrete, and in each period men and women draw their productivities. If single, with some probability they meet a potential partner that comes with a couple specific match quality shock, and they decide whether to marry, cohabit or to stay single. If they are in a couples, they observe a realization of the match quality shock as well as of their productivity, and according to those they decide whether to stay together or to split. Both singles and couples make consumption and savings decisions, using their money for private or public good expenditure. Couples also make female labor supply decisions[6] and female time can be used to produce the public good, but this comes at the cost of a loss in productivity. The gains of being in a couple comes from love, risk sharing and labor market specialization. Instead, the gains of marriage with respect to cohabitation comes from a more functioning risk sharing and a better specialization in time use, which derives from the high cost of divorce serving as a commitment device. These gains of marriage

[6] We assume that single females and all men work full time.

deteriorates when the love shock is low enough to cause a high risk of divorce and frequent renegotiations: in this case cohabitation might be the better option, since we assume that the cost of separation will be lower than the cost of marriage.



NOTES: Number of spells and transitions as arising from the data in our sample.

FIGURE 1

4.1 Preferences

Women f and men m derive utility consuming a private good c and a household public good Q. The public good can be interpreted in terms of both the quantity and quality of children, as well as the goods and services produced within the household, as washing clothes or home cooked meals. Preferences are separable in the two goods and across time. Agents derives utility from a couple specific love shock ψ which evolves over time and it can be interpreted as can be interpreted as the value of love and companionship in a couples. The intra period utility of a single agent $s \in (f, m)$ is:

$$u(c_t^s, Q_t^s) = \frac{c_t^{s\,1-\sigma}}{1-\sigma} + \alpha \frac{Q_t^{s\,1-\xi}}{1-\xi},$$

where the superscript s on Q accounts for the fact that there is no partner to share the public good. Instead, the utility for agent $s \in (f, m)$ in a couple is:

$$u^C(c_t^s, Q_t) = \frac{c_t^{s\,1-\sigma}}{1-\sigma} + \alpha \frac{Q_t^{1-\xi}}{1-\xi} + \psi_t,$$

where the match quality evolves over time according to the following law of motion:

$$\psi_t = \psi_{t-1} + \epsilon_t, \text{ where } \epsilon_t \sim \mathcal{N}(0, \sigma_\psi^2) \text{ and } \epsilon_1 \sim \mathcal{N}(0, \sigma_{\psi,1}^2).$$

4.2 Home Production

In our model each agent in embodied with one unit of time. While singles and married men are assumed to supply inelastically one unit of market labor, females in a couple can be out of the labor force to devote their time producing the home good Q. The public good can be produced buying d goods in the market. Following Greenwood et al. (2016) we define the production function of home good as:

$$Q_t = [d_t^\lambda + \kappa(1 - P_t^f)^\lambda]^{\frac{1}{\lambda}}, \text{ where } 0 < \lambda < 1. \tag{1}$$

The parameter λ captures the degree of substitutability between female time and the use of durables in the production of the home good. This structure implies that when the relative price of durables decreases and when wages goes up, households will use less female time for its production, and hence female employment will increase. The variable P_t^f is a dummy variable that that takes value 1 when the women is participating in the labor market.

4.3 Wages

The labor income for agents $s \in \{f, m\}$ depends on their age t and on a permanent income component z_t^s:

$$\ln(w_t^s) = f^s(t) + z_t^s,$$

where $f^s()$ is a gender specific function that captures the evolution of productivity over age. The permanent income component z_t^s evolves over time as:

$$z_t^s = z_{t-1}^s - (1 - P_t^s)\mu + \zeta_t^s, \text{ where } \zeta_t^s \sim^{iid} \mathcal{N}(0, \sigma^\zeta), \text{ and } \zeta_1^s = z_1^s. \tag{2}$$

Note that μ is the loss in productivity that affects women[7] that are not participating in the labor market. It can be be interpreted as a reduced form way of capturing both the missed opportunity to accumulate human capital while working as wells as the skill atrophy deriving from interruptions, a phenomenon described by Adda et al. (2017). Modeling the loss in productivity for not working is an important feature of our model as it creates an incentive to join the labor force for women that expect to divorce or separate soon.

