

# Marriage and Cohabitation

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## Abstract

Despite the large occurrence of cohabitation and its strong link to important behavioral outcomes, it has received little attention in the literature. In this paper, we develop and estimate a dynamic model of household formation and dissolution, fertility and labor supply and use the estimated model to perform policy experiments that investigate the welfare implications of different institutional arrangements regarding divorce regulations. The point of departure from the previous literature is that we take into account the intermediate stage of non-marital cohabitation. For many couples the choice is not just between being married and remaining single, but there is a third option that is non-marital cohabitation, and it provides a tradeoff between the advantages and disadvantages of getting married and remaining single. We find that labor market outcomes, as well as marital sorting patterns are strongly linked to individuals' choices regarding different living arrangements. Our goal is to use the estimated model to assess the welfare implications of inefficiencies that may arise in co-residential relationships due to lack of commitment.

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# 1 Introduction

The number of unmarried couples living together has increased significantly between 1960 and 2000. Today, there are 9.7 million Americans living with an unmarried different-sex partner. More importantly, the marital stability, labor supply, and fertility of men and women are strongly linked to their living arrangements. Using the Panel Study of Income Dynamics and 1979 cohort of the National Longitudinal Survey (NLSY79), we find that married women work less than single women, but that the effect of cohabitation compared to being single is statistically insignificant. A similar analysis for men reveals that both cohabiting and married men tend to work more than single men, with married men working more than those cohabiting. The empirical evidence also shows that the patterns of marital sorting are quite different for cohabiting unions compared to married unions. For example, in cohabiting unions partners tend to be much more similar to each other in terms of education levels, compared to partners in married unions.<sup>1</sup> Despite the large occurrence of cohabitation and its strong link to important behavioral outcomes, it has received little attention in the literature concerned about household formation, dissolution and household labor supply.<sup>2</sup>

The goal of this paper is to assess the implications of family policies, such as divorce regulations, on intra-household allocation, fertility, household formation and dissolution patterns. In order to do this, we develop and estimate a dynamic model of household formation and dissolution, fertility and labor supply and use the estimated model to perform policy experiments that investigate the welfare implications of different institutional arrangements regarding divorce regulations. The point of departure from the previous literature is that we take into account the intermediate stage of non-marital cohabitation. In other words, for many couples the choice is not just between being married and remaining single, but there is a third option that is non-marital cohabitation, and it provides a tradeoff between the advantages and disadvantages of getting married and remaining single.

There are various ways in which cohabitation may differ from legal marriage. For example, there are significant differences in the legal regulations the unmarried cohabitants and married couples face in the United States. The first important distinction is that unmarried cohabitants do not need to follow strict procedures to dissolve the living arrangement. This leads to an important feature of cohabitation, which is that it enables partners to take advantage of the

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<sup>1</sup>A detailed exposition of these empirical facts can be found in the data section.

<sup>2</sup>Some exceptions are Brien, Lillard and Stern (2006), Choo and Siow (2005), and Reinhold (2007). Brien, Lillard and Stern (2006) study cohabitation decisions and find that individuals cohabit in order to learn about their potential partners and hedge against future bad relationship specific shocks. Choo and Siow (2005) investigate marriage and cohabitation behavior in Canada. Reinhold (2007) investigates the relationship between premarital cohabitation and subsequent marital instability, and more importantly, how this relationship has changed significantly over time.

benefits of living together, without the commitment that legal marriage requires. For example, Brien, Lillard and Stern (2006) show that the lower cost of separation makes co-residential relationships attractive for couples, as it gives the opportunity to hedge against future bad shocks to the relationship quality while taking advantage of benefits of living together such as joint consumption of a public good, returns to specialization, and children. However, the lack of commitment in a cohabiting relationship relative to marriage has disadvantages, as the increased chance of dissolution may prevent the couple from fully realizing some of these benefits. Therefore, for a lot of couples, the choice is not only between being married and remaining single, but a third option of non-marital cohabitation, which has advantages and disadvantages relative to the other options

In the model, in each period a single individual meets a potential partner with an exogenous probability and decides whether he/she is going to continue being single, start cohabiting with the partner, or get married. In addition to their relationship, the agents choose in each period how to divide their time between housework, labor market work and leisure, and whether to have children or not. Working at a given period increases their human capital, and hence future wages. The presence of children shift the marginal utility from public good consumption, and therefore increase the relationship surplus. Agents face uncertainty regarding their earnings, their match quality if they are in a relationship, and preferences for children. In order to characterize the allocations chosen by married/cohabiting individuals, we employ the collective household model in a dynamic framework with no commitment so that couples cooperate but they are unable to commit to future allocations as in Mazzocco and Yamaguchi (2007). For the couple's problem, we make the assumption that the outcomes to the household's allocation problem are constrained efficient so that the solution to the couple's problem is obtained by using a Pareto problem with participation constraints. Due to lack of commitment, the share of the total household resources that a partner receives is subject to change depending on his/her outside option each period. In addition, the partners are not able to commit to not separate in the future, and face uncertainty regarding future marital instability. This gives rise to inefficiencies within the relationship since (1) Household members cannot contract over transfers to be made in the future periods of the relationship, (2) Household members cannot make conditional transfers for future separation states. The potential for inefficiencies is higher for higher levels of probability of separation. Holding everything else constant, this probability is higher for a cohabiting couple as their cost of separation is lower. The size of the efficiency concerns depend on the home production technology and preferences. We consider different specifications for the home production technology in the paper.

The gains from living together in the model are: (1) Increasing returns to scale in the production of a public good, (2) Specialization in home production and market work, (3) A

match-specific benefit, which is observable but is subject to change as the relationship progresses. The extent to which each of these gains are realized depends on whether the couple chooses to cohabit or get married. The tradeoff that the couple faces in making this choice is as follows. Cohabitation allows the partners to benefit from living together, without the requirement to face legal separation costs in the event of negative match specific shocks. Marriage makes future separation more costly, and this enables the agents to fully specialize. This also has implications on the degree of positive assortative mating for cohabiting unions in comparison to marital unions. This is because the substitution possibilities in the time inputs of the spouses in the household production function translates into different mating patterns depending on the degree of commitment the couple has access to. In this case, patterns of marital sorting observed in the data are strongly linked to the intra-household decision process, as in Del Boca and Flinn (2006).

We are ultimately interested in the welfare implications of partners' inability to make binding agreements. Inefficiencies may arise in relationships due to lack of access to a commitment technology.<sup>3</sup> However, more importantly, individuals can choose the degree of commitment they have access to in their relationship, through choosing between marriage and cohabitation. These choices depend on their observable and unobservable characteristics, the characteristics of their potential matches, the quality of their match, as well as preferences and the home production technology. In this paper, we develop a framework that allows us to control for such selectivity into different living arrangements (marriage, cohabitation, remaining single).

We structurally estimate the model using data from the 1979 cohort of the National Longitudinal Survey (NLSY79) and the Panel Study of Income Dynamics (PSID), which have detailed information on relationship and wage histories, as well as labor market and housework hours of partners. The model is estimated by simulated method of moments, which minimizes a weighted average distance between a set of sample moments and moments simulated from the model.

The paper is organized as follows. In Section 2, we present a two-period version of the full model in order to analyze the main channels at work. In Section 3, we present the details of the full model. Section 4 presents the data. Section 5 gives the estimation method. Section 6 concludes.

