Prenuptial Contracts, Labor Supply and Household Investments*

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Abstract

This paper examines prenuptial contracts that allow couples in Italy to choose, at virtually no cost, how their assets will be divided in case of divorce. Unique administrative data on marriages and divorces from 1995 to 2011 indicate that the majority of newlyweds (67% in 2011) choose to forgo the default community property regime and to maintain separate property, which in other countries would require signing a costly prenuptial contract. In addition, the data suggest that couples choose community property to provide insurance to wives who forgo labor market opportunities and undertake household-specific investments. We estimate a dynamic model of marriage, female labor supply, savings and divorce to match the patterns of regime choice and outcomes observed in the administrative data. The estimates suggest that, as the rate of female labor participation increases and the gender wage gap decreases, there are increasing gains from separate property. Hence, lower costs of prenuptial contracting, as occurs in Italy and other civil law countries, might lead to substantial welfare gains for both husbands and wives, greater rates of female labor participation, lower probability of divorce and higher rates of household savings.

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Supporting the specialization of household members between market and home production activities is a fundamental purpose of family life (Becker, 1991). When women have a comparative advantage in home production, it might be optimal for the household to have wives undertake substantial household-specific investments and forgo labor market opportunities. As a result of this investment, women's human capital typically depreciates, hindering their ability to support themselves in case of divorce. Hence, if the risk of divorce is high, specializing in home production can be costly for women if husbands cannot commit to income transfers after the end of the marriage.

This paper studies whether couples use prenuptial contracts that establish property rights over household resources to promote efficient levels of intra-household specialization and labor market participation of wives. We examine an environment in which the financial and effort cost of signing a particular kind of prenuptial contract are very low: by marking their choice on the marriage license application, Italian couples can choose at the time of marriage how their marital property will be divided in case of divorce. Such a choice can be done at no upfront cost, and is regularly enforced by courts.

In this context, similarly to other civil law countries, two regimes can be chosen, which are the most prevalent systems of property allocation around the world (The World Bank, 2012). The default regime is *community property*, which presumes that the assets accumulated during the marriage belong to both spouses and are divided equally in case of divorce, irrespectively of who financially contributed to the purchase. The alternative regime is *separation of property*, in which spouses hold separate assets that they keep in case of divorce. As a comparison, community property is the legal regime in place in several U.S. states and it is broadly comparable to the nationwide default, while obtaining separation of property requires signing a prenuptial agreement in the United States.[1]

Data from the national statistical institute (ISTAT) indicate that separation of property is a popular choice among Italian couples: in 2011, 67% of newlyweds agreed to a separation of property regime, forgoing the default community property.[2] Such a rate is relatively high compared to estimates of the take up of prenuptial agreements in the United States, which is often indicated to be approximately 10% (Rainer, 2007; Mahar, 2003). These numbers suggest that the high upfront costs might partly explain the low take up of prenuptial agreements in the United States, although the regime choice examined in this paper captures only a subset of the the type of contracts that can be obtained through an actual prenuptial agreement.

It is worth noticing that a sizable fraction of couples (33% in 2011) chooses to keep their assets

[1] During the 1970s and '80s, the legal division of property upon divorce changed radically in most U.S. states. Traditionally, spouses held separate property that they would keep in case of divorce. Today, property is usually divided by courts irrespectively of who holds the formal title of ownership (Turner, 2005) and in many states marital assets are assumed to be community property that belong in equal shares to both spouses.

[2] If community property were not the default option, its prevalence could potentially be even lower, as default options appear to have a large impact on household financial decision (Madrian and Shea, 2001).

in community property. The fraction of households choosing to maintain the default regime of community property was as high as 60% in 1995, and has been steadily declining ever since. Choosing this regime greatly restricts the set of property allocations compared to separation of property: households in community property commit to dividing assets exactly equally in case of divorce, irrespectively of spouses' relative contribution to household income. On the contrary, separation of property grants greater flexibility to spouses' assets accumulation, but does not allow for *ex ante* commitment over asset allocation, because throughout the marriage, whenever they purchase an asset, spouses will have to specify who owns it and in what proportion.

We use unique administrative data on the universe of marriages, divorces and separations to examine the choices of property regime by Italian couples from 1995 to 2011 and how household characteristics and outcomes are correlated with the regime chosen. We document that marriages in which the wife does not participate in the labor market and which have more children are also more likely to have chosen community property, while households in which the wife works and contributes to a greater fraction of household income are more likely to choose a regime of separation of property. Marriages in which the wife is more educated, and hence has a greater opportunity cost of specialization, are more likely to choose separation of property, even controlling for the educational achievement of the husband.

We also show that geographic variation in the cost of childcare due to changes in the resources of local governments, which provide public childcare, are associated with corresponding changes in regime choice: when local governments reduce the supply of public childcare, women are less likely to participate in the labor market and couples are more likely to opt for community property.

These patterns in the data are consistent with the hypothesis that community property might serve as a way to provide insurance in case of divorce to the spouse who makes household-specific investments, which is typically the wife. Such a commitment comes at the cost of lower flexibility compared to separation of property, as property can only be divided fifty-fifty in community property, while any sharing rule can be achieved in separation of property.

To capture this mechanism and the tradeoff in regime choice, we build a stochastic dynamic model of marriage, savings, labor supply and divorce. The basic formulation of this model, which follows from the literature on risk sharing with limited commitment (Kocherlakota, 1996) and has been often applied to household decision making, cannot explain why some couples might prefer restricting their future choices by electing community property: we show that, as long as households make *ex post* efficient decisions, separation of property is the constrained efficient property division regime even under limited commitment. The proof relies on the time consistency of the household planning problem, up to a change in the intra-household allocation parameters (Marcet and Marimon 2011).

To capture the fact that a sizable fraction of couples elects community property, and in

particular couples in which the wife undertakes a substantial household-specific investment, we modify the basic limited commitment model to accommodate an endogenous non-cooperative phase that (possibly) precedes divorce. Spouses anticipate that they may choose not to cooperate in the periods preceding divorce, and that such non-cooperative behavior will cause the allocation of property at divorce to depart from the efficient one, i.e. the allocation that allows both spouses to smooth the marginal utility of consumption when transitioning into a divorce. If this is the case, spouses might prefer at the time of marriage to constrain their property allocation options and guarantee that, if the wife intends to make a household-specific investment, she can receive a fixed and sizable share of household assets, as ensured by community property.

We estimate the model by the method of simulated moments (calibrate at this stage), targeting, among other moments, the take up rates of separation of property and its change following exogenous changes in childcare costs. We then use the estimated model to perform welfare and counterfactual analysis. The estimates indicate that the gains from separation of property increase as women's contribution to household income increases, and that allowing households to opt out of community property might lead to higher rates of female labor market participation, lower divorce rates and higher saving rates.

1 Prenuptial contracts and property division

Divorce was introduced in Italy in 1970, and confirmed with a referendum on May 11th 1974.[3] In the following year, a reform of family law introduced *community property*, a regime that presumes that all assets accumulated during the marriage are jointly owned by the spouses, irrespectively of the relative financial contributions, as long as these assets are not the result of bequests or gifts.[4] Previously, couples held their assets separately, in a regime called *separation of property*. The reform allowed couples to choose between community property and separation of property, with community property as the default option.[5] This system is still in place today, and the choice between the two regimes can be done at the time of marriage at no cost. After marriage, any change to a marital property regime chosen at the time of marriage requires a bilateral contract in the presence of a notary.

The primary difference between the two regimes arises in case of divorce. In community property, assets that are acquired after marriage are divided equally between husband and wife, irrespectively of spouses' individual financial contributions. Both spouses' names appear on the titles to all household assets, which cannot be sold or liquidated without the authorization of both spouses. In separation of property, each asset is assigned to the spouse who holds the

[3]Law no.898 of December 1st 1970, *Disciplina dei casi di scioglimento del matrimonio.*

[4]Law no.151 of May 19th 1975.

[5]Until 1978, couples that were already married before 1975 could opt out of community property through a *unilateral* notary act (i.e. even in the absence of the consent of one spouse).

formal title to the property (i.e., has his or her name on a bank account or on a vehicle or on a house an so on). Couples who have chosen separation of property can easily replicate community property by ensuring that each spouse's name appears on the formal title of every asset and account owned by the household.

While the central distinction between the two regimes arises in case of divorce, separation of property and community property might also have different implications for bequests in case of death of one of the spouses: in community property, one half of the household assets will be inherited by the members of the household (including the surviving spouses), while in separation of property, it is only the fraction of assets formally owned by the deceased which is divided between the heirs.

There is also one difference between the two regimes that is independent of divorce or widowhood. While there is no personal bankruptcy in Italy, there exists bankruptcy of non-incorporated businesses, which hence only involves self-employed workers who own non-incorporated businesses. In such case, the spouse's assets cannot be seized if the couple has chosen separation of property, but are seized in community property. Hence, separation of property provides a way of sheltering a fraction of household assets from the risk of bankruptcy. For this reason, whenever possible, we will confirm that our findings are robust to excluding couples in which at least one spouse is self employed.

2 Administrative data on property division regimes

This paper utilizes administrative data collected by the Italian National Institute of Statistics (ISTAT) between 1995 and 2011. The institute collects information on the characteristics of *every* marriage, separation and divorce occurred in Italy. Since 1995, information about the marital property regime chosen by the couple is available for all marriages. This leads to over 4 million of observation, on average 250,000 per year. Since 2000, the same type of information is also available for every divorce (over 400,000 observations) and separation (over 800,000 observations) records. Table 2 reports the number of observations included in the datasets.

2.1 Data on marriages

The administrative ISTAT data on choices at the time of marriage indicate that, over the past decade, separation of property has been the most common regime choice of Italian newlyweds: 67% in 2011, 66% in 2010 and 64% in 2009 of newlyweds have elected to hold their assets in a separation of property regime. Since the year 2000, more than half of Italians have made such a choice (Figure 1, panel a). The rates of separation of property are only slightly lower among first marriages and among couples with no self-employed spouse (Figure 1, panel b and c).