4.4 Budget Constraints

The budget constraint of single agents $s \in \{f, m\}$ is:

$$a_{t+1}^s = Ra_t^s + w_t^s - c_t^s - d_t^s, \text{ with } a_{t+1}^s \geq 0, \tag{3}$$

where a^s are agent's savings, w^s is the wage and c^s and d^s are consumption in the private good and the expenditure used to produce the public good. The budget constraint for a

[7] As we anticipated men always participate in the labor market, hence $P_t^m = 1 \; \forall \; t$.

couple instead is:

$$a_{t+1} = Ra_t + w_t^m + P_t^f w_t^f - c_t^f - c_t^m - d_t, \text{ with } a_{t+1} \geq 0, \tag{4}$$

where P_t^F is a dummy of female labor force participation. When a couple divorces in t, we assume

$$a_t^m + a_t^f = \delta a_t,$$

where δ is the fraction of total assets a_t left[8] after divorce. Separation instead comes with no monetary costs[9]. An important feature of our model is the role of property rights upon divorce, which define how assets are divided. We distinguish three cases which define the share of assets χ going to the women:

1. *Community Property.* Assets are split exactly in half: $\chi = 0.5$
2. *Equitable Distribution.* $\chi \sim \mathcal{U}(1/3, 2/3)$.[WHAT I WISH WE HAD]
3. *Title Based Regime.* χ is proportional to the productivity of the women compared to the one of the men, formally

$$\chi = \frac{\exp z^f}{\exp z^f + \exp z^m}.$$

It is worth noting that we depart from Voena (2015) in the way title based regime is modeled: she assumes that assets are split following a couple decision, while for us the sharing rule depends only on z^F and z^M. Since in our model relative productivities are the only source of disagreement,if we took the modeling assumption of Voena (2015) we would still get that

[8] The assumption that divorce erodes a fracction of wealth is common to Cubeddu and Ríos-Rull (2003).

[9] In reality the monetary cost of separation is likely to be positive. We assumed it to be zero because of the difficulties that arises when it comes to identify it. In fact, the gap in divorce and separation cost is what is actually needed to match the data.

the sharing rule is mainly determined by productivities[10]. Moreover, making the sharing rule endogenous would give cohabitation a strong advantage with respect to a community property or equitable distribution marriage[11], which makes hard to match the data.

4.5 Problem of the Singles

We start by by describing the problem for a single agent $i \in \{f, m\}$ in t. The agent have to make consumption and saving decisions, and she is also determining expenditured_t^i. In $t+1$ she meets a potential partner j of the opposite sex with probability λ_{t+1} and she can decide to enter a partnership, which also depend on whether the potential partner will agree. If the two decides to marry, the variable MA_{t+1} will take value 1, while $CO_{t+1} = 1$ if the couple decides to cohabit. Otherwise, MA_{t+1} and CO_{t+1} will be equal to 0. Note we assume singles to always participate in the labor market. The state variable of a single then is $\omega_t^i = \{a_t^i, z_t^i\}$, while her choices are represented by the vector $\mathbf{q}_t^i = \{a_{t+1}^i, c_t^i, d_t^i\}$. We denote by $V_t^{i,S}(\Omega_t^i)$ the value function of agent s, which we define as

$$\begin{aligned} V_t^{iS}(\omega_t^i) = \max_{\mathbf{q}_t^i} u(c_t^i, Q_t^i) + \beta E_t \Big\{ & (1-\lambda_t) V_{t+1}^{iS}(\omega_{t+1}^i) + \\ & \lambda_t \big\{ (1 - Ma_{t+1})(1 - CO_{t+1}) V_{t+1}^{i,S}(\omega_{t+1}) + \\ & M_{t+1} V_{t+1}^{i,M}(\Omega_{t+1}) + CO_{t+1} V_{t+1}^{i,C}(\Omega_{t+1}) \big\} \Big\}, \\ \text{s.t. } (3) \text{ and } (1). \end{aligned} \tag{5}$$

[10] If we had individual specific love shocks, our reduced from modeling assumption would give different results instead.