## **2 A Two-Period Model of Marriage, Cohabitation and Labor Supply**

In this section, we solve a two-period version of the full dynamic model in order to demonstrate the main channels at work. Consider an economy made up of individuals who live for two periods. Each individual is endowed with a wage  $w_i$ . In each period, the agents get utility from their

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<sup>3</sup>Lundberg and Pollak (2001) conduct a detailed analysis of inefficiencies that may arise in marriage, due to lack of commitment.

private leisure,  $l_i$ , and the consumption of a public good  $Q$ . Agents who choose to live together also get utility from their match specific quality,  $\theta$ , which is revealed to them in the second period.

Utility in the first and second period is strongly separable in the private leisure and public good, and is given by,

$$\begin{aligned} u_{i,1}(l_{i,1}, Q) &= \frac{l_{i,1}^{1-\sigma_l}}{1-\sigma_l} + \frac{Q_1^{1-\sigma_Q}}{1-\sigma_Q} & i = m, f \\ u_{i,2}(l_{i,2}, Q) &= \frac{l_{i,2}^{1-\sigma_l}}{1-\sigma_l} + \frac{Q_2^{1-\sigma_Q}}{1-\sigma_Q} + \theta & i = m, f \end{aligned}$$

where  $\theta$  is the quality of the couple-specific match. The public good  $Q$  is produced with a household production technology which uses the time inputs of the spouses,  $d_m, d_f$ , and a good,  $g$ , purchased in the market at a price normalized to 1. Expenditure on the market good  $g$  is given by the sum of the total income of the household, so that  $g = w_m h_m + w_f h_f + Y$ , where  $Y = Y_m + Y_f$  is the household's total non-labor income. The agents divide their time between market work and housework, and leisure. The home production technology is,

$$Q = (d_m^\nu + d_f^\nu)^{\frac{1}{\nu}} g$$

so that the home production technology exhibits increasing returns to scale. In the following section, we consider the implications different specifications for the production technology, with varying values of  $\nu$  which govern the different substitution possibilities between the time inputs ( $d_m$  and  $d_f$ ) of the partners. When the agent lives alone,  $Q$  is produced with the following home production technology,

$$Q^S = d_i^S g^S \quad i = m, f$$

The timing of the two period model is as follows. Each individual  $i$  starts the first period as a single agent endowed with wage  $w_i$ . At the beginning of the period each agent meets a partner with a wage endowment  $w_j$  with an exogenous probability  $P_w(w_j)$ . The potential partners then decide whether they are going to cohabit together, get married or remain single for that period. At the beginning of the second period, if they are married or cohabiting, they observe their couple-specific match quality and decide whether they are going to stay together or separate. If they start the second period as single agents (which happens if they choose to not match with the partner they met at the beginning of the first period), they only make decisions regarding how to divide their time between market work, home production and leisure in the second period.

We solve the model backwards, starting with the decision problem in the second period. First

consider individuals who are single agents in the second period. They can be in the single state in the second period through one of the following ways: (1) They started the period as single, (2) They started the period in a relationship, but chose to separate after observing the match quality  $\theta$ . The value of being a single agent for person  $i$  in period 2 is determined by the solution to the following problem,

$$\begin{aligned} \max_{h_{i,2}^S, d_{i,2}^S} \quad & u(l_{i,2}^S, Q_{i,2}^S) \\ \text{s.t.} \quad & Q_{i,2}^S = d_{i,2}^S g_{i,2}^S \\ & g^S = w_i h_i^S + Y_i \end{aligned}$$

Now consider individuals who are in a relationship (cohabiting or married) in the second period. Once the match quality is realized, the time allocation of the partners is determined as the solution to the following problem,

$$\begin{aligned} \max_{h_{m,2}, d_{m,2}, h_{f,2}, d_{f,2}, \xi} \quad & \mu u(l_{m,2}, Q_2) + (1 - \mu) u(l_{f,2}, Q_2) \\ \text{s.t.} \quad & Q_2 = Q = (d_{m,2}^\nu + d_{f,2}^\nu)^{\frac{1}{\nu}} g_2 \\ & g_2 = w_{m,2} h_{m,2} + w_{f,2} h_{f,2} + Y_i \\ & T = h_{i,2} + d_{i,2} + l_{i,2} \quad i = m, f \\ & u(l_{i,2}, Q_2) + \theta \geq u(l_{i,2}^S, Q_2^S) + \kappa \end{aligned}$$

where  $\kappa$  is the separation penalty (with  $\kappa < 0$ ), and is equal to  $\kappa_C$  if cohabiting and  $\kappa_R$  for married couples. Given the Pareto weight from the previous period,  $\mu$ , the couple maximizes the above problem with respect to their labor market and housework hours as well as relationship status  $\xi$ . Let  $\Omega_2 = \{\mu, w_{m,2}, w_{f,2}\}$ , so that the optimal solution is  $\{h_{i,2}^*(\Omega_2), d_i^*(\Omega_2), Q^*(\Omega_2), \xi^*(\Omega_2)\}$ .

The wages in the second period are determined by the human capital that is accumulated in the first period. For an agent that works for  $h_{i,1}$  hours in the first period, his second period wages are augmented by that amount,

$$w_{i,2} = w_{i,1} + \gamma h_{i,1}$$

In the beginning of the second period, for married/cohabiting partners, the value of match quality  $\theta$  is revealed and each partner decides, given the current weight  $\mu$  determined in the first period, whether or not to stay in the relationship, or to separate. If they separate, each partner becomes single and receives utility from consumption of leisure and the public good as a single person, and also incurs the separation penalty denoted by  $\kappa_M$ , if they are married, and  $\kappa_C$  if they are cohabiting.

If the participation constraint binds for both of the partners, they separate. If the participation constraint binds for only one partner, the planner weight for that partner is increased to the point where he or she is indifferent between staying and leaving, as in Marcet and Marimon (1998) and Mazzocco and Yamaguchi (2007). If there is no weight that satisfies both participation constraints, the couple separates. This occurs whenever the total surplus generated outside the relationship, minus the separation penalties, is larger than what can be achieved within it.

The planner solves the second period time allocation problem using updated Pareto weight  $\tilde{\mu}$ , which is determined by the following rule,

$$\tilde{\mu} = \begin{cases} \mu & \text{if } u(l_{i,2}^*, Q_2^*) + \theta > u(l_{i,2}^S, Q_2^S) \quad i = m, f \\ \underline{\mu} & \text{if } u(l_{m,2}^*, Q_2^*) + \theta < u(l_{m,2}^S, Q_2^S) + \kappa \\ \bar{\mu} & \text{if } u(l_{f,2}^*, Q_2^*) + \theta < u(l_{f,2}^S, Q_2^S) + \kappa \end{cases}$$

where  $\underline{\mu}$  is the weight at which the solution to the planner's problem is solved with a binding participation constraint for the male,

$$u(l_{m,2}, Q_2) + \theta = u(l_{m,2}^S, Q_2^S) + \kappa$$

and  $\bar{\mu}$  is the weight at which the solution to the planner's problem is solved with a binding participation constraint for the female,

$$u(l_{f,2}, Q_2) + \theta = u(l_{f,2}^S, Q_2^S) + \kappa.$$

Now we specify the agent's problem in the first period. Every agent in the economy starts the first period as single. They meet a partner with wage  $\tilde{w}$  with an exogenous probability denoted by  $P_w(w_j)$ . An individual with  $w$  then solves the following problem to decide whether he/she is going to get together with the person she meets (either through cohabiting or getting married). Consider an agent who is endowed with wage  $w_i$  and meets a partner with wage  $w_j$ . In the first period, the solution to the following problem characterizes the optimal hours allocation of the couple conditional on forming a relationship, either cohabiting or married. If setting the Pareto weights in the first period at  $\mu = \frac{1}{2}$  induces both partners to enter the relationship rather than remain single, then we set  $\mu = \frac{1}{2}$ . Otherwise, we increase the weight on the agent who would prefer to remain single until the point at which he or she is indifferent between remaining single and entering into the relationship. Having determined the weight  $\mu$ , the planner solves the following problem:

$$\begin{aligned}
& \max_{h_{m,1}, d_{m,1}, h_{f,1}, d_{f,1}, \xi} & \mu & [u(l_{m,1}, Q_1) + \beta V_{m,2}(\mu, w_m, w_f, \xi)] \\
& & + (1 - \mu) & [u(l_{f,1}, Q_1) + \beta V_{f,2}(\mu, w_m, w_f, \xi)] \\
& \text{s.t.} & & Q_1 = (d_{m,1}^\nu + d_{f,1}^\nu)^{\frac{1}{\nu}} g_1 \\
& & & g_1 = w_{m,1} h_{m,1} + w_{f,1} h_{f,1} + Y_i \\
& & & T = h_{i,1} + d_{i,1} + l_{i,1} \quad i = m, f
\end{aligned}$$

The couple maximizes the above problem with respect to their labor market and housework hours as well as relationship status  $\xi$ . So that:

$$V_{i,1}(w_m, w_f) = u(l_i^*(w_{m,1}, w_{f,1}), Q^*(w_{m,1}, w_{f,1})) + \theta + \beta V_{i,2}(\mu, w_{m,1}, w_{f,1}) \quad i = m, f$$

The couple does not observe their match specific quality  $\theta$  until the beginning of the second period, so  $\theta$  does not enter their problem in the first period.

For a fixed Pareto weight, it is straightforward to derive the closed form solution to the hours choices of the couple in terms of their wages and the parameters of the mode. However, the participation constraints in the second period make the analytical solution less tractable, so we solve the above two period model numerically by discretizing the choice variables of hours. Our main goal here is to demonstrate the implications of limited commitment and household specialization concerns on sorting and living arrangement patterns for different parameter values and different specifications for the home production technology. The parameters of the two period model and the values used for plotting the decision rules are displayed in Table 1. These are not estimated parameters. We plot the decisions rules for the agents for different functional forms for the production technology that specify different substitution possibilities between the time inputs of the spouses into home production. Before we go on to the solution of the two period model, we briefly outline the channels at work in the model.

In the model, the gain from marriage/cohabitation stems from joint consumption of a public good in the household, increasing returns to scale property of the home production technology and potential gains from specialization due to comparative advantage of the spouses in the labor market if they have differing wages. These generate positive economic gains from marriage in the sense that the output the partners generate together is greater than the sum of the outputs that the partners can obtain separately. However, the extent to which each of these gains are realized depends on whether the couple chooses to cohabit or get married. The tradeoff that the couple faces in making this choice is as follows. The couple faces uncertainty regarding their match quality, and this uncertainty is resolved at the beginning of the second period: (1) Cohabitation

provides an opportunity to hedge against a possibly negative match quality in the second period. Therefore, cohabitation allows the partners to benefit from the advantages of living together, without the requirement to face legal separation costs in the event of negative match specific shocks, (2) Marriage makes future separation more costly, and this might enable the agents to achieve a higher level of total surplus through full specialization. The reason for this is the fact that the couple cannot commit to not separate in the second period. However, legal marriage can be viewed as a device to make separation more costly for the partners.

The *ex ante* efficient solution entails full specialization within the household when the partners have different wages. If the couple is unable to make binding commitments to not separate in the future, then they will adjust their period 1 behavior to reflect an expected future separation. The partners' time in period 1 is divided between market work, and production of a household public good. If they cannot commit to a division of second-period household surplus that compensates the home worker for foregone earnings power, then the family will choose an inefficient level of specialization, and produce too little of the public good. Cohabitation makes this intertemporal commitment more difficult. The lower degree of commitment in a cohabiting relationship can therefore be expected to lead to increased employment rates of women and lower household specialization. On the other hand, the increased labor market opportunities of women might also contribute to increased cohabitation rates, as the equalization of men and women in the labor market means the decline of comparative advantages and hence lower gains from specialization. Marriage moves the family to a more efficient level of production, however this benefit of marriage diminishes with decreasing comparative advantages in the labor market.

## 2.1 Solution of the Two-Period Model

There are two important predictions of the model that we investigate looking at the decision rules of the agents: (1) Labor market hours, (2) Living arrangements (marriage, cohabitation or living alone), (3) Sorting patterns in terms of the wage endowments of males and females. Depending on the parameter values, the prediction of the model is that all three are strongly influenced by the differing degrees of commitment between marriage and cohabitation, as well as the choice of whether to live alone or with a partner. All decision rules considered are those pertaining to the first period and their arguments are the wage pair of the potential match that meets at the beginning of the period,  $w_m, w_f$ . In the model, each agent with  $w_i$  meets a potential partner with wage  $w_j$ . They then choose hours of work as well as whether they will cohabit, get married or remain single.

### 2.1.1 Specification 1

We first consider a home production technology where: (1) Housework hours of partners are perfect substitutes, (2) The technology exhibits increasing returns to scale so that, for example, doubling the inputs of home production and market purchases raises the output by a factor more than two. The home production technology is,

$$Q = (d_m + d_f)g$$

Given this home production technology, the efficient allocation for a couple with differing wages is for the higher wage partner to specialize labor market, and the lower wage person to specialize in home production. However, under limited commitment, this efficient allocation might not be achieved. For example, in a match in which the female has the lower wage, the efficient outcome would have her work in home production. However, when she works at home in the first period, she foregoes higher wages in the second period, decreasing the value of her outside option. Without commitment, the male is not able to compensate her for this with future period transfers. Because of the high separation penalty, marriage is associated with a greater degree of commitment and more specialization.

In Figure 1 we plot labor market and housework hours for the male partner against his wage in the first period, averaging over the possible values of female wage. In this parameterization, the cohabitation penalty is fixed at zero and the marriage separation penalty is sufficiently high that no married couples end up divorcing in the second period. This higher level of commitment for married couples allows a higher degree of specialization in the first period. The male partner specializes in housework at low wages and labor market work at high wages. On the other hand, for those couples who choose to cohabit, the degree of specialization is lower, with much less variation in hours for different wages.

In Figure 2 we plot their decision rules regarding relationship status after they meet in the first period against the wage pairs of each potential match. The plot shows that couples who end up cohabiting are those with similar wage endowments, who stand to benefit less from specialization. Matches with larger wage differentials choose to marry instead to take advantage of the increased specialization that comes with stronger commitment. When both partners have very high wages, neither wishes to forego the benefits of working in the labor market so the gains to specialization are smaller and we see a widening of the region in which the couple chooses to cohabit

### 2.1.2 Specification 2

The decision rules discussed above are sensitive to our specification of the home production technology in this specification. To illustrate this we consider an alternative home production technology. The second specification we consider is the following:

$$Q = (d_m^\nu + d_f^\nu)^{\frac{1}{\nu}} g$$

where  $g = w_m h_m + w_f h_f + Y$  and  $\nu$  governs the elasticity of substitution between the housework time inputs of the spouses in the production technology. Compared to the previous specification, this specification nests different degrees of substitution possibilities between the time inputs of the spouses, so that we allow for concavity and some complementarity between partners' time use depending on the value of  $\nu$ . In this case the optimal allocation of hours in the household does not necessarily entail full specialization, and interior solutions will arise. The partner with high wages will still work more in the market. However, in this case, the gains from specialization are smaller. Figure 4 contains the graph of the matches formed given the wage pairs under this home production technology. Compared to the previous specification, there is far more cohabitation and far less marriage. Only for those couples with very large wage differentials do the gains from specialization outweigh the utility loss from being less able to dissolve a match that turns out to be of low quality.