Table 1: **Number of observations in the administrative data**

year	separations	divorces	marriages
1995	-	-	290,009
1996	-	-	278,611
1997	-	-	277,738
1998	-	-	280,034
1999	-	-	280,330
2000	71,969	37,573	284,410
2001	75,890	40,051	264,026
2002	79,642	41,835	270,013
2003	81,744	43,856	264,097
2004	83,179	45,097	248,969
2005	82,291	47,036	247,740
2006	80,407	49,534	245,992
2007	81,359	50,669	250,360
2008	84,165	54,351	246,613
2009	85,945	54,456	230,613
2010	88,191	54,160	217,700
2011	-	-	204,830

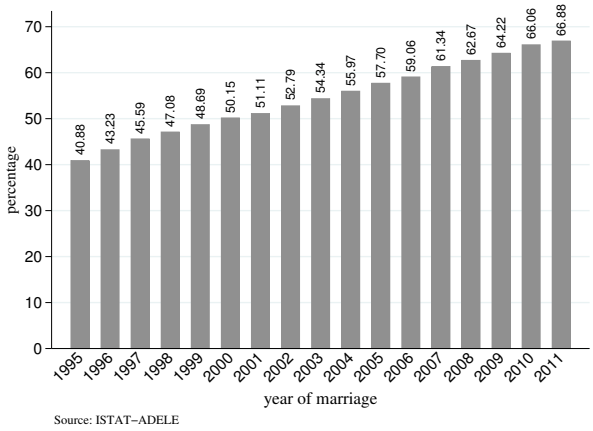
Note: Observations from the *Rilevazione dei matrimoni* (1995-2011), the *Rilevazione delle cessazioni degli effetti civili del matrimonio (divorzi)* (2000-2009) and the *Rilevazione delle separazioni* (2000-2009). The data provides information on the universe of couples marrying in each calendar year between 1995 and 2011 and divorcing or separating in each year between 2000 and 2009.

Family law experts indicate that community property is the most suitable regime for couples in which one spouse specializes in home production activities, while separation of property grants greater flexibility to couples in which both spouses are able to invest in their careers. As suggested by a Professor of Private Law at the University of Milan on a major newspaper:

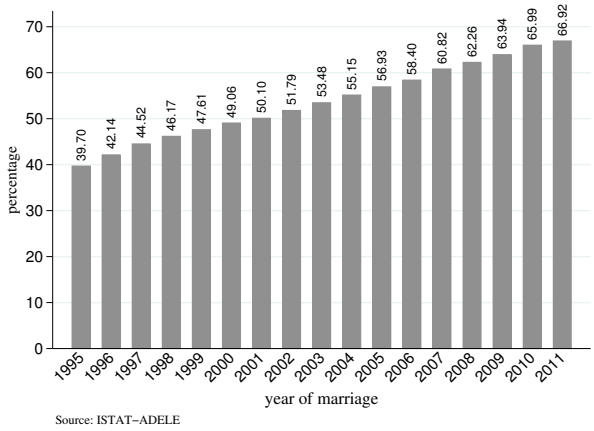
> "[...]separation of property can be recommended to those couples in which the burden of the family needs is equally distributed between the spouses. If instead the spouses plan to organize their life so that one of the two will be primarily dedicated to housework, leaving the other one free to devote itself to its career, then community property is a choice that should be carefully considered." (Rimini 2012, translated from Italian).

The administrative data reveal that separation of property is systematically correlated with predictors of intra-household specialization. Households in which the wife reports to be a housewife tend to have chosen a community property regime, while households with a wife employed in the formal labor market are more likely to choose a separate property regime. We observe

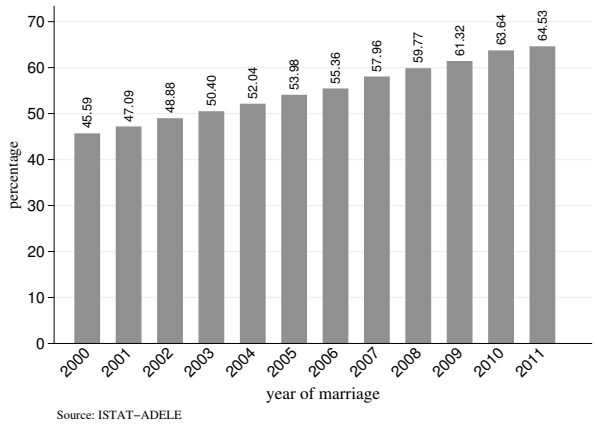
Figure 1: Percentage of newlyweds that choose a separation of property regime



(a) All marriages



(b) First marriages



(c) No self-employed spouse

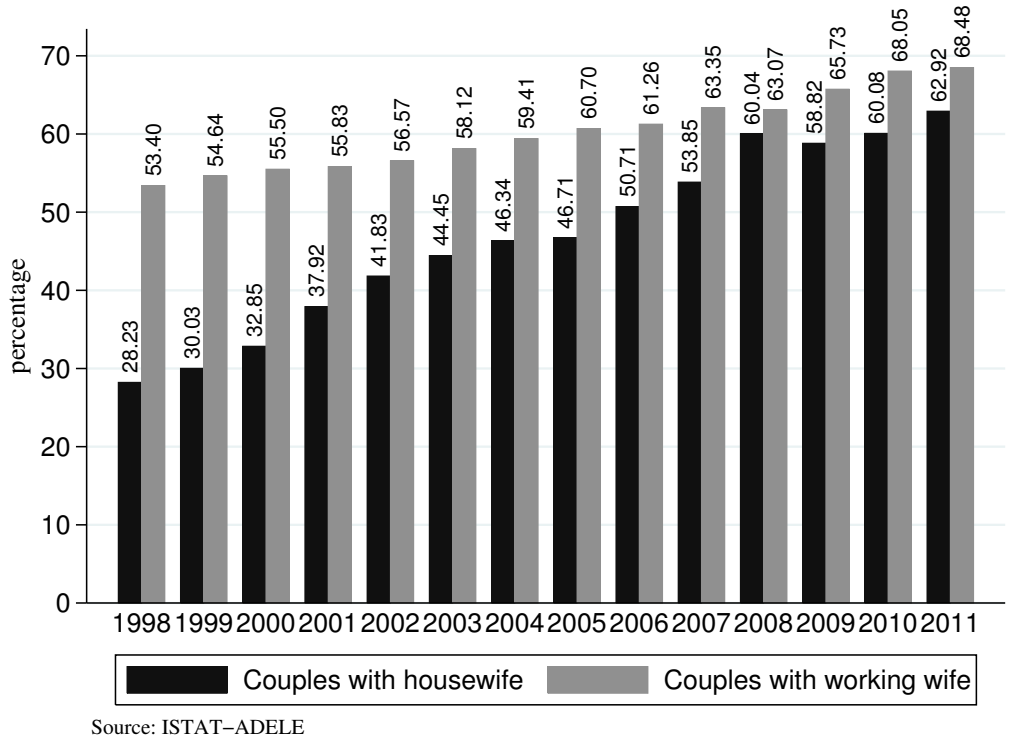
Data source: ISTAT. 1995-2011. *Rilevazione dei matrimoni.*

this relation across all years in the sample (Figure 2).[6]

We examine annual regime choice data aggregated at the provincial level. Provinces represent a relatively small geographic unit, corresponding to a labor market. Examining data on the choice of regime at the provincial level over time indicates that changes in employment rates of women of marriage age are associated with changes in regime choice: higher rates of female employment among young women (25-34) are correlated with higher rates of separation of property (table 3, columns 1 and 2), while the correlation fades away for older women (35-44, see columns 3 and 4). The variable *% women employed 25-34* represents the annual employment rate among women aged 25-34 years residing in the province. The data for these variables comes from the *Labor*

[6]The probability that such a pattern would be generated randomly if there was no relation between employment status and regime choice is equal to $\frac{1}{2^{11}} < 0.001$.

Figure 2: Percentage of newlyweds that choose a separation of property regime by the wife's employment status



Data source: ISTAT. 1995-2011. *Rilevazione dei matrimoni.*

Force Survey (LFS) conducted quarterly by ISTAT. The estimates do not include households usually living abroad and permanent members of communities (religious institutes, army etc..).

The choice of separation of property is also correlated with spouses' education achievement, particularly the one of wives. Conditioning on the husband's education, the likelihood that a couple chooses separation of property is increasing in the wife's education for all years from 1995 to 2011 (see Figure 3). In a regression that controls for both spouses' educational attainment, geographic location of the household, spouse's age at marriage and spouses' self-employment status, the level of education of the wife is a statistically significant determinant of the regime chosen for every year, while the one of the husband is not statistically significant in some years, and especially in the more recent ones.

Such a pattern is consistent with the one of intra-household specialization because, in Italy, the educational attainment of a woman is highly correlated with the likelihood of employment: the average rate of labor market participation is 82% among married women under the age of 60 with a college degree, 64% among women with a high school degree and 39% among women with a middle school degree in the Survey of Household Income and Wealth (1998-2010).

Table 2: **Summary statistics**

	observations	mean	std.dev.	min	max
% employed age 25-34 female	820	58.8	16.9	20.5	85.1
% employed age 35-44 female	820	62.3	15.8	24.8	89.7
% childcare coverage	928	32.0	26.0	0.0	97.3
ln(municipal tax revenue)	911	10.4	0.8	3.1	12.9
unemployment rate	821	7.8	4.2	1.9	21.6
regional college education rate	841	13.2	2.4	9.1	19.6

Note: The variable *% childcare coverage* represents the percentage of children aged 0-2 years that reside in the province attending public infancy day-care services. This variable is part of the *Indagine sugli interventi e i servizi sociali dei comuni singoli o associati* collected every year by ISTAT since 2003. The variable *% women employed 25-34* represents the annual employment rate among women aged 25-34 years residing in the province. The data for these variables comes from the Labor Force Survey (LFS) conducted quarterly by ISTAT. The estimates do not include households usually living abroad and permanent members of communities (religious institutes, army etc..). The variable *% college graduates* represents the percentage of residents in the region between age 25 and 64 with tertiary education (college and above) attainment, part of the EUROSTAT Regional Statistics Database collected annually since 2000 for each region of the countries in the EU. The variable *ln(municipal tax revenue)* is the natural logarithm total revenues of the province accrued during the year through local property and income taxes. The data is collected yearly since 2003 by the local finance division of the Italian Ministry of Interior.

While the highest spousal educational attainment in a household might capture a better understanding of the institutional framework, the fact that a woman's educational attainment *conditional* on the one of the husband is positively correlated with the likelihood of choosing separation of property is harder to justify without accounting for patterns of labor supply. Moreover, lack of information is less of a concern in this context as couples typically learn about these regimes when taking pre-marital courses in their churches, required for couple who marry in a Catholic ceremony, which are approximately 60% of all ceremonies.