[11] This would happen because separation would have more degrees of freedom that divorce, where it is the court that decides the sharing rule.

4.6 Household Planning Problem

The problem of the couple depends both on the type of relationship, cohabitation or marriage, and on the divorce regime, which can be either *mutual consent* or *unilateral*. Separation is always unilateral. Under the unilateral regime, one partner can initiate the separation/divorce process alone, while under mutual consent the agreement of both is needed.

Mutual Consent Regime

Under mutual consent marriage $\hat{M}$, couples solve a pareto problem where the weight[12] of the wife is θ^f, while the one of the husband is $1-\theta^f$. The state vector is $\Omega_t^{\hat{M}} = \{a_t, z_t^f, z_t^m, \psi_t, \theta^f\}$, while the variables over which the couple maximize are summarized by the vector $\mathbf{q}_t^M = \{a_{t+1}, d_t, c_t^m, c_t^f, P_t^f, D_t\}$, where D_t is a dummy variable that takes value 1 is divorce happens and 0 otherwise. The formal probelm that a couple married is t solve is:

$$
\begin{aligned}
V_t^{\hat{M}}(\Omega_t^{\hat{M}}) = &\max_{\mathbf{q}_t^M}(1-D_t)\{\theta^f u(c_t^f, Q_t) + (1-\theta^f)u(c_t^m, Q_t) + \psi_t + \beta E_t V_{t+1}^{\hat{M}}(\Omega_{t+1}^{\hat{M}})\} \\
&+ D_t\{\theta^f V_t^{fS}(\omega_{t+1}^f) + \theta^m V_t^{mS}(\omega_t^m))\} \\
\text{if } D_t = 0: \quad & \text{s.t. (4) and (1)} \\
\text{if } D_t = 1: \quad & \text{s.t. (3), (1) for } i \in \{f,m\}, \\
& a_t^m + a_t^f = \delta a_t, \\
& a_t^m, a_t^f \text{ determined according to property right regime}, \\
& V_t^{fS}(\omega_t^f) > W_t^{f\hat{M}}(\Omega_t^{\hat{M}}), \\
& V_t^{mS}(\omega_t^m) > W_t^{m\hat{M}}(\Omega_t^{\hat{M}}).
\end{aligned} \tag{6}
$$

[12] Refer to subsection 4.7 for a description about how pareto weight are initially set.

$W_t^{i\hat{M}}$ for $i \in \{F, M\}$ is defined as

$$W_t^{i\hat{M}} = u(\tilde{c}_t^i, \tilde{Q}_t) + \psi_t + \beta E_t V_t^{i\hat{M}}(\Omega_{t+1}^{\hat{M}}), \tag{7}$$

where $\tilde{\mathbf{q}}_t^{\hat{M}} = \{\tilde{a}_{t+1}, \tilde{d}_t, \tilde{c}_t^m, \tilde{c}_t^f, \tilde{P}_t^f\}$ is the arg max of problem (6) conditionally on having chosen $D_t = 0$. $V_{t+1}^{i\hat{M}}(\Omega_{t+1}^{\hat{M}})$ instead can be obtained by the expectation of the sum of the time utilities that the agent get from $t+1$ to T, where the variables entering the utility function derive derive from the the pareto problem if the agent is in a relationship, otherwise they are the solution of (5). Under mutual consent regime the pareto weight is never rebargained, which makes risk sharing efficient. It also makes harder a divorce to happen, since the member that after a shock is relatively worse off can exercise her veto power to avoid a divorce: this feature makes labor specialization easier.