In Figure 3, we plot the hours for male partner against his wage in the first period in this specification of the model, again averaging over the possible values of female wage. For cohabiting couples, for most wage values, labor market hours simply increase in response to increasing wage, with a simultaneous decrease in housework hours. For married couples, the time allocation is dominated by the selection effect. Since the only couples that marry are those with large wage differentials, we see a sudden jump in labor market hours and a corresponding decrease in housework hours as we pass from a region of low-wage males and high high-wage females to one in which high-wage males are paired with very low-wage females.

## 3 Full Model

Agents make decisions regarding relationship status, employment, and fertility in each period. At each age  $a$ , a single individual chooses the following: hours of labor market work ( $h_a$ ), hours of housework ( $d_a$ ), whether to cohabit or marry (if receive an offer) or continue search as a single person, whether to become pregnant or not (if at a fecund age). When married, the individuals jointly choose: hours of labor market work and housework of both spouses, whether to become pregnant or not, and whether to stay married or separate. When cohabiting, the individuals face

the same alternatives as when they are married, with the addition of the decision to get married or not.

In the model, the individual's latent type determines their labor market (because the type specific skill endowments determine their wages) as well as their marriage market opportunities (latent type determines the distribution of potential partner's education).

### 3.1 Preferences

The individual's utility flow depends on his/her private leisure, public good consumption (produced by an intra-household production process with domestic labor supplies of the partners as inputs if married or cohabiting, private if single), number of children, and match quality (if married). The utility function of an individual of latent type  $j$  is given by,

$$\begin{aligned}
 u(l_a, Q_a, n_a; \varepsilon_a, \Omega_a, j) = & \frac{l_a^{1-\sigma_l}}{1-\sigma_l} + (1+n_a)\frac{Q_a^{1-\sigma_q}}{1-\sigma_q} \\
 & + (\alpha_{n1} + \varepsilon_a^n)n_a + \alpha_{n2}n_{i,a} \\
 & + 1\{\xi_{a-1} = m, \xi_a = s\}\kappa_m(j) + 1\{\xi_{a-1} = c, \xi_a = s\}\kappa_c(j)
 \end{aligned}$$

where  $n$  is the number of children in the household, and is allowed to affect the marginal valuation of the public good.  $\kappa_R(j)$  and  $\kappa_C(j)$  indicate the cost of separating for a married couple and a cohabiting couple, respectively, so that the separation cost is determined by the relationship status in the preceding period ( $\xi_{a-1}$ ). The cost of separating is also determined by the individual's type  $j$ .  $\xi$  denotes the relationship status and takes on three values: marriage, cohabitation, and being single. The utility function of a married or cohabiting individual also includes the match quality for that period, denoted by  $\theta_a$ .

We also make a distinction between the number of children each individual had prior to meeting their current partner, and the number of children they have with their current match. The child utility is different depending on the current living arrangement of the parents. Let  $n_m$  and  $n_f$  denote the number of children the male and female have from prior relationships and  $n$  denote the number of children they have from the current match. If currently not living with the parent of the child, the mother/father's valuation of the child will be different in comparison to when they are together. This is due to the possibility that parents are able to spend less time with their child when they are separated, as they only have shared custody.

### 3.2 Fertility and Children

Each period, individuals get a random iid shock ( $\varepsilon_a^n$ ) to their preferences for children. If the female chooses to become pregnant, she has a child in that period, so that her number of children

increases to  $n + 1$  that period.

### 3.3 Labor Market

Given their marital status, education, labor market experience, and home production, agents decide the number of hours they will work in the labor market. Working in a period more than a certain number of hours ( $\bar{H}$ ) increases the individual's measured by labor market experience by 1 period and this increases the individual's future wages. The wage of an individual of age  $a$  is determined by:

$$\begin{aligned} \ln w_a &= r + HC(e_a, x_a, \varepsilon_a^w) \\ &= \gamma_0(j) + \gamma_1 x_{it} + \gamma_2 x_{it}^2 + \gamma_3 1\{work_{a-1} = 1\} + \gamma_4 e_a + \varepsilon_a^w \end{aligned}$$

The rental price of human capital is denoted by  $r$ , and the accumulated level of human capital stock for the individual at age  $a$  is  $HC(\cdot)$  and is determined by initial skill endowments (which differs by the person's latent type), education, labor market experience and a random iid shock.  $e_a$  denotes the accumulated education level of the individual at age  $a$  and  $x_a$  denotes the accumulated labor market experience at age  $a$ . The wage is also determined by an indicator function that denotes whether the individual was working in the preceding period. The random shocks to the human capital stock  $\varepsilon_w^a$  are assumed to be normal and serially independent.  $\gamma_0(j)$  is the type-specific intercept for a person of type  $j$ , so that differences in the wages obtained may differ due to different initial skill endowments (that are determined by the latent type) or due to discrimination (through the rental price of human capital,  $r$ ). We do not distinguish between the two cases.

### 3.4 Marriage Market and Match Quality

Every period, a single individual with characteristics  $e$  (education) and  $x$  (experience) and receives a marriage/cohabitation offer from a person with characteristics  $\tilde{e}$  and  $\tilde{x}$  with probability  $\lambda(e, \tilde{e}, x, \tilde{x})$ , that is given by

$$\lambda(e, \tilde{e}, x, \tilde{x}) = \frac{f(e, \tilde{e}, x, \tilde{x})}{1 + \exp(f(e, \tilde{e}, x, \tilde{x}))}$$

where

$$f(e, \tilde{e}, x, \tilde{x}) = \lambda_0 + \lambda_1(e - \tilde{e})^2 + \lambda_2(x - \tilde{x})^2$$

Once a potential partner with characteristics  $\tilde{e}$  and  $\tilde{x}$  is drawn, the potential couple then draws a match quality of the partnership, given by  $\theta$ . The couple then decides whether to marry/cohabit or whether to remain single and continue search. The problem that the couple faces when they are making this decision is outlined below in the household's problem section.

When the potential couple meets, they draw a match quality  $\theta$ . If they decide to get married or cohabit, their match quality follows a Markov process during the course of their relationship, so that in each period they draw a new match quality conditional on the match quality in the previous period using a Markov transition matrix. As in Brown and Flinn (2006), we have a finite number of match quality values  $\theta_1, \dots, \theta_M$ , where  $M=4$ . The probability of getting a match quality of  $\theta_j$  given the previous period match quality is  $\theta_i$  is given by  $p_{ij}$ , so that the Markov transition matrix for  $\theta$  is:

$$P^\theta = \begin{bmatrix} p_{11} & p_{12} & p_{13} & p_{14} \\ p_{21} & p_{22} & p_{23} & p_{24} \\ p_{31} & p_{32} & p_{33} & p_{34} \\ p_{41} & p_{42} & p_{43} & p_{44} \end{bmatrix}$$