Variation in childcare costs is also associated with regime choice. Rationing of publicly-funded childcare is believed to greatly influence women's likelihood of timely re-entry in the labor market after pregnancy in Italy (Del Boca and Vuri, 2007). We examine province-level data on publicly-provided childcare: on average, only 32% of children aged 0 to 2 in a province have access to such services, for which often long queues and elaborate allocation mechanisms are devised (Table 2). There exists also a substantial amount of variation in the offer of these services, which is correlated with the resources of the local government (i.e. municipalities, provinces and regions, which are the three unites of local governments). Even within a province, the supply of public childcare fluctuates over time as a result of changes in the resources of local governments. We examine the correlation between changes in public childcare coverage in a province, measured as the percentage of children under the age of 2 who have access to publicly-provided childcare, and the percentage of newlyweds choosing separation of property in each year and province. We use the natural logarithm of local tax revenue as an instrument for childcare coverage in each

Table 3: Separation of property and female employment

	(1) % separation of property	(2) % separation of property	(3) % separation of property	(4) % separation of property
% employed women 25-34	0.223	0.080		
	(0.098)	(0.030)		
% employed women 35-44			0.111	-0.029
			(0.102)	(0.061)
Year fe.	Yes	Yes	Yes	Yes
Region f.e.	Yes	No	Yes	No
Province f.e.	No	Yes	No	Yes
Observations	829	821	861	745
R-squared	0.884	0.942	0.902	0.905
Clustered standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1				

Notes: Estimation equation is:

$$Percentage\,choosing\,separation\,of\,property_{p,r,t} = Percentage\,employed_{p,r,t} + \delta_t + \gamma_r + \epsilon_{p,r,t}$$

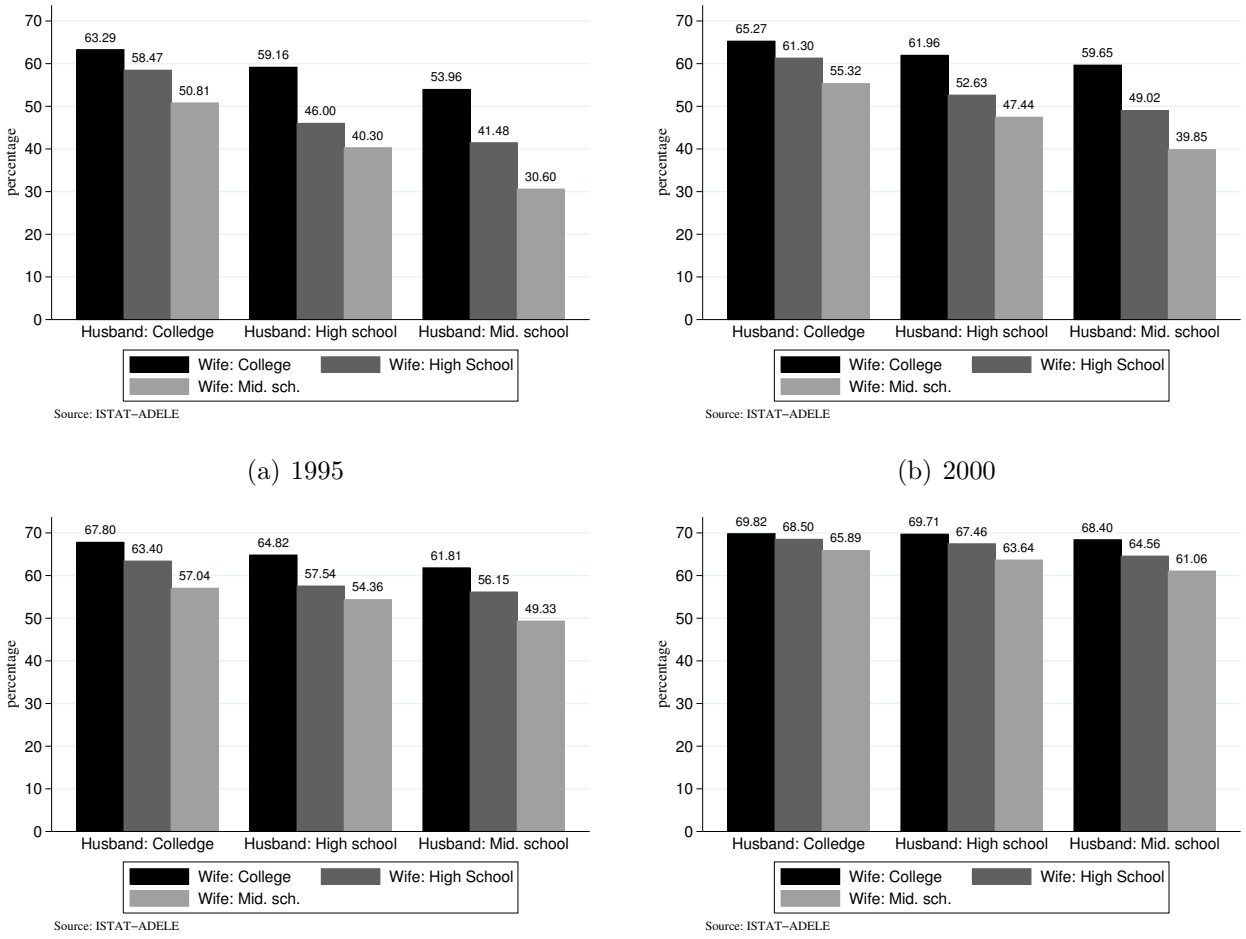
The variable *% separation of property* is based on ISTAT administrative data between 1995 and 2011 and represents the percentage of newlyweds who have chosen separation of property in a give year and province. The variable *% women employed 25-34* represents the annual employment rate among women aged 25-34 years residing in the province. The data for these variables comes from the Labor force survey (LFS) conducted quarterly by ISTAT. The estimates do not include households usually living abroad and permanent members of communities (religious institutes, army etc..).

province and year, estimating the following system:

$$\%\ childcare\ coverage_{p,r,t} = \lambda \cdot ln(municipal\ tax\ revenue)_{p,r,t} + \mu' X_{p,r,t} + \nu_r + \pi_t + \epsilon_{p,r,t}$$
$$\%\ separation\ of\ property_{p,r,t} = \alpha \cdot \%\ childcare\ coverage_{p,r,t} + \beta' X_{p,r,t} + \gamma_r + \delta_t + \upsilon_{p,r,t}$$

The variable *% childcare coverage* represents the percentage of children aged 0-2 years that reside in the province attending public infancy day-care services. This variable is part of the *Indagine sugli interventi e i servizi sociali dei comuni singoli o associati* collected every year by ISTAT starting in 2003. The variable *% college graduates* represents the percentage of residents in the region between age 25 and 64 with tertiary education (college and above) attainment, part of the EUROSTAT Regional Statistics Database collected annually since 2000 for each region of the countries in the EU. The variable *ln(municipal tax revenue)* is the natural logarithm total revenues of the province accrued during the year through local property and income taxes.

Figure 3: Percentage of newlyweds choosing a separation of property regime, by level of education of each spouse (Italy, 1995-2011)



(a) 1995

(b) 2000

(c) 2005

(d) 2010

Source: ISTAT. 1995-2011. "Rilevazione dei matrimoni." The data provides information on the universe of couples marrying in each calendar year between 1995 and 2010. Sample of first marriages.

The data is collected yearly since 2003 by the local finance division of the Italian Ministry of Interior.[7] The regressions control for year (δ_t) and region (γ_r) fixed effects, but not for province fixed effects. Hence, the regression also exploit time-invariant differences in provincial level characteristics *within* a given region.

The regressions indicate that a 1 percentage point increase in childcare coverage is associated with a 0.3 percentage points increase in the take-up of separation of property among newlyweds (table 4, column 7). This association is robust to controlling for socio-economic variables at the provincial and regional level (column 8): the variable *% college graduates* represents the

[7]Available online at `http://finanzalocale.interno.it/docum/index.html`.

percentage of residents in the region between age 25 and 64 with tertiary education (college and above) attainment, part of the EUROSTAT Regional Statistics Database collected annually since 2000 for each region of the countries in the EU, while the variable *Total unemployment rate* is also based on the Labor Force Survey provincial data.

Table 4: Separation of property and childcare costs

	(1) OLS	(2) OLS	(3) 1st stage	(4) 1st stage	(5) RF	(6) RF	(7) IV	(8) IV
	% separation of property	% separation of property	% childcare coverage	% childcare coverage	% separation of property	% separation of property	% separation of property	% separation of property
% childcare coverage	0.000	0.000					0.003	0.003
	(0.000)	(0.000)					(0.001)	(0.001)
ln(local tax rev)			6.557	7.158	0.024	0.020		
			(1.853)	(1.622)	(0.006)	(0.006)		
Year fe.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region f.e.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Total unempl. rate	No	Yes	No	Yes	No	Yes	No	Yes
% college graduates	No	Yes	No	Yes	No	Yes	No	Yes
Observations	928	747	912	745	1,219	753	911	744
R-squared	0.545	0.550	0.514	0.514	0.606	0.562	0.246	0.306

Clustered standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

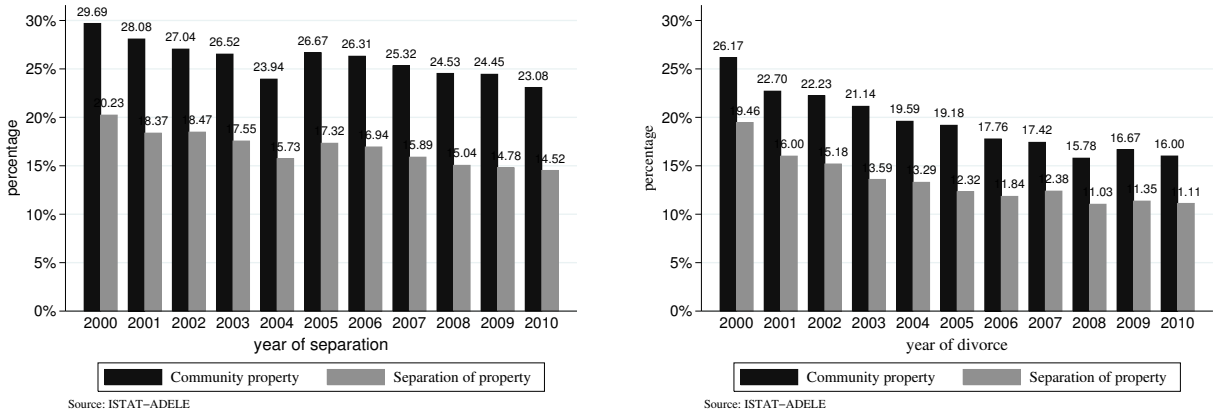
Notes: The variable *% childcare coverage* represents the percentage of children aged 0-2 years that reside in the province attending public infancy day-care services. This variable is part of the *Indagine sugli interventi e i servizi sociali dei comuni singoli o associati* collected every year by ISTAT since 2003. The variable *% women employed 25-34 (35-44)* represents the annual employment rate among women aged 25-34 (35-44) years residing in the province. The data for these variables comes from the Labor Force Survey (LFS) conducted quarterly by ISTAT. The estimates do not include households usually living abroad and permanent members of communities (religious institutes, army etc..). The variable *% college graduates* represents the percentage of residents in the region between age 25 and 64 with tertiary education (college and above) attainment, part of the EUROSTAT Regional Statistics Database collected annually since 2000 for each region of the countries in the EU. The variable *ln(municipal tax revenue)* is the natural logarithm total revenues of the province accrued during the year through local property and income taxes. The data is collected yearly since 2003 by the local finance division of the Italian Ministry of Interior, available online at `http://finanzalocale.interno.it/docum/index.html`.