Unilateral Divorce Regime

Under the unilateral divorce regime, denoted by $\overline{M}$, couples solve a pareto problem where the weight of the wife is θ_t^f and the one of the husband is θ_t^m. Note that, in opposition to the mutual consent regime, now pareto weights are allowed to vary over time. This happes whenever a member of the couple is better off divorcing: the other member will try to convinve her not to split offering her a larger share of resources. The state vector of this proble is $\Omega_t^{\overline{M}} = \{a_t, z_t^f, z_t^m, \psi_t, \theta_t^f, \theta_t^m\}$, while the variables over which the couple maximize are summarized by the vector $\mathbf{q}_t^M$. The formal probelm that a couple married is t solve is:

$$
\begin{aligned}
V_t^{\overline{M}}(\Omega_t^{\overline{M}}) = & \max_{\mathbf{q}_t^M}(1-D_t)\{\theta_{t+1}^f u(c_t^f, Q_t) + \theta_{t+1}^m u(c_t^m, Q_t) + \psi_t + \beta E_t V_{t+1}^{\overline{M}}(\Omega_{t+1}^{\overline{M}})\} \\
& + D_t\{\theta_t^f V_t^{fS}(\omega_{t+1}^f) + \theta_t^m V_t^{mS}(\omega_t^m))\} \\
& \text{if } D_t = 0: \qquad \text{s.t. (4) and (1),} \\
& \qquad\qquad\qquad \theta_{t+1}^f = \theta_t^f + \mu_t^f, \\
& \qquad\qquad\qquad \theta_{t+1}^m = \theta_t^m + \mu_t^m, \\
& \text{if } D_t = 1: \qquad \text{s.t. (3), (1) for } i \in \{f, m\}, \\
& \qquad\qquad\qquad a_t^m + a_t^f = \delta a_t, \\
& \qquad\qquad\qquad a_t^m, a_t^f \text{ determined according to property right regime,}
\end{aligned} \tag{8}
$$

where θ_{t+1}^f and θ_{t+1}^m adjust such that the following participation constraints are satisfied:

$$
\begin{aligned}
W_t^{f\overline{M}}(\Omega_t^{\overline{M}}) \geq V_t^{fS}(\omega_t^f), \\
W_t^{m\overline{M}}(\Omega_t^{\overline{M}}) \geq V_t^{mS}(\omega_t^m).
\end{aligned} \tag{9}
$$

Note that μ_t^i are the langrange multipliers associated with spouses' participation constraints. Similarly to mutual consent regime, $W_t^{i\overline{M}}$ for $i \in \{f, m\}$ is defined as

$$
W_t^{i\overline{M}} = u(\tilde{c}_t^i, \tilde{Q}_t) + \psi + \beta E_t V_{t+1}^{i\overline{M}}(\Omega_{t+1}^{\overline{M}}), \tag{10}
$$

where $\tilde{\mathbf{q}}_t^{\overline{M}} = \{\tilde{a}_{t+1}, \tilde{d}_t, \tilde{c}_t^m, \tilde{c}_t^f, \tilde{P}_t^f\}$ is the arg max of problem (6) conditionally on having chosen $D_t = 0$. $V_{t+1}^{i\hat{M}}(\Omega_{t+1}^{\overline{M}})$ instead can be obtained by the expectation of the sum of the time utilities that the agent get from $t+1$ to T, where the variables entering the utility function derive derive from the the pareto problem if the agent is in a relationship, otherwise they are the solution of (5). Under the unilaral divorce regime pareto weights varies every time one participation constraint is binding, which makes risk sharing worse than in the mutual divorce regime. Labor market specialisation is also less functioning, since the higher risk of divorce makes women willing to insure against this event through labor market participation. Property rights upon divorce plays a significative role when splitting is unilateral: for example under community propery the least wealthy member can bargain a higher share of resources since the threat of divorce is real. This could not happen under a title based regime.