We restrict the elements of  $P^\theta$  so that the probability of drawing the same match quality as the preceding period does not depend on the level of the match quality and is given by  $\pi_0$ . Moreover, the probability of drawing a higher match quality does not depend on the level of  $\theta$  either. The same is true for drawing a lower match quality. Only the distance between the match qualities, and the direction of change is what matters in terms of the transition probabilities. With these restrictions, the transition matrix becomes:

$$P^\theta = \begin{bmatrix} \pi_0 & \pi_+(1) & \pi_+(2) & \pi_+(3) \\ \pi_-(1) & \pi_0 & \pi_+(1) & \pi_+(2) \\ \pi_-(2) & \pi_-(1) & \pi_0 & \pi_+(1) \\ \pi_-(3) & \pi_-(2) & \pi_-(1) & \pi_0 \end{bmatrix}$$

### 3.5 Home Production Technology

There is a public good that is domestically produced using the domestic labor supplies of the partners as inputs. The intra-household production technology is given by  $Q(d_m, d_f, g)$ , where  $d_m, d_f$  are the partners' number of housework hours and  $g$  is the amount of goods purchased in the market for the production of the public good. The output of the intra-household production process is not observable and is not marketable. At age  $a$ , the public good is produced according

to the following technology:

$$Q_a = (d_{m,a}^\nu + d_{f,a}^\nu)^{\frac{1}{\nu}} g$$

### 3.6 Budget Constraint

The couple's income is given by the sum of their earnings and non-labor income,  $w_a^m h_a^m + w_a^f h_a^f + Y$ . The cost of children is a function of the number of children in the household. The price of the public good  $g$  is normalized to be 1, so that the budget constraint that a married/cohabiting couple faces is:

$$\varphi(n_a) + \varphi(n_{m,a}) + \varphi(n_{f,a}) + g = w_{m,a} h_{m,a} + w_{f,a} h_{f,a} + Y$$

where  $Y$  is the total non-labor income of the couple.  $\varphi(n_a)$  is the cost of children and is given by:

$$\varphi(n_{i,a}) = \zeta_1 n_a + \zeta_2 n_a^2$$

Also,  $\varphi(n_{m,a})$  and  $\varphi(n_{f,a})$  are the cost of children that are not from the current partnership. The parents pay only a certain proportion of the total cost of their children from previous relationships in this case.

For a single individual, the budget constraint is:

$$\varphi(n_a) + g = w_a h_a + Y_i$$

### 3.7 Household's Problem

The problem of a cohabiting/married couple is as follows. The first best allocation to the couple's problem can be derived by solving the following social planner's problem:

$$\begin{aligned} \max_{h_{m,a}, h_{f,a}, l_{m,a}, l_{f,a}, p_a} & \mu_m \sum_a^A \beta^a u(l_{m,a}, Q_a, n_a, n_{m,a}, n_{f,a}, p_a, \theta_a; \varepsilon_{m,a}, \Omega_{m,a}, j) \\ & + (1 - \mu_m) \sum_a^A \beta^a u_f(l_{f,a}, Q_a, n_a, n_{m,a}, n_{f,a}, p_a, \theta_a; \varepsilon_{f,a}, \Omega_{f,a}, j) \end{aligned}$$

The couple chooses the male and female labor market hours ( $h_m, h_f$ ) as well as their housework hours ( $d_m, d_f$ ), and whether to get pregnant that period or not ( $p$ ). The couple does not have access to a commitment technology, therefore we formulate the Pareto problem with participation

constraints so that the problem becomes:

$$\begin{aligned}
& \max_{h_{m,a}, h_{f,a}, l_{m,a}, l_{f,a}, p_a} && \mu_{m,a} \sum_a^A \beta^a u(l_{m,a}, Q_{m,a}, n_a, n_{m,a}, n_{f,a}, p_a, \theta_a; \varepsilon_{m,a}, \Omega_{m,a}, j) \\
& && + (1 - \mu_{m,a}) \sum_a^A \beta^a u_f(l_{f,a}, Q_{f,a}, n_a, n_{m,a}, n_{f,a}, p_a, \theta_a; \varepsilon_{f,a}, \Omega_{f,a}, j) \\
& \text{s.t.} && \sum_{r=a}^A \beta^{r-a} u(l_{m,a}, Q_{m,a}, n_a, n_{m,a}, n_{f,a}, p_a, \theta_a; \varepsilon_{m,a}, \Omega_{m,a}, j) \geq \bar{V}_{m,a} \\
& && \sum_{r=a}^A \beta^{r-a} u_f(l_{f,a}, Q_{f,a}, n_a, n_{m,a}, n_{f,a}, p_a, \theta_a; \varepsilon_{f,a}, \Omega_{f,a}, j) \geq \bar{V}_{f,a}
\end{aligned}$$

We can reformulate this problem in its recursive form using the approach of Marcat and Marimon (2000) and Mazzocco and Yamaguchi (2006) where they expand the set of state of variables by including a new state variable,  $M_{ia}$  that denotes the Pareto weight plus the cumulative sum of the Lagrange multipliers on the participation constraints at all periods from 1 to  $t$ . Hence, whenever spouse  $i$ 's participation constraint binds, the weight on this utility function is increased. Divorce is an efficient outcome in this problem and it occurs whenever there are no more gains to staying married.

## 4 Data

We use observations from the 1979 cohort of the National Longitudinal Survey of Youth (NLSY79), a nationally representative sample of 12,686 men and women who were 14-22 years old at the time of the initial 1979 survey. We focus on members of the cross-sectional sample, a group of 6,111 youths chosen to be representative of the non-institutionalized civilian segment of the United States population in that age group. Members of this sample was re-interviewed annually from 1979-1994 and bi-annually since then, the most recent available wave being in 2006, when members of the sample were aged 41-49. In each wave, it was determined for all un-married respondents whether they were living with a member of the opposite sex whom they identified as a "partner." We therefore see all instances of marriage or cohabitation in which the couple are living together at the time of the survey.

The sample is 49.1% male. Racially, 12.3% of the sample identify themselves as black, and 7.3% as Hispanic. Approximately half (48.6%) have attended some college by the end of the sample period. Cohabitation is a extremely common for this cohort with 38.4% of the sample cohabiting at some point during the survey period. Variation in cohabitation rates by race are small, with 38.1% of whites and 40.2% of blacks cohabiting at some point. Differences by

education level are more pronounced with 33.6% of those with at least some college cohabiting compared to 43.0% of those with no college education.

Eighty-two percent of respondents enter into legal marriage during the sample period. Unlike cohabitation rates, there is significant variation in marriage rates by race with 85.7% of whites, 79.1% of Hispanics and just 60.7% of blacks marrying. Differences in marriage rates by education are small, 83.6% for those with some college compared to 80.7% of those without. Interestingly, we find that whether a respondent ever marries is uncorrelated with whether or not he or she ever cohabits.

Over the course of the sample period, we observe the respondents in 7,424 relationships with distinct partners. In 38.3% of these, the couple lives together un-married, either before or without ultimately getting married. Of all cohabiting relationships, 47% eventually result in marriage. Conversely, we observe that 23% of marriages begin as cohabiting relationships. The true number is likely higher as our tabulation excludes episodes of pre-marital cohabitation that were sufficiently short that respondent was not interviewed during the period. In Figure 5 and 6, we show the rates at which cohabiting couples marry, plotted against the length of the relationship. We disaggregated by race in Figure 5 and by education in Figure 6. For all groups, as the couple cohabits longer, the likelihood that they convert the relationship into a legal marriage decreases. Cohabiting whites are more likely than blacks or Hispanics to marry, as are those with some college compared to those without.