2.2 Data on separations and divorces

The data on separations and divorces provides additional evidence that the choice between community property and separation of property is related to spouses' expected household-specific investments.

First, we observe that women in community property households are between 7 and 5 percentage points more likely report being housewives at the time of separation and at the time of divorce (figure 4, panel a and b).

Figure 4: Property regimes and female employment (Italy, 2000-2010)



(a) Wife is housewife at separation

(b) Wife is housewife at divorce

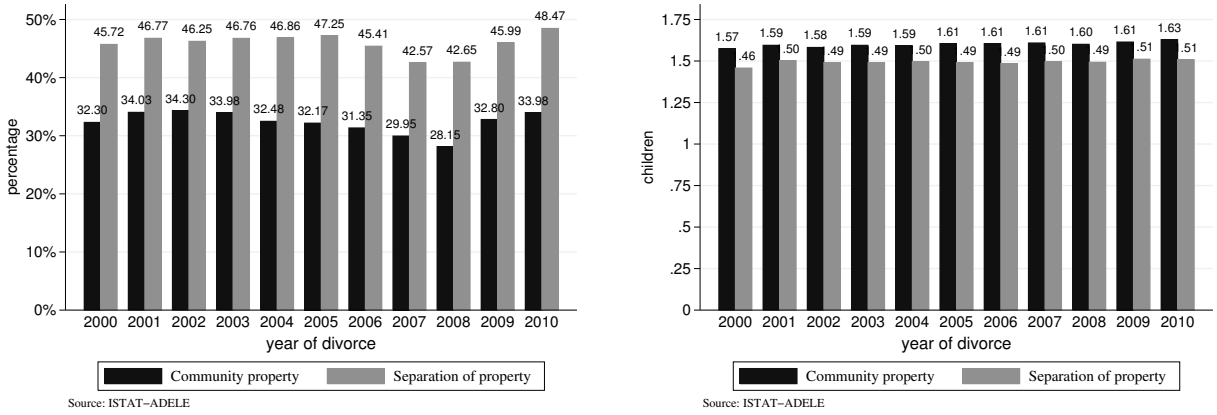
Data source: ISTAT. 2000-2010. *Rilevazione delle separazioni. Rilevazione dei divorzi.*

Household fertility outcomes are also consistently correlated with regime choice: household that had chosen separation of property are over 10 percentage points more likely to not have children at the time of divorce. Conditional on having children at the time of divorce, they have a lower number on average: approximately 1.5 in community property and 1.6 children in separation of property (figure 5, panel a and b).

The different extent of specialization is reflected in divorce settlements data: mothers in community of property are also 2 percentage points more likely to be assigned sole custody of children, as an alternative to joint custody (father custody is rare). Such an outcome might be more common among mothers working longer hours (figure 6, panel a). Also, women in community property households are 3 to 5 percentage points more likely to also be granted alimony as they transition into the labor market.

In sum, descriptive evidence from both the data about marriages, separations and divorces suggests that community property is more prevalent along households that have higher degrees of Beckerian specialization, i.e. households in which the wife makes a substantial household specific-investment, in particular towards the childrearing.

Figure 5: Property regimes and fertility outcomes at divorce (Italy, 2000-2010)

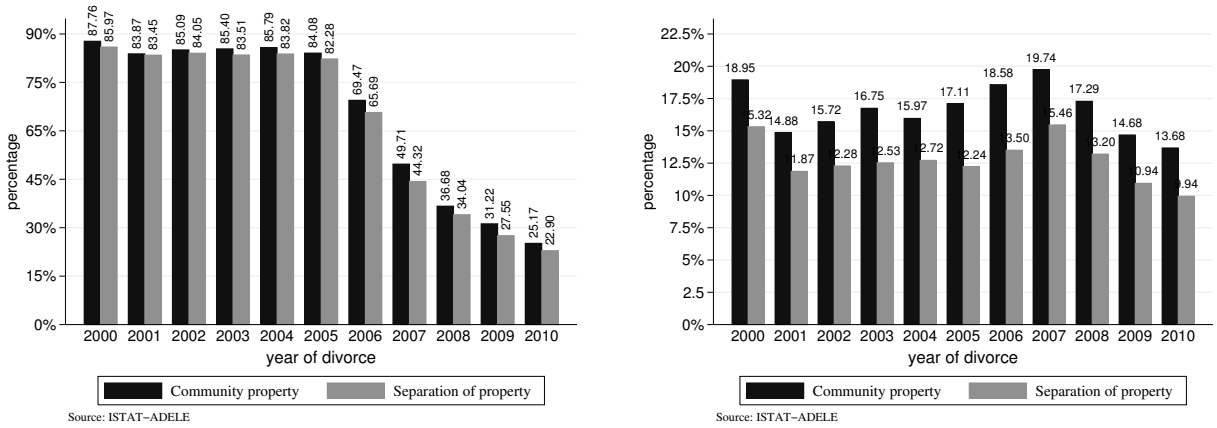


(a) Probability of having no children

(b) Number of children, if any

Data source: ISTAT. 2000-2010. *Rilevazione dei divorzi.*

Figure 6: Property regimes and household-specific investment (Italy, 2000-2010)



(a) Mother is assigned primary custody

(b) Wife is granted alimony

Data source: ISTAT. 2000-2010. *Rilevazione dei divorzi.*

3 The model

To capture the trade-offs that spouses face when choosing between separation of property and community property, in this section we develop a model of intra-household decision making. Imagine a Coasean environment where both spouses can contract with full commitment on *all* marital outcomes at the time of marriage. In such an environment, the regime choice is irrelevant: couples in this *ex ante* Pareto-optimal environment simply construct an enforceable prenuptial contract that ensures efficient outcomes during marriage. It is natural then to ask whether relaxing the assumption of *ex ante* efficiency with a household model with *ex post*

efficiency and limited commitment explains the gains to choosing at the time of marriage to a more restricting regime of property division, such as community property, compared to the more flexible separation of property.

To answer this question, we begin by considering a household model of *ex post* efficient behavior with limited commitment. Two people, the husband H and the wife W, live from time 1 until time T. They get married at time t_0 and commit to a property divisions regime. In every period from time 1 to T, the household choose savings, how to allocate private consumption between the spouses (c_t^j for both $j \in \{H, W\}$), labor supply (P_t^j for both $j \in \{H, W\}$) and whether to stay together or divorce. Couples must also decide on the allocation of savings (A_t^j for both $j \in \{H, W\}$) depending on the property division regime chosen at the time of marriage. Couples cooperate, but are faced with competing outside options. Reallocation of resources arises during marriage to ensure that each spouses outside option are met, but onlywhen an allocation that satisfies each spouse's is not feasible, spouses default to their outside options.

Asset accumulation and allocation depend on the property division regime. The general form of the budget constraint is:

$$A_{t+1} - (1 + r) \cdot A_t + x_t = y_t^H + (y_t^W - g_t^k) \cdot P_t^W. \tag{3.1}$$

where A_t is a risk-free asset that bears a risk-free return r in the following period, y_t^H is the husband's income, $P_t^W = 1$ if the woman works, earning income y_t^W and paying child-care expenses (g_t^k) and x_t is the total monetary expense allocated in period t.

In separation of property, assets can be flexibly allocated between each spouse's "accounts" A^H and A^W, leading to the following formulation of the budget constraint:

$$(A_{t+1}^H + A_{t+1}^W) - (1 + r) \cdot (A_t^H + A_t^W) + x_t = y_t^H + (y_t^W - g_t^k) \cdot P_t^W. \tag{3.2}$$

In community property, there is only one asset A_t, which corresponds to imposing that $A^H = A^W$.

Despite introducing lack of contractibility in commitment and allowing for agents to renegotiate during marriage, we show that this partially *ex post* efficient framework admit an *ex ante* Pareto-optimal representation, albeit one with additional constraints. In the context of household regime-choice, the *ex post* constraints placed by a property division regime translates into constraints on the set of allowable allocations. Given this framework, we find that, when the divorce state is the default outside options for both spouse, the equivalent set of allowable allocations in a community property regime is a strict subset of the equivalent set of allowable allocations in a separation of property regime. Lack of commitment and *ex post* renegotiation alone cannot explain the benefits to committing to a community property regime and the fact that a sizable proportion of couples that do not opt out of this regime.

Hence, we augment the standard cooperative household model with limited commitment by

allowing spouses to default to an intermediate phase, one that (possibly) precedes the divorce state. During this phase, which we call the *autarky phase*, households interact in a limited fashion but do not get divorce. We find that introducing this intermediate phase better reflects the household behavior during the periods leading to a divorce.

Allowing for a default state within marriage can lead some households to choose to the community property regime. In that phase, in separation of property, assets are allocated by spouses in a non-cooperative way, and hence it might be preferable, from the perspective of the (constrained) efficient household planing problem, to restrict the household options by committing to community property at the time of marriage.

3.1 The cooperative phase

From the time they marry, spouses cooperate in each period when choosing consumption allocation, savings and labor force participation decision. The household cooperative decision is based on each spouse's bargaining position. At the time of marriage, a spouse's bargaining position is summarized by the Pareto weights, θ^j for each $j \in H, W$. These weights evolve over time, and their evolution depends on both spouses' outside option (V_t^{jO}). If in a given period the outside option of one spouse is greater that her value of being married given the current bargaining positions, which we denote as $\theta^j + M_t^j$, her weight will increase to guarantee that she agrees to remain married. This household model closely follows the approach used in the literature on risk sharing under limited commitment (Kocherlakota, 1996; Ligon, Thomas, and Worrall, 2002), which has been previously applied to household behavior (Mazzocco, 2007; Mazzocco, Yamaguchi, and Ruiz, 2007; Ligon, 2011; Voena, 2011).This mode is recursive in nature and is time consistent up to some renegotiation of the intra-household bargaining power.

During this cooperative phase, each spouse's felicity function takes the form

$$u(c_t^j, P_t^j; \xi_t) = u(c_t^j, P_t^j) + \xi_t + \Xi(k_t).$$

The function $u(c_t^j, P_t^j)$ is a standard felicity function over each spouse's consumption c_t^j and labor force participation P_t^j. An additive component ξ_t. the match quality process, captures the spouses' benefits and costs of being in the current marriage, while $\Xi(k_t)$ reflects the gains of raising a child in an intact marriage as a function of the number of children k_t .