Cohabitation

Cohabiting couples, denoted by C, solve a pareto problem where the weight of the wife is θ_t^f and the one of the husband is θ_t^m.The state vector is $\Omega_t^C = \{a_t, z_t^f, z_t^m, \psi_t, \theta_t^f, \theta_t^m\}$, while the variables over which the couple maximize are summarized by the vector $\mathbf{q}_t^C = \{a_{t+1}, d_t, c_t^m, c_t^f, P_t^f, S_t, MA_t\}$. S_t and MA_t are dummy variable that take value 1 is the couple respectively separate of marry[13] and 0 otherwise. The formal probelm that a cohabiting couple is t solve is:

$$\begin{aligned}
V_t^C(\Omega_t^C) = \max_{\mathbf{q}_t^C} & (1-S_t)\{\theta_{t+1}^f u(c_t^f, Q_t) + \theta_{t+1}^m u(c_t^m, Q_t) + \psi_t + \beta E_t V_{t+1}^C(\Omega_{t+1}^C)\} \\
& + MA_t\{\theta_{t+1}^f u(c_t^f, Q_t) + \theta_{t+1}^m u(c_t^m, Q_t) + \psi_t + \beta E_t V_{t+1}^M(\Omega_{t+1}^M)\} \\
& + S_t\{\theta_t^f V_t^{fS}(\omega_{t+1}^f) + \theta_t^m V_t^{mS}(\omega_t^m))\} \\
\text{if } S_t = 0: \quad & \text{s.t. (4) and (1)}, \\
& \theta_{t+1}^f = \theta_t^f + \mu_t^f, \\
& \theta_{t+1}^m = \theta_t^m + \mu_t^m, \\
\text{if } S_t = 1: \quad & \text{s.t. (3), (1) for } i \in \{f, m\}, \\
& a_t^m + a_t^f = a_t, \\
& a_t^m, a_t^f \text{ determined as in the title based regime,}
\end{aligned} \tag{11}$$

[13] We denote marriage by M, which might be fall under unilateral divorce regime $\overline{M}$ or mutual consent $\hat{M}$.

where θ^f_{t+1} and θ^m_{t+1} adjust such that the following participation constraints are satisfied:

$$\begin{aligned} W_t^{fC}(\Omega_t^C) &\geq V_t^{fS}(\omega_t^f), \\ W_t^{mC}(\Omega_t^C) &\geq V_t^{mS}(\omega_t^m). \end{aligned} \tag{12}$$

Note that μ_t^i are the langrange multipliers associated with spouses' participation constraints. W_t^{iC} for $i \in \{f, m\}$ is defined as

$$W_t^{iC} = u(\tilde{c}_t^i, \tilde{Q}_t^i) + \psi_t + \beta E_t V_{t+1}^{iC}(\Omega_{t+1}^C), \tag{13}$$

where $\tilde{\mathbf{q}}_t^C = \{\tilde{a}_{t+1}, \tilde{d}_t, \tilde{c}_t^m, \tilde{c}_t^f, \tilde{P}_t^f\}$ is the arg max of problem (6) conditionally on having chosen $D_t = 0$. $V_{t+1}^{iC}(\Omega_{t+1}^C)$ instead can be obtained by the expectation of the sum of the time utilities that the agent get from $t+1$ to T, where the variables entering the utility function derive derive from the the pareto problem if the agent is in a relationship, otherwise they are the solution of (5).

4.7 Partnership Choice and the Mating Market

In each period t singles have a probability λ_t to meet a potential partner of their same age and with a productivity and wealth that depends on their productivity z_t and assets a_t. Formally:

$$\ln(a_t^p) = \ln(a_t) + \hat{\epsilon}, \text{ where } \hat{\epsilon} \sim \mathcal{N}(0, \sigma_{\hat{p}}^2), \tag{14}$$

$$z_t^p = z_t + \tilde{\epsilon}, \text{ where } \tilde{\epsilon} \sim \mathcal{N}(0, \sigma_{\tilde{p}}^2). \tag{15}$$

These assumptions allow us to capture in a reduced from fashion that people are mating assortatively[14] both within marriage and cohabitation, as Gemici and Laufer (2014) point

[14] In the life cycle models featured in Ciscato (2019), Shephard (2019) and Reynoso (2019) assortative mating arise in marriage markets through the interactions of preferences, incentives, supply and demand forces.

out. Once the meeting happened, agents have to decide whether to stay in a couple and eventually decide which partnership contract to choose. Note that for the rest of this section we will refer to marriage as M, but depending on property rights upon divorce we have $M \in \{\hat{M}, \overline{M}\}$. We model their choices in three steps.