In Figure 7, we plot the rates of marriage and cohabitation by age for the different racial groups. We see an high rate of relationship formation into the mid-twenties. By age 24, 8-9% of the sample is cohabiting, with significantly higher fractions of the group married: 44% for whites, 40% for hispanics and 25% for blacks. As the cohort ages into their late 20's, the percentage of white respondents who are married continues to rise steadily but the growth of married blacks and hispanics, while still positive, slows dramatically. Looking at the cohabitation rates during these years, we see that the relative increase in marriage rates among whites is balanced by a relative increase in cohabitation rates by blacks and Hispanics. Cohabitation rates among white respondents peak at 8% at age 27, but continue to increase until age 32 for blacks and Hispanics, peaking at 11% and 12% respectively. At older ages, all groups reach a steady state with 70% of whites, 55% of hispanics, and 34% of blacks married. Cohabitation rates decline slowly from age 30 until the end of the sample period, when they reach 5-7%.

We next wish to examine the difference in behavior between marital and cohabiting relationship. The largest difference is that rate at which the the relationships dissolve. In Figures 8 and 9, we plot the hazard rate of relationship dissolution, defined as the probability that a married or cohabiting respondent no longer identifies the current spouse/partner as a spouse or partner in the following year's interview. We plot this rate by the length of the relationship, and include

only observations before 1994, when the survey switched to a bi-annual format. The results are disaggregated by race in Figure 8 and by education in Figure 9. In general, cohabiting relationships are roughly two to three times as likely as marital relationships to dissolve in a given year. For both marriages and cohabitations, the relationships of white respondents are the least likely to dissolve, those of black respondents the most likely. Respondents with at least some college tend to have more stable marriages than those without.

Our model predicts that because cohabiting couples have a lower level of commitment and are more likely to dissolve the relationship, they are less able to specialize. Traditionally, the male partner specializes in labor-market production and the female partner in home-production, so we hypothesize that married or cohabiting women should work less in the labor force and more at home than single women, but that this effect should be stronger for married women. As a simple descriptive test of this hypothesis, we regress the number of hours worked by women on dummy variables for marital and cohabitation status, controlling for age and children and including person-specific fixed effects. The results of this regression are shown in Table 4. We find that married women do work less than single women, but the effect of cohabitation compared to being single is statistically insignificant. A similarly specified regression for men reveals that both cohabiting and married men tend to work more than single men, with married men working more than those cohabiting.

The other important behavioral outcome of our model is time spent on home production. The NLSY does not include information on hours worked at home<sup>4</sup>. Instead, we draw information on housework hours from the Panel Study of Income Dynamics (PSID), a longitudinal study that began with 4800 representative households in 1968. Members of these households and of households formed by their descendants were re-interviewed every year from 1968 to 1996 and bi-annually thereafter. The core PSID sample consists of two independent samples: a cross-sectional national sample, known as the SRC (Survey Research Center) sample, and a national sample of low-income families, known as the SEO (Survey of Economics Opportunities) sample. In 1990 and 1997, a supplemental sample of Latino households and Immigrant families were added to the core PSID sample. The estimation sample used in this paper includes only those individuals who are associated with families from the SRC.

Ascertaining marital and cohabitation status in the PSID is not as simple as in the NLSY. For the years 1968-1977, the PSID does not make the distinction between marriage and permanent cohabitation, and identifies a respondent in either kind of relationship as “married.”. Starting in 1978, the survey records the legal marital status of the head, which can be used to distinguish between those who are legally married and those who are cohabiting. After 1993, the survey

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<sup>4</sup>There is information on housework hours from a time-use survey, but this was conducted only in the 1981 wave.

asks only for the legal marital status so it is no longer possible to distinguish a respondent who is single from one who is cohabiting using these questions.

Alternatively, starting in 1983, the PSID records in greater detail the relationship of each member of the household to the head. First-year cohabiters are identified by a special code, as are “permanent cohabiters,” defined as those cohabiters who have been in the household long enough to have appeared in an earlier wave of the survey. (Information such as hours worked that is collected for wives is also collected for permanent cohabiters.) From the relationship code assigned to the head’s wife or partner, we are able to construct an alternative measure of the relationship’s status.

For our tabulations, we use both approaches to identify married and cohabiting couples, using one if the other is ambiguous, and discarding the few observations where the two measures contradict each other.

The method by which we identify married and cohabiting couples does not let us clearly identify the relationship status of any observations before 1977. We also do not use observations after 1997, when the PSID switched from an annual to a bi-annual format. We use only heads of household and their wives or cohabiting partners. Finally, we restrict our analysis to the original SRC sample and eliminate those respondents for whom a relationship status is ever ambiguous.

This leaves us with a sample containing 170,637 observations of 12,048 distinct individuals between 1977 and 1997. Fifty-one percent of the sample is female, 18.1% have at least some college, 86.7% identify themselves as white and 10.5% as black.

During the years in which these respondents are surveyed, 45.4% are observed to be married and 9% to cohabit (these include the 6.1% who are observed both cohabiting and married). Because we do not observe typical respondents for as many years as those in the NLSY, these numbers are considerably smaller than the statistics from the NLSY. When broken down by race, we find that white respondents are much more likely to have been married than black respondents (47.5% compared to 29.6%) but just as likely to cohabit (8.1% of white respondents compared to 8.9% of black). Differences are much more pronounced when analyzed by education. Among respondents with at least some college, 75.5% are observed to be married at some point during the sample period and 13.4% to cohabit, compared to just 55.4% married and 10.9% cohabiting for those with less education. These patterns are similar to those observed in the NLSY79 cohort.

We next consider the choice of relationship status by the joint education status of couples. Among couples in which both members have at least some college, 6.4% cohabit at some point, including those who do or do not eventually marry. This statistic is similar, 6.9%, for couples in which neither partner has some college education. Among couples with different educational status, 11.5% of those in which the female has more education cohabit at some point compared

with just 6.9% in which the male has more education. Couples in which the woman has more education than the man stand to gain particularly little from specialization into traditional gender roles. The fact that these couples are far more likely to cohabit than any other combination of education supports out hypothesis that couples who form cohabiting relationships are less motivated by the gains from specialization.

Having described the marriage and cohabitation patterns of our PSID sample, we consider the differences in housework hours between couples of different relationship status. Single men supply an average of 9.3 hours per week of housework compared to 14.4 for single women. In married couples, the wife performs an average of 23.9 hours of housework and the husband 7.2. The corresponding numbers for cohabiting couples are 17.1 hours for the female partner and 9.4 for the male partner, suggesting that cohabiting couples do engage in significantly less traditional gender specialization than married couples. To be more careful about other factors that might affect the division of housework, we regress the hours of housework for both partners on dummies for the relationship status, controlling for number of children, hours worked in the labor market by both partners, and person-specific fixed effects. The results of this regression are shown in Table 5. We find that in legal marriages, compared to cohabitation, the wife works an additional 1.9 hours per week in the house and the husband 2.0 hours fewer. Thus our conclusion regarding the effect of the relationship status on specialization seems fairly robust.

## 5 Estimation Method

Estimation is carried out by simulated method of moments where the model parameters are chosen to minimize a weighted average distance between a set of sample moments and moments simulated from the model. The moments used in the estimation are listed below. Moments related to the couples' labor supply behavior are as follows:

1. Number of hours worked and wages by work by experience, education level, number of kids. These moments are separately calculated for single, married and cohabiting individuals.
2. Number of hours and wages worked by characteristics of the married or cohabiting partner.
3. Standard deviation of wages and the correlation between the wages of husbands and wives for cohabiting and married unions.