The state space comprises of spouses' individual incomes and assets, of match quality and of marital status. We call this collection of states the primitive state space and denote it by $\omega_t = (z_t^H, z_t^W, h_t^W, A_t^H, A_t^W, \xi_t) \in \Omega_t$. In addition, we include a state variable that captures any past renegotiation of intra-household allocations made by the spouses in order to sustain the cooperative state (M_t^j for $j \in H, W$) with respect to the Pareto weight θ^j, which is determined at the time of marriage. An additional state variable captures the mode of interaction and takes

value 0 if the couple is cooperating ($O_t = 0$). Note that at soon as cooperation ceases, we assume that couples can no longer go back to a cooperative state so that $O_t = 0$, whenever $O_m = 0$ for any $m < t$.

We describe the household's behavior recursively and first consider the terminal period. The couple enters into the period with the state $(\mathbf{M_T}, \omega_T, O_T)$. Assume first that spouses can sustain the cooperative state in the terminal period, then they choose consumption allocation as follows:[8]

$$\begin{aligned} &\max_{c_T^j} \sum_{j\in\{H,W\}} (\theta^j + M_T^j) u(c_T^j) \\ &\text{s.t. budget constraint in cooperative state} \\ &u(c_T^j) \geq V_T^{jO}(\omega_T) \text{ for } j = H, W \end{aligned}$$

The first order conditions of the Lagrangian leads to the following classical condition:

$$\frac{u'(c_T^H)}{u'(c_T^W)} = \frac{\theta^W + M_T^W + \lambda_T^W}{\theta^H + M_T^H + \lambda_T^H}$$

where λ_T^j is the Lagrange multiplier on spouse's j participation constraint.

The solution to the problem above yields a cooperative state value function for each spouse, which is defined in states in which cooperation is sustainable: $V_T^{jM} : \Omega_T^M \to \mathbb{R}_+$, where $\Omega_T^M \subset \Omega_T$ denotes the set of all states in which cooperation is sustained: $(y_T^H, y_T^W, A_T^H, A_T^W, \xi_T) \in \Omega_T^M$ if and only if there exists at least one *feasible* allocation for which

$$u(c_T^j) \geq V_T^{jO}(\omega_T) \text{ for both } j \in H, W.$$

Note that, if cooperation is sustainable, then it is always optimal for couples to continue cooperating ($O_T = 0$).[9] On the contrary, if cooperative state is not sustainable, that is, if there exists no feasible allocation that satisfies both spouses' participation constraints, then the state defaults to the outside option and $O_T = 1$.

The value of each spouse entering into the terminal period, which considers the possibility of

[8]Spouses are assumed to retire before the last period T, and hence there is no labor participation choice at this point.

[9]To see this, suppose that given $(y_T^H, y_T^W, A_T^H, A_T^W, \xi_T)$ some feasible allocation, say $\tilde{c}_T^j$ yields $u(\tilde{c}^j) \geq V_T^{jO}(\omega_T)$, and suppose that $\hat{c}^j$ solves the problem above. By definition of a maximand to the problem above, we must have that

$$\sum_{j\in\{H,W\}} (\theta^j + M_T^i) u(\hat{c}^j) \geq \sum_{j\in\{H,W\}} (\theta^j + M_T^j) u(\tilde{c}^j) \geq \sum_{j\in\{H,W\}} (\theta^j + M_T^j) V^{jO}(\omega_T).$$

a moving out of the cooperative state in this period, say $V_T^j(\omega_T)$, can be defined as follows:

$$V_T^j(\mathbf{M_T}, \omega_T, O_T) = \begin{cases} V_T^{jO}(\omega_T) & \text{if } O_T = 1 \\ V_T^{jM}(\mathbf{M_T}, \omega_T) & \text{if } O_T = 0 \end{cases}$$

Having defined the household's problem in the terminal period, one can describe the household's behavior at an arbitrary period in the same manner. In particular, suppose that each spouses' continuation values $V_{t+1}^j(\cdot)$ have been appropriately defined for each $j \in H, W$. At time t, households evaluate whether the cooperative behavior can be sustained, and whether renegotiation to the existing bargaining positions $(\theta^j + M_t^j)$ is needed. In particular, households must determine whether there is a consumption allocation (c_t^j), asset allocation (A_{t+1}^j), labor force participation decision for the wife (P_t^W) satisfying the intertemporal budget constraint, and a renegotiated deviation from the current relative bargaining levels λ_t^j such that

$$u(c_t^j, P_t^j; \xi_t) + \beta E_t[V_{t+1}^j(\omega_{t+1})|M_{t+1}^j = M_t^j + \lambda_t^j] \geq V_t^{jO}$$

for both $j = H, W$.

As in the terminal period, a household will always choose to cooperate if it is sustainable (i.e. if there exists an allocation that satisfies both spouses' participation constraints). If a solution to the problem above exists, then $V_t^{jM}(\omega_t)$ can be defined as

$$V_t^{jM}(\mathbf{M_t}, \omega_t, O_t = 0) = u(\hat{c}_t^j, \hat{P}_t^j; \xi_t) + \beta E_t[V_{t+1}^j(\mathbf{M_{t+1}}, \omega_{t+1}, O_{t+1})|\hat{a}_t, M_{t+1}^j = M_t + \hat{\lambda}_t^j],$$

where $\hat{a}_t$ denotes the optimal household decision and V_t^j can be similarly defined as in the terminal period. A full description of the recursion defining the value function (via backward induction) is provided in the appendix.

3.2 Sequential formulation and prenuptial contracts

We begin this subsection by discussing the household contracting problem. Households commit to a history-dependent consumption allocation, savings, labor and asset allocation decision. Such contract, however, must be feasible, in the sense that it must satisfy the household's budget constraint and adhere to the asset-splitting regime. Formally, a *prenuptial contract* $\mathbf{a} = (a_1(\cdot), \cdots, a_t(\cdot))$ specifies for each date t and every history of states up to and including date t, a consumption allocation (c_t^j), individual savings account each spouses carry on in the next period (A_{t+1}^j) and female labor force participation in the current period (P_t^W).

We consider *ex ante* efficient behavior: couples choose a feasible contract $\mathbf{a}$ that maximizes

the following objective:[10]

$$\sum_{j\in\{H,W\}} \theta^j \sum_{t=1}^{T} \beta^{t-1} E_1 \left[u(c_t^j, P_t^j; \xi_t)\,(1 - O_T) + \tilde{v}_t^{jO} \right]$$

$$\text{s.t. the regime-dependent budget constraints and} \tag{3.3}$$

$$(1 - O_T) \left(\sum_{k=0}^{T-t} \beta^k E_{t+k} \left[u(c_{t+k}^j, P_{t+k}^j; \xi_t)\,(1 - O_{t+k}) + \tilde{v}_{t+k}^{jO} \right] - V_t^{jO}(\omega_t) \right) \geq 0$$

$$\text{for every } t = 1, \cdots, T \text{ and } j = H, W$$

where

$$\tilde{v}_t^{jO} = \begin{cases} V_t^{jO} & \text{if cooperation first failed in the } t\text{-th period } (O_T = 1,\ O_{t-k} = 0 \text{ for } k = 1, ...t-1) \\ 0 & \text{otherwise.} \end{cases}$$ [11]

The contracting problem above yields a valuation of being married at the time of marriage m for each spouse, $\tilde{V_m}^{jM}(\theta, \omega_t)$. The household's problem presented here is similar to the intertemporal problems discussed in Marcet and Marimon (2011) with the appropriate modification to incorporate the possibility of a marital dissolution. It is well known that problems of this type, which incorporate forward-looking constraints, are not time consistent. In particular, if a household were to reevaluate their contract at a later date $t > m$, it need not be the case that the same household (i.e., a household with the same initial Pareto weights θ^H, θ^W), would choose the same contract that was optimally chosen at the time of marriage. The intuition behind such a failure is that any binding participation constraint, at any time before t, no longer needs to be satisfied in period t. Hence, the "future" planner at time t would naturally dispose of such constraint, when considering a new contract that maximizes the weighted objective lifetime utility in that period.

[10] It is always optimal for the planner, as in the recursive formulation, to sustain a cooperative state whenever it is possible to do so at each state. Hence, the cooperative state can be recursively defined as in the previous formulation of the problem. See appendix for the exact formulation. Couples choose a contract that maximizes their time-one weighted lifetime utilities, while accounting for the effect of such contract on the possibility of cooperation ceasing in the future.

[11] Formally,

$$\tilde{v}_t^{jO} = V_t^{jO} \prod_{m=1}^{t} O_t(1 - O_{t-m}).$$

with $C_0 = 0$. Notice that if cooperation ceased in the $t+m$-th period then

$$\sum_{k=0}^{T-t} \beta^k V_{t+k}^{jO}(\omega_{t+k}) \prod_{m=1}^{t+k} O_{t+k}(1 - O_{t-k}) = \beta^m V_{t+m}^{jO}$$

3.3 Discussion: the regime choice

We show in the appendix that the solution to the contracting problem above yields a time-consistent solution up to some changes to the within-period Pareto weights. In fact, the result shows that the recursive problem discussed above yields a value function equivalent to the value function derived from the sequential problem. We summarize this result in the following theorem:

Theorem 3.1. *Consider an* ex post *efficient household starting marriage in time t_0 with a predetermined bargaining weights $\theta = (\theta^H, \theta^W)$. There is a corresponding optimal contract at the time of marriage that yields the same outcome on the equilibrium path as that of solution to the* ex post *efficient household problem. Moreover, such a contract solves the household's contracting problem described above and $V_1^{jM}(\theta, \omega, 1) = \tilde{V}^{jM}(\theta, \omega)$ for any θ and ω.*

Proof. See Appendix. □

Given this equivalence, a household that behaves *ex post* efficiently is weakly better off if the corresponding sequential problem affords a more flexible set of contracts in each period. In a community property regime, spouses divide assets equally, which adds an additional constraint on the the law of motion governing each spouses' feasible asset accumulation. The set of feasible contracts that reflect this additional constraint must then be a subset of the initial set of feasible contracts discussed above, if outside options do not differ across the two regimes. Consequently, contracts maximized over this more restrictive set of contracts (community property) can never be strictly preferred by the household, and separation of property is weakly preferred by an *ex post* constrained-efficient household in each period. We formally state this insight in the following proposition.

Proposition 3.2. *If outside option value functions V_t^{jO} for $j \in \{H, W\}$ are invariant to the property division regime chosen at the time of marriage, then separation of property is the optimal regime for the household in each period t.*

Proof. See Appendix. □

Previous models of intra-household allocations with two-sided limited commitment assume that the default outside option to intra-household cooperation is divorce (Mazzocco (2007), Mazzocco, Yamaguchi, and Ruiz (2007), and Voena (2011)). The divorce state and its associated value functions typically depend on the property division regime *only* through its ultimate effect on each spouse's assets at the time of divorce, proposition 3.2 states that in all these models we would observe full participation in a separate property regime. We build on these existing models by relaxing this assumption. In particular, we introduce an additional outside option beyond divorce and allow couples to cohabit but interact in a limited, non-cooperative fashion. The next section discusses these two outside options.