1. The couple consider marriage M (cohabitation C) as a viable alternative if the set of pareto weights[15] θ^f such that the couple prefers to marry (cohabit) is non-empty. Formally, for relationship $J \in \{M, C\}$ the set is

$$\Theta_t^J(\Omega_t^J, \omega_t^f, \omega_t^m) = \big\{\theta_t : V_t^{fJ}(\Omega_t^J) \geq V_t^{fS}(\omega_t^f), V_t^{mJ}(\Omega_t^J) \geq V_t^{mS}(\omega_t^m)\big\}. \tag{16}$$

2. If the set for marriage (cohabitation) is non-empty, the pareto weight for the potential marriage $\theta^{m,f}$ (cohabitation $\theta^{c,f}$) is set through symmetric Nash Bargaining.[16] Formally[17], for $J \in \{M, C\}$ $\theta^{J,f}$ is set to :

$$\theta_t^{J,f} = \underset{\theta_t^f \in \Theta_t^J}{\arg\max}\, \Upsilon^J(\theta_t^f, \Omega_t^{J,-1}, \omega_t^f, \omega_t^m), \tag{17}$$

where

$$\Upsilon^J(\theta_t^f, \Omega_t^{J,-1}, \omega_t^f, \omega_t^m) = \big[V_t^{fJ}(\Omega_t^{J,-1}) - V_t^{fS}(\omega_t^f)\big] \times \big[V_t^{mJ}(\Omega_t^{J,-1}) - V_t^{mS}(\omega_t^m)\big]. \tag{18}$$

3. Four possible situation can arise:

   - $\Theta_t^M = \emptyset$ and $\Theta_t^C = \emptyset \Rightarrow$ stay single.

[15] Without loss of generality, we impose $\theta^f + \theta^m = 1$ at first meeting.

[16] The assumption that the initial pareto weight is pinned down by Nash Bargaining can be found in Low et al. (2018).

[17] For consistency with the rest of the paper we define $\Omega_t^{J,-1}$ as the state vector for the couple excluding pareto weights.

- $\Theta_t^M \neq \emptyset$ and $\Theta_t^C = \emptyset \Rightarrow$ marry.
- $\Theta_t^M = \emptyset$ and $\Theta_t^C \neq \emptyset \Rightarrow$ cohabit.
- $\Theta_t^M \neq \emptyset$ and $\Theta_t^C \neq \emptyset \Rightarrow$ marry if $\Upsilon^M(\Omega_t^M, \omega_t^f, \omega_t^m) \geq \Upsilon^C(\Omega_t^C, \omega_t^f, \omega_t^m)$, otherwise cohabit.

This framework is a natural extension of the nash bargaining problem[18] to discrete choices [CITATION OF RELEVANT PAPER HERE].

5 Estimation

6 Counterfactual Experiments

7 Welfare Analysis

8 Conclusion

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[18] Note that we could have chosen a different protocol for determining the choice between marriage and cohabitation. For example, we could have decided to impose a sequential structure to the problem, assuming that first agents compare cohabitation to singleness, obtaining the envelop of the two, where the pareto weight is set as above. Then, the agents make their final choice solving a pareto problem where the outside option is the outcome of the first step. We tried applying this methodology: results were indistinguishable from our main strategy.

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Appendix

A Computational Appendix

Arnoud et al. (2019)+Cartis et al. (2019)

B Estimation of Income Processes