Moments related to the marital formation and dissolution behavior of agents are:

1. Overall separation rate among married unions.
2. Overall separation rate among cohabiting unions.

3. Separation rate by length of relationship among those couples who are cohabiting as well as those who are married.
4. Number of children by relationship status.
5. Transition rates between different marital status and living arrangements.
6. Transition rates between relationship status, and having a child in subsequent periods.
7. Hazard rates out of marriage and being single, or out of being in a cohabiting union, into different states.
8. Average length of relationship by race and education.

The method of moments estimator used is defined as follows:

$$\min g(\theta)'Wg(\theta) \tag{1}$$

The weights are the inverse of the estimated variances obtained from the micro-data, divided by the number of individuals that contribute to each moment.  $g(\theta)$  is defined as follows:

$$g(\theta) = \frac{1}{N} \sum_{i=1}^N g_i(\theta) = [\bar{m}^1 - \mu^1(\theta), \dots, \bar{m}^K - \mu^K(\theta)] \tag{2}$$

where  $\{\bar{m}_1, \dots, \bar{m}_k, \dots, \bar{m}_K\}$  correspond to each of the data moments defined above, and  $\{\mu_1(\theta), \dots, \mu_k(\theta), \dots, \mu_K(\theta)\}$  are the corresponding model moments.  $N$  denotes the number of individuals in the sample.

## 6 Conclusion

The results from the two-period model indicate that choices about non-marital cohabitation have important implications for patterns of marital sorting, and degree of specialization in the household. As returns to specialization fall, the number of cohabiting couples increase, and the degree of positive assortative mating falls for cohabiting unions. The level of the divorce penalty is a strong determinant of these patterns.

More importantly, our results indicate that the patterns of marital sorting by type of union formed, can have important information about the home production technology as well as the degree of commitment the couple has access to in their relationship. The simple two period model is able to generate the differences in the labor supply, housework hours and patterns of marital sorting of members of cohabiting and married unions that we observe in the data. We

next estimate the full dynamic model in order to perform policy experiments, and assess the welfare implications of inefficiencies that may arise in co-residential relationships.

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Table 1: **Parameters used for the Decision Rules**

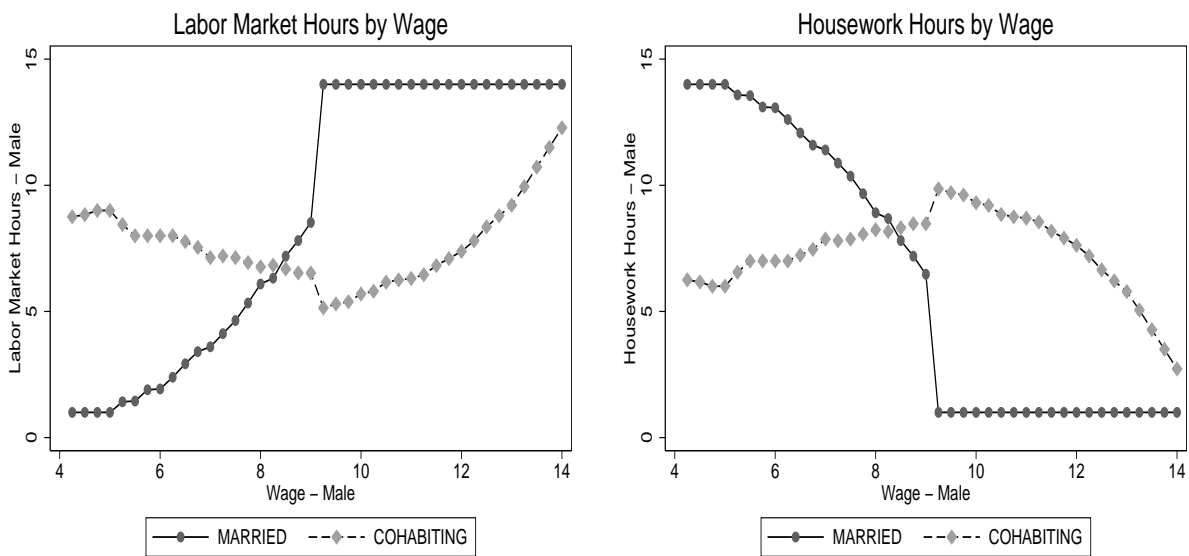
$\kappa_C$	0
$\kappa_M$	-100
$\gamma$	1
$\underline{\theta}$	-60
$P_{\theta}(\underline{\theta})$	0.5
$P_{\theta}(\bar{\theta})$	0.5
$\lambda_m$	0.5
$\lambda_f$	0.5
$\nu$	2.25
$\sigma_l$	0.5
$\sigma_Q$	0.5