3.4 Outside option I: The divorce state

We characterize the value of being divorced, given state variables ω_t^D, as $V_t^{jD}(\omega_t^D)$. In this problem, $\omega_t^D = \{A_t^H, A_t^W, z_t^H, z_t^W, h_t^W\}$, where A_t^H and A_t^W denote each spouses assets. After divorce, spouses live off their individual income and assets. They both contribute to the consumption of their children as a fraction of their own consumption (which is meant to capture the cost of child custody and of child support) according to the equivalence scale $e(k)$ and they share childcare expenses. The budget constraint becomes:

$$A_{t+1}^j - (1+r)\cdot A_t^j + c_t^j \cdot e(k_t) = (y_t^j - \frac{g_t^k}{2})\cdot P_t^j. \qquad j = H, W \tag{3.4}$$

In each period t, a divorcee has an exogenous probability $\pi_t^{j\Omega}$ of remarrying another person. The probability of remarriage depends on gender, age and the divorce law regime. If remarriage occurs, it is an absorbing state and the problem is analogous to the one of a married couple during a full cooperative state (see below) with no possibility of divorce. We denote each spouse's value function during remarriage by $V_t^{jR}(\omega_t)$.[12]

In each period, the divorcee chooses consumption, savings and whether or not to work (if she is a woman). Thus, the value of being divorced at time t is:

$$V_t^{jD}(\omega_t) = max_{c_t^{jD}, P_t^{jD}, A_{t+1}^{jD}} \; u(c_t^{jD}, P_t^{jD}) + \beta\left\{\pi_{t+1}^{j\Omega} E[V_{t+1}^{jR}(\omega_{t+1}|\omega_t)] + (1-\pi_{t+1}^{j\Omega}) E[V_{t+1}^{jD}(\omega_{t+1}|\omega_t)]\right\}$$
$$\text{s.t. budget constraint in divorce (3.4), for } j = H, W.$$

3.5 Outside option II: The autarky state

When cooperation ceases to be feasible, couples select their outside option. This outside option needs not to be equal to a divorce (Lundberg and Pollak, 1993; Del Boca and Flinn, 2012). We introduce an alternative phase, which may precede divorce, which we call the *autarky phase*. During the divorce states, any form of interaction ceases but during the autarky phase

[12]The value of being remarried is

$$V_t^{jR}(\omega_t) = u(c^{j*R}, P^{j*R}) + \beta E[V_{t+1}^{jR}(\omega_{t+1}|\omega_t)]$$

for $j = H, W$, from the solution to the problem

$$V_t^R(\omega_t) = max_{c_t^{HR}, c_t^{WR}, P_t^{WR}, A_{t+1}^R} \theta u(c_t^{HR}, P_t^{HR}) + (1-\theta) u(c_t^{WR}, P_t^{WR}) + \beta E[V_{t+1}^R(\omega_{t+1}|\omega_t)])$$

subject to the couple's budget constraints:

$$A_{t+1}^R - (1+r)\cdot A_t^R + x_t = y_t^H + (y_t^W - g_t^k)\cdot P_t^W. \tag{3.5}$$

couples live in the same household but do not cooperate on intertemporal asset allocation and labor force participation decision; each spouse makes her own consumption, savings and work decision, similar to the divorce phase. Unlike the divorce phase, the period utility takes the form:

$$u^{j,aut} = u(c_t^j, P_t^j) + \kappa\xi_t + \Xi(k_t) \text{ for } \kappa \in (0,1)$$

The period utility includes a scaled version of the marital taste shock $\kappa\xi_t$, which reflects the limited interaction that the autarkic behavior allows. By still living together, spouses gain $\Xi(k_t) \geq 0$, which depends also on the presence and on the number of children in the household.

During autarky phase, couples face the budget constraint described in equation 3.5. In particular, couples maintain separate financial accounts and live off individual income and assets. In each period, either spouse can unilaterally divorce. When the autarky phases ceases, assets are divided according to the regime chosen by the couple at the time of marriage. In a separation of property regime, each spouse keeps the assets from their individual account $A_t^{j,divorce} = A_t^{j,aut}$. In a community property regime, courts pool spouses' assets from their own individual account and divide them equally at the time of divorce: $A_t^{j,divorce} = \frac{A_t^{H,aut} + A_t^{W,aut}}{2}$ for $j = H, W$.

During periods of autarky, each spouse accounts for the other spouse's state space and current-period action when choosing optimal savings and labor force participation. In both regimes, each spouse's assets affect the divorce state since both spouses can unilaterally end the autarky phase. Moreover, in a common property regime a spouse's asset at divorce depends on the other spouse's savings decision in the previous periods. Hence, the autarkic phase forms a non-cooperative game between the two spouses.

We restrict our attention to Markov Perfect Equilibria and formulate the game in a sequential fashion. However, the formulation here can be naturally described as a game of history-dependent asset allocation and labor force participation decision that is sub-game perfect and specified on pay-off relevant states.

Let $\omega_t = \{A_t^H, A_t^W, z_t^H, z_t^W, \xi_t, h_t^W\}$. We begin by recursively defining the value of being in an autarkic state in equilibrium (i.e., a value function defined by the equilibrium path of the game) and suppose that such valuation has been defined in period $t+1$ for both spouses, say $V_{t+1}^{j,aut}(\omega_{t+1})$ (i.e., the equilibrium path has been defined in period $t+1$. Divorce occurs when one spouse unilaterally decides to dissolve the marriage and to remain single. In particular, $D_{t+1}(\omega_{t+1}) = 1$ if and only if $V_{t+1}^{jD}(\omega_{t+1}^D) \geq V_{t+1}^{j,aut}(\omega_{t+1})$ for both spouses $j \in \{H, W\}$. Here ω_{t+1}^D is the state-space each spouse inherits at divorce. This state space depends on the marital-regime choice as follows:

$$\omega_{t+1}^D = \begin{cases} \{\frac{A_{t+1}^H + A_{t+1}^W}{2}, \frac{A_{t+1}^H + A_{t+1}^W}{2}, z_{t+1}^H, z_{t+1}^W, \xi_t, h_{t+1}^W\} & \text{in common property} \\ \{A_{t+1}^H, A_{t+1}^W, z_{t+1}^H, z_{t+1}^W, \xi_t, h_{t+1}^W\} & \text{in separate property} \end{cases}$$

Let $V_t^{j,aut}(\omega_t | \sigma_t^{-j})$ be the current-period valuation during the autarkic phase contingent on

the other spouse's strategy σ_t^{-j}, which specifies the intertemporal allocation and work decision (for the wife):

$$V_t^{j,aut}(\omega_t|\sigma_t^{-j}) \equiv \max_{\sigma_t^j} u(c_t^j, P_t^j) + \kappa\xi_t + \Xi(k_t) + \beta \Big\{ E\Big[D_{t+1}(\omega_{t+1}) V_t^{jD}(\tilde{\omega}_{t+1}) \\ +(1 - D_{t+1}(\omega_{t+1})) V_{t+1}^{j,aut}(\omega_{t+1}) \mid \sigma_t^{-j}, \sigma_t^j, \omega_t \Big] \Big\}$$

subject to each spouses budget constraint during autarky.

We are now ready to define the value function in the current period $V_t^{j,aut}(\omega_t)$. As mentioned earlier, we restrict our attention to Markov Perfect Equilibrium so that one may define the equilibrium via backward induction. In particular, having defined $V_{t+1}^{j,aut}(\omega_{t+1})$ the equilibrium outcome in period t, $(\sigma_t^{H^*}(\omega_t), \sigma_t^{W^*}(\omega_t))$, can be aptly described as follows:

$$\sigma_t^{j^*}(\omega_t) = \arg\max_{\sigma_t^j} u(c_t^j, P_t^j) + \kappa\xi_t + \Xi(k_t) + \beta \Big\{ E\Big[D_{t+1}(\omega_{t+1}) V_t^{jD}(\omega_{t+1}^D) \\ +(1 - D_{t+1}(\omega_{t+1})) V_{t+1}^{j,aut}(\omega_{t+1}) \mid \sigma_t^{-j^*}(\omega_t), \sigma_t^{j^*}(\omega_t), \omega_t \Big] \Big\}$$

Consequently, $V_t^{j,aut}(\omega_t) = V_t^{j,aut}(\omega_t|\sigma_t^{-j^*})$ for both $j \in \{H, W\}$.

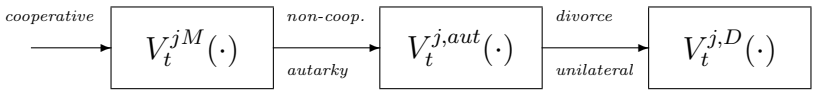
3.6 Summarizing the marital states

Our model relaxes the common assumption placed on each spouse's outside option, i.e. that only one outside option, typically divorce, is available to spouses. Figure 7 summarizes the various marital states leading to a divorce. Couples start by acting in a cooperative manner until it is no longer feasible to do so, i.e. until there exists no feasible allocation that satisfies each spouse's participation constraint, and they shifting into an autarkic state. In particular, we let the outside option $V_t^{jO}(\cdot) = V_t^{j,aut}(\cdot)$. During an autarky phase, either spouse can unilaterally deviate from such state and file for divorce. If either one of the spouse immediately finds divorcing optimal upon after ceasing the cooperative state then we have the specific case of $V_t^{jO}(\cdot) = V_t^{jD}(\cdot)$. We emphasize that the value function during an autarky phase, $V_t^{j,aut}(\cdot)$, depend on the marital regime choice.

Introducing the non-cooperative option allows to explain why some couples might prefer community property: from the point of view of the (constrained-)efficient planning problem at the time of marriage, it might be preferable to limit the ability of spouses to depart from the efficient allocation of assets during the autarkic phase.

Of course, other candidate theories might explain. For instance, even when spouses always *ex post* cooperate, the presence of transaction costs may prevent couples from electing the constrained efficient regime at the time of marriage. Yet, there is a substantial amount of evidence

Figure 7: Summary of marital status



supporting the hypothesis that couples' consumption and labor supply choices are Pareto efficient (Chiappori, Fortin, and Lacroix, 2002; Bobonis, 2009; Attanasio and Lechene, 2011). Our model takes the view that couples cooperate whenever possible, and that cooperation might break down as divorce becomes more likely. Such a framework imposes that spouses transfer assets to one another, following the prescription of the *ex post* efficient household planning problem, under most circumstances. However, as the match quality deteriorates, the benefits of cooperating decrease and divorce becomes more likely, assets may be more likely to save individually, in a non-cooperative fashion. In fact, in the estimation (for now, calibration) exercise, the parameters that govern the likelihood of an autarkic phase are estimated to match the take up of community property: in the absence of autarky (i.e. when $\kappa = 1$ and $\Xi = 0$), all couples choose separation of property, as indicated by Proposition 3.2.