# DECISION RULES USING THE TWO-PERIOD MODEL - SPECIFICATION 1

Table 2: Spouse Differences in Hours Worked by Relationship Choice

	Market Hours	Housework Hours
Married	13	13
Cohabiting	6	6

Figure 1: Hours by Wage and Relationship Choice in First Period



# DECISION RULES USING THE TWO-PERIOD MODEL - SPECIFICATION 1

Figure 2: Sorting Patterns by Relationship Choice

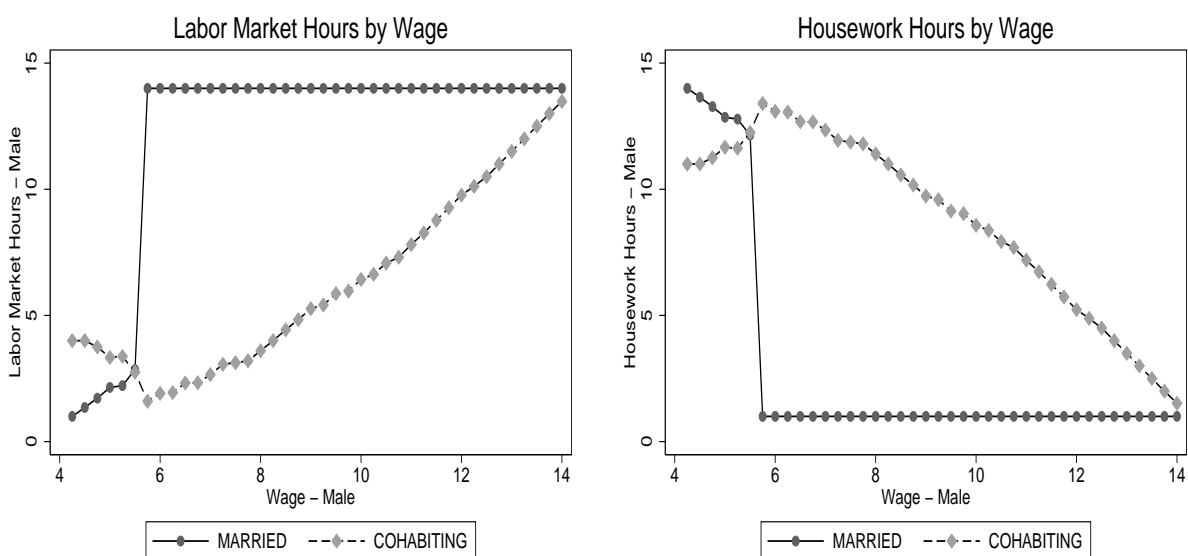


DECISION RULES USING THE TWO-PERIOD MODEL - SPECIFICATION 2

Table 3: Spouse Differences in Hours Worked by Relationship Choice

	Market Hours	Housework Hours
Married	13	13
Cohabiting	12	12

Figure 3: Hours by Wage and Relationship Choice in First Period



# DECISION RULES USING THE TWO-PERIOD MODEL - SPECIFICATION 2

Figure 4: Sorting Patterns by Relationship Choice



Figure 5: Proportion of Cohabiting Unions who Marry By Race

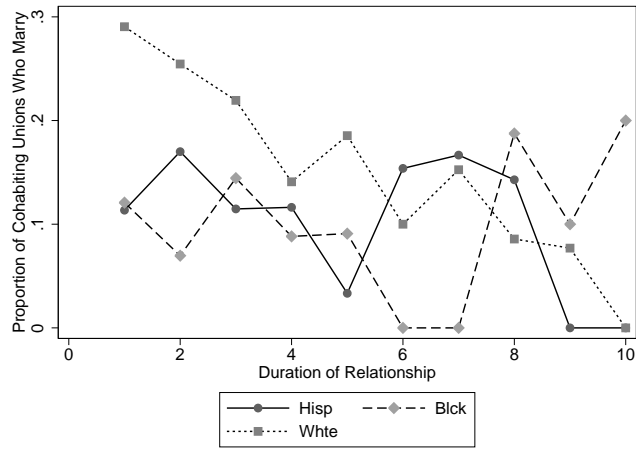


Figure 6: Proportion of Cohabiting Unions who Marry By Education

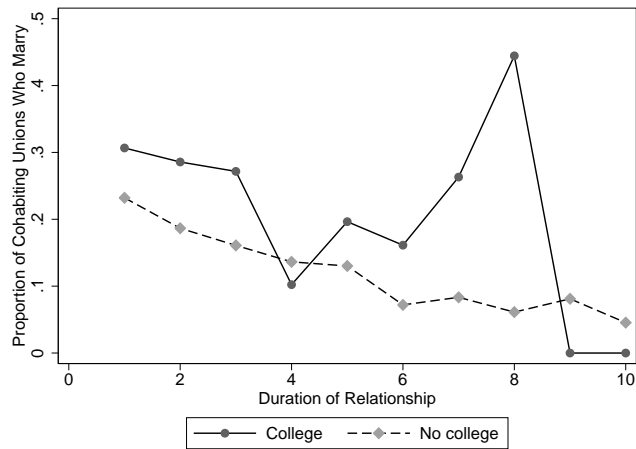


Figure 7: Marriage and Cohabitation Rates by Age

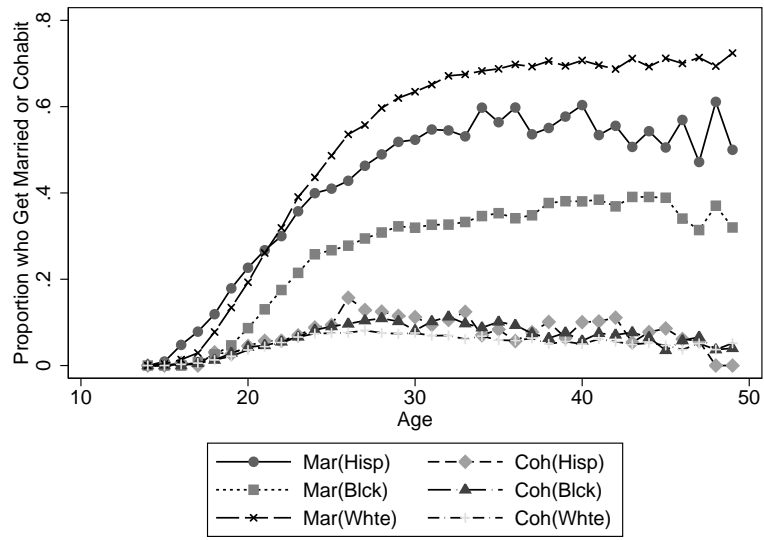


Figure 8: Proportion of Unions that Dissolve By Race

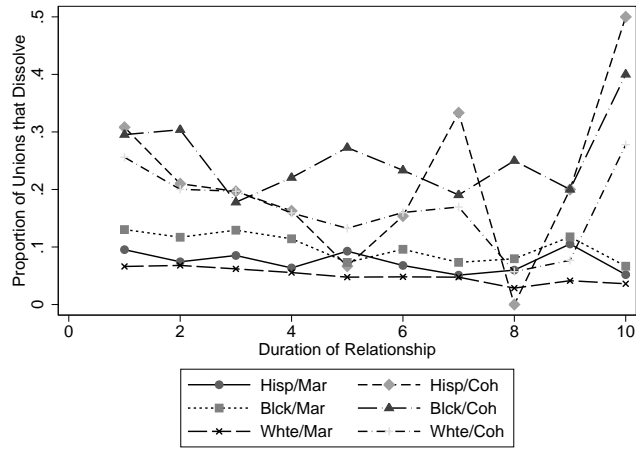


Figure 9: Proportion of Unions that Dissolve By Education

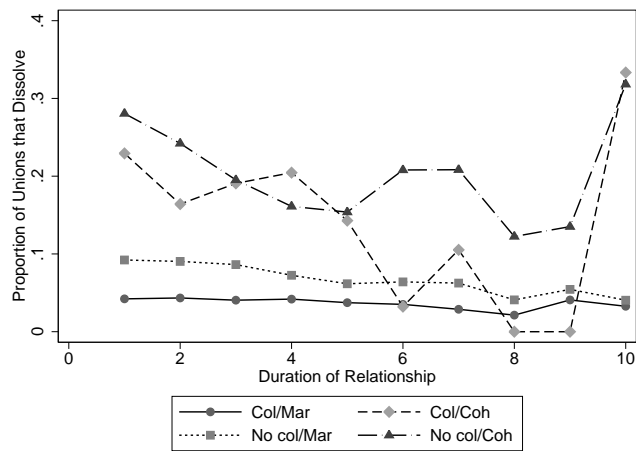


Table 4: **Regression of Hours Worked**

Dependent variable is the total number hours spent working in the previous calendar year at all jobs. The regression includes dummies for married or cohabiting households, with singles the excluded category. Individual fixed effects are included. The regressions for men includes 55,760 observations of 2,997 distinct respondents. The regressions for women includes 59,599 observations of 3,107 distinct respondents. Standard errors are in parentheses.

	Male		Female	
Age	239	(3.2)	249	(3.3)
Age squared	-3.23	(.051)	-3.31	(.051)
one child	19.4	(13)	-416	(11)
two children	-7.1	(14)	-674	(12)
>2 children	-33.8	(18)	-842	(16)
Married	168	(11.2)	-85.5	(9.0)
Cohabiting	127	(15.6)	-9.32	(14.5)
constant	-2302	(46)	-2565	(47)
$R^2$		.19		.16

Table 5: **Regression of Housework Hours**

Dependent variable is weekly hours spent on household production, the answer to the question “About how much time do you [or does your spouse] spend on housework in an average week, I mean time spent cooking, cleaning and doing other work around the house.” The regression includes only married or cohabiting households, with cohabiting the excluded category. Household fixed effects are included. The regression for the wife’s hours includes 52,556 observations of 5,169 distinct households. The regression for the husbands’s hours includes 51,525 observations of 5,593 distinct households. Standard errors are in parentheses.

	Husband’s Hours		Wife’s Hours	
Married	-2.04	(.17)	1.9	(.37)
Husband’s work hours	-.075	(.002)	.070	(.004)
Wife’s work hours	.029	(.002)	-.29	(.004)
one child	.60	(.09)	3.52	(.16)
two children	.93	(.10)	5.58	(.17)
>2 children	1.35	(.13)	8.21	(.22)
constant	11.1	(.19)	23.3	(.21)
$\bar{R}^2$		.05		.22