3.7 Parametric forms and computational implementation

We describe below the parametric forms that we used for the numerical implementation of the model described above.

3.7.1 Preferences

Both husband and wife derive utility from own consumption c^j and disutility from own labor force participation P^j for $j = H, W$. The per-period utility from consumption follows Constant Relative Risk Aversion (CRRA) form and is separable in the disutility for participating in the labor market:

$$u(c, P) = \frac{c^{1-\gamma}}{1-\gamma} - \psi P, \qquad \text{with } \gamma \geq 0 \text{ and } \psi > 0.$$

Preferences are separable across periods of time and states of the world.

3.7.2 Match quality process

The match quality process evolves over time following an AR(1) process to reflect the persistence in the taste:

$$\xi_t = \phi\, \xi_{t-1} + \epsilon_t, \qquad \xi_1 = \epsilon_1 \qquad \text{where } \epsilon_t \text{ is distributed as } N(0, \sigma^2) \text{ and } \phi < 1.$$

3.7.3 Economies of scale and children

Spouses benefit from economies of scale in consumption: for a given level of household expenditure x, spouses' consumption depends on the household inverse production function

$$x = F(c^H, c^W)\, e(k) = \left[(c^H)^\rho + (c^W)^\rho\right]^{\frac{1}{\rho}} e(k).$$

With $\rho \geq 1$, this functional form implies that, for a given level of expenditure, a couple is able to consume more than what it could consume if spouses were living separately. The magnitude of economies of scale in the household depends on the consumption gap between spouses: if one spouse does not consume anything, there are no economies of scale. Economies of scale are maximized when spouses consume the same amount. Children affect household consumption according to an equivalence scale, denoted as $e(k)$ (where k stands for "kids").

Childbirth occurs at predetermined ages of the parents and fertility is exogenous.

3.7.4 Income over the life-cycle

Each spouse's labor income (y^j for $j = H, W$) depends on her human capital (h^j) and on her permanent income (z^j):

$$ln(y_t^j) = ln(h_t^j) + z_t^j.$$

Spouses experience permanent income shocks, which follow a random walk process:

$$z_t^j = z_{t-1}^j + \zeta_t^j \quad \text{and} \quad z_1^j = \zeta_1^j \tag{3.6}$$

in which ζ_t^j is i.i.d. as $N(0, \sigma^2_{\zeta^j})$ and is correlated between spouses.

Human capital is accumulated through labor force participation. The law of motion for each spouse's human capital h^j is:

$$ln(h_t^j) = ln(h_{t-1}^j) + (\lambda_0^j + \lambda_1^j \cdot t) \cdot P_{t-1}^j.$$

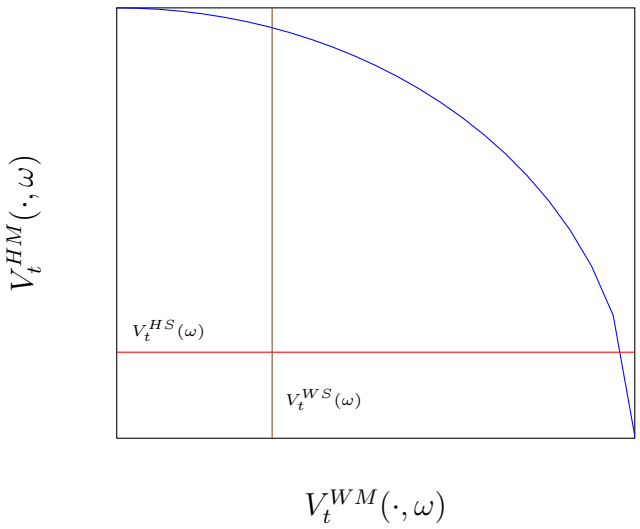
If a woman worked in the previous period, her human capital increases at a rate $\lambda_0^W + \lambda_1^W t$. Since men always work until they retire, $P_{t-1}^H = 1$, $\forall t$. At the end of period $T - R$, spouses retire and

receive a share of their pre-retirement income in every subsequent period. If a woman works, the household faces childcare expenses g_t^k, which are a function of the number of children and of their age.

3.7.5 The marriage market and admissible Pareto weights

To aide in the identification of Pareto weights, we consider each spouse's outside option at the time of marriage, i.e. the value of remaining single at the time of marriage $V^{jS}(\cdot)$. We construct a marriage market with search friction to compute each person's outside option before marriage. In this market, couples randomly meet with probability ν_t in each period t. A couple that meets forms a match (θ, ω_t) and marriage occurs if and only if $V_t^{HM}(\theta, 1-\theta, \omega_t) \geq V_t^{HS}(\omega_t)$ and $V_t^{WM}(\theta, 1-\theta, \omega_t) \geq V_t^{WS}(\omega_t)$. Figure 2 depicts the trace of the contract curve with respect to θ and the bounds provided by the marriage market. Details of the marriage market and the recursive construction of value functions V^{jS} can be found in the appendix.

Figure 2: Bounds on the Pareto Frontier



4 Model calibration

We calibrate the model using parameters from the literature and other parameters calibrated to match a number of empirical moments in the administrative data and in the data from the *Survey of Households Income and Wealth* for the 2000 marriage cohort of college graduates, as described in table 5. The ultimate goal of this exercise is in fact to structurally estimate the model by explicitly targeting these moments using the method of simulated moments.

Table 5: **Parameters of the model**

Parameter	Value	Reference
Initial age	24-27	ISTAT
Years in each period	2	
Age at terminal period	75-78	
Retirement age	60-63	
Economies of scale in marriage (ρ)	1.4023	McClements scale
Relative risk aversion (γ)	1.5	Attanasio *et al.* (2008)
Utility cost of working (ψ)	0.0030	match childcare response
Gender offer wage ratio	0.7	match FLP
Match quality (σ,ϕ)	0.002, 0.95	match divorce rate over the life cycle
Scale of marriage preferences in autarky (κ)	0.1	match regime choice
Meeting probability (ν_t)		match age at marriage
Gain from marriage ($\Xi(\cdot)$)		match marriage rates
Market returns on assets (r)	0.02	
Discount factor (β)	0.98	Attanasio *et al.* (2008)
W's age at childbearing	30 and 34	ISTAT
Childcare costs (g^k)	3,500	ISTAT
Retirement income	70%	replacement rate
Income process (λ_0,λ_1,σ_z^2)		SHIW data

4.1 Simulations

We simulated the model for a random sample of 1,000 households, according to the parametrization described above. The simulations replicate a number of basic facts form the administrative data. First, the take up of separation of property increase with the wife's educational attainment (table 6, Panel A), as seen in the administrative data. Moreover, low (exogenous) fertility or lower cost of childcare both raise the take up of separation of property (table 6, panels B and C).

The simulations can also replicate some interesting facts in the data that were not explicitly targeted in the calibration. For the parameters values described above and among college graduates (for which the simulations have been computed), the simulated data indicates that the prevalence of separation of property is higher among couple that end up divorcing (58%) compared to couple that remain together (54%). In the overall actual administrative sample, 50% of all couples married in the year 2000 chose separation of property, while the rate of separation of property is 60% for those couples that ended up divorcing (at least before 2010, see figure 8). The model can replicate this fact because community property, for the couple who choose it, allows for efficient intra-household specialization that is not available to the other couples,

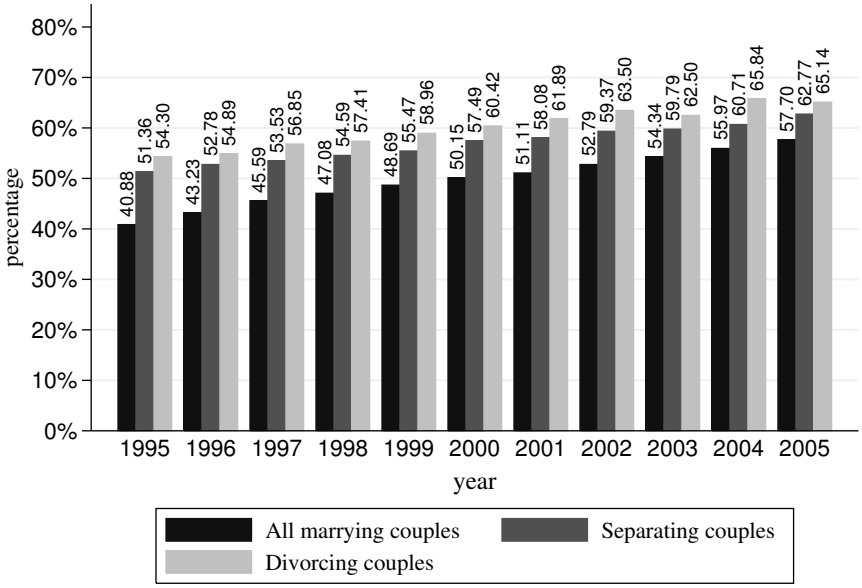
Table 6: **Simulation: regime choice at marriage by couple characteristics**

Panel A Wife's education	% separation of property
College graduate	57.9%
High school graduate	46.2%
High school dropout or below	40.7%
Panel B **Number of children**	**% separation of property**
No children	61.2%
Two children	57.9%
Panel C **Childcare costs**	**% separation of property**
Half the average	61.1%
Average	57.9%

Notes: In the simulation, the husband is a college graduate. Unless otherwise specified, the wife is a college graduate, the couple has two children and childcare cost are average.

who did not find a fifty-fifty sharing rule to be optimal compared to a flexible, but uncommitted, arrangement. This outcome is not ensured for all parameter values, because couples with higher match quality will self-select into separation of property, leading to a selection mechanism of the opposite sign.

Figure 8: Property regimes and marital stability: percentage in separation of property by year of marriage (Italy, 2000-2010)



Source: ISTAT–ADELE

Data source: ISTAT. 2000-2010. *Rilevazione dei divorzi. Rilevazione delle separazioni.*

4.2 Counterfactual exercise

To examine the welfare implications of the opportunity to choose separation of property at no cost, we simulate the model for 1,000 households both under the current Italian system and after eliminating regime choice, forcing couples into community property. This exercise suggests that the possibility of choosing a property regime in a costless fashion, like in Italy, promotes higher household savings, lower divorce rates and higher rates of female labor participation (table 7).

Table 7: **Counterfactual exercise: eliminate separation of property**

Outcome	Δ with no regime choice
Change in female employment	-1pcpt
Change in divorce probability	6pcpt
Change in household savings	-30%

5 Final remarks

This paper examines whether prenuptial contracts are used to support efficient intra-household specialization and female labor market participation. To this end, we examine an environment in which a particular kind of prenuptial contract is available at no financial cost and at limited effort cost. We develop and calibrate a dynamic model of intra-household allocation that captures the effect of prenuptial contracts on household labor supply, saving and divorce. Consistently with the patterns observed in the data, the model predicts that community property, in some cases, allows wives to efficiently specialize in home production, allowing her to smooth consumption when going into a divorce.

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Appendices

Appendix A: Equivalence between the recursive and sequential formulation of the value functions

This section illustrates how one can recursively formulate the sequential marriage problem with participation constraint discussed in section 2.6. Participation constraints are inherently forward looking in the sense that future consumptions are constrained by the current-period participation constraint. Problems of these form generally do not exhibit a recursive Bellman formulation. Marcet and Marimon (2011) show, however, that these problems admit a modified ("saddle-point") Bellman formulation in the case when the partnership is fully sustainable (i.e., in the case when a contract for which the participation constraints are fully sustainable in *all* states of the world exists). In this paper, we show that the marriage problem with marital dissolution also admits a "saddle-point" Bellman formulation. The argument relies on Marcet and Marimon's inclusion of the accumulated Lagrange multipliers as a state variable, which allows one to frame the sequential problem in a recursive fashion. It turns out that the same argument can be used to show that a recursive formulation exists in the marriage problem with an outside option by slightly modifying the state space.[13]

The constrained-efficient sequential problem

Couples in this problem choose a contract at a particular point in time and commit to it.[14] A contract $\mathbf{a}^t$ chosen in date t specifies, for any date $t+k$ with $k \geq 0$, a consumption allocation $(c^j_{t+k}(\cdot))$, female labor-force participation in the current period $(P^j_{t+k}(\cdot))$, and individual savings account that each spouses carry on in the next period in the event of a divorce $(A^j_{t+k+1}(\cdot))$. Such contract, at each subsequent period from time t, is taken to be a function of the history of states up to and including the date $t+k$, $h_{t+k} = (\omega_1, \cdots, \omega_{t+k})$; where the primitive state space includes each spouses' income (y^j_t), individual assets (A^j_t), and a marital preference shock ξ_t.

If the state space merely comprises of the primitives $(z^H_t, z^W_t, h^W_t, A^H_t, A^W_t, \xi_t)$ then the information needed to construct a contract need no longer admit a Markovian structure. This follows directly from the fact that a marital dissolution is an absorbing state so that a contract must keep track of all previous periods (specifically, periods in which the realized state resulted in a marital dissolution). To remedy this issue, we include the marital status O_t in each period in time as a state variable and extend contracts to be a function of these states. In this case, all

[13] Marcent and Marimon's frame their problem in an infinite-horizon setting. Our model is a finite-horizon model so one other purpose of this appendix is to elucidate Marcet and Marimon's argument in this setting, which is widely used in the empirical literature of limited commitment.

[14] We are mainly interested in the contracts chosen at the time of marriage. This generalization, however, will be useful in the discussion below.

the information needed for the specified plan in date t is the primitive state in that date ω_t and the cooperative state O_t. Hence, the specified plan for this date $c_t^j(\cdot)$, $P_t^W(\cdot)$, and $A_{t+1}^j(\cdot)$ can be restricted to depend solely on (ω_t, O_t). Notice that the value of a contract is immaterial during phases when autarky ceases.

We say that a contract $\mathbf{a^t}$ specified in date t is *feasible* if it satisfies the budget constraints:

$$(1+r)(A_{t+k+1}^H + A_{t+k+1}^W) = A_{t+k}^H + A_{t+k}^W + (y_{t+k}^W - g_{t+k})P_{t+k}^W + y_{t+k}^H - x_t$$

$$A_{t+k}^j \geq 0, \ , A_T^j = 0, x_{t+k} = F(c_{t+k}^H, c_{t+k}^W) \text{ for } k = 0, \cdots, T-t \text{ and } j \in \{H, W\}$$

All optimization discussed in this section is with respect to the set of feasible contracts.

We are now in a position to recursively define the cooperative state. We let the cooperative-state process depend on the current state and the cooperative state in the previous period. Hence, the cooperative-state process can be summarized as a function $O_t : \Omega_t \times \{0, 1\}$. It then follows that the cooperative state itself is a Markov process since ω_t is Markovian. The cooperative-state process is defined as follows:

1. For the terminal period, $C_T(\omega_T, 1) = 1$ for every $\omega_T \in \Omega_T$. Moreover, $C_T(\omega_T, 0) = 0$ if and only if there exists at least one feasible contract specified in date T such that

$$u(c_T^j, P_T^j; \xi_t) \geq V^{jO}(\omega_T) \tag{5.1}$$

   for each spouse $i \in \{H, W\}$.

2. For $t = 1, \cdots, T-1$, $O_t(\omega_t, 1) = 1$ for every $\omega_t \in \Omega_t$ and $O_t(\omega_t, 0) = 0$ if and only if there is at least one feasible contract specified at date t, say $\mathbf{a^t}$ satisfying:

$$E_t\left[\sum_{k=0}^{T-t} \beta^k \left(u(c_{t+k}^j, P_{t+k}^j; \xi_{t+k})(1 - O_{t+k}) + V_{t+k}^{jO} O_{t+k}(1 - O_{t+k-1})\right)\right] \geq V_t^{jO} \tag{5.2}$$

   for each spouse $j \in \{H, W\}$; where E_t denotes the expectation conditional on the state ω_t and the contract $\mathbf{a^t}$.

Equation 5.2 is spouse j's participation constraint at time t, which takes into account the possibility of a noncooperative state in subsequent periods. As soon as marriage ends in time $t+k$, each spouse receives her outside option V_{t+k}^{jO}, which is the spouses outside-option value in this period.[15] Couples would seek contracts that satisfy these participation constraints whenever

[15]Notice by construction that

$$\prod_{m=1}^{t+k} O_{t+k}(1 - O_{t+k-m}) = O_{t+k}(1 - O_{t+k-1})$$

possible.[16] Thus, when optimizing over contracts at date t, couples are bound to the participation constraints:

$$(1-O_{t+k})\left(E_{t+k}\left[\sum_{m=0}^{T-(t+k)}\beta^m u(c^j_{t+k+m},P^j_{t+k+m};\xi_{t+k+m})(1-O_{t+k_m})\right.\right.$$
$$\left.\left.+\sum_{m=0}^{T-(t+k)}\beta^m V^{jO}_{t+k+m}O_{t+k+m}(1-O_{t+k+m-1})\right]-V^{jO}_{t+k}\right)\geq 0 \tag{5.3}$$

for every $k=0,\cdots,T-t$.

At time of marriage couples choose a feasible contract $\mathbf{a^1}$ that maximizes the following objective subject to the constraint given in (5.3) for $t=1$:

$$\sum_{j\in\{H,W\}}\theta^j\sum_{t=1}^{T}\beta^{t-1}E_1\left[u(c^j_t,P^j_t;\xi_t)\,(1-O_t)+V^{jO}_t(\omega_t)O_t\,(1-O_{t-1})\right]$$

with $C_0=0$.

This household problem is similar to the dynamic problems with forward-looking constraints discussed in Marcet and Marimon (2011) with the appropriate modification of incorporating the possibility of a marital dissolution. It is well known that these inter-temporal problems are only time consistent up to a modification of the state space. If both spouses were to reevaluate their contract at a later date, it need not be the case that the same household (i.e., a household with the same bargaining weight θ), would choose the same contract that was optimally chosen at the beginning of marriage. In this appendix, we show that such time inconsistent behavior can be characterized as a change in the bargaining weight of the planner and the evolution of these bargaining weight depend on each spouses' outside options. In particular, suppose a planner reevaluates her contract at date t so that its problem can be aptly described by the following:

$$\max_{\mathbf{a^t}}\sum_{j\in\{H,W\}}\theta^i\sum_{k=0}^{T-t}\beta^t E_1\left[u(c^j_{t+k},P^j_{t+k};\xi_{t+k})\,(1-O_{t+k})+V^{jO}_{t+k}O_{t+k}\,(1-O_{t+k-1})\right]$$

s.t. participation constraints in (5.3) for H and $W, O_{t-1}=0$

feasibility constraints.

In this case, the optimal contract $\mathbf{a^t}$ need not the same as the specified contract that solves the initial marriage problem. The reason being is that the t-th period problem disposes of earlier

[16]Note that this is not an assumption but rather a feature of the model. Whenever possible couples would always want to specify contracts so that marriage is sustainable

participation constraints. Indeed, if the optimal contract solved at the time marriage is such that a participation constraint binds for some period $r < t$, then the re-evaluated contract must be different from the initial contract promised at the time of marriage. Now, suppose that the planner in time t changes the way it weighs the spouses so that each spouses' Pareto weight are given by $\theta^j + M_t^j$; where M_t^j captures the deviation from the initial bargaining stance due to the presence of binding participation constraints. Call the solution to the problem (1.3) with these deviated Pareto weights $\tilde{\mathbf{a}}^{\mathbf{t}}(M_t^H, M_t^W)$. We show that the solution to the household problem at the beginning of marriage yields contract from time t up to the terminal period, say $\hat{\mathbf{a}}^{\mathbf{t}}$, such that $\hat{\mathbf{a}}^{\mathbf{t}} = \tilde{\mathbf{a}}^{\mathbf{t}}(M_t^H, M_t^W)$ for some $(M_t^H, M_t^W) \in \mathbb{R}^2$. Moreover, these deviations in the initial Pareto weights can be completely characterized as the cumulated Lagrange multipliers of binding constraints specified by the contract $\hat{\mathbf{a}}$ from the time of marriage up to the t-th period. With this in mind, we define the value function associated with this deviated constrained efficient problem at time t as

$$\begin{aligned} V_t(\mathbf{M_t}, \omega_t, O_t) = \max_{\mathbf{a^t}} & \sum_{j\in\{H,W\}} (\theta^i + M_t^j) E_t \left[\sum_{k=0}^{T-t} \beta^k u(c_{t+k}^j, P_{t+k}^j; \xi_{t+k}) (1 - O_{t+k}) \right. \\ & \left. + V_{t+k}^{jO} O_{t+k} (1 - O_{t+k-1}) \right] \\ & \text{s. t. the participation constraint in (1.3), } O_{t-1} = 0 \\ & \text{and the feasibility constraints} \end{aligned} \tag{5.4}$$

The fact that optimal contracts at the beginning of marriage are consistent up to renegotiation suggest that an inclusion of these deviations in Pareto weight as a state space would aid in providing a recursive formulation. Indeed, the inclusion of these deviations as a state space is important to the reformulation of the household problem in a recursive fashion, which we illustrate in the following subsection.

The recursive formulation: an ex post constrained efficient household

Since the sequential problem is only time consistent up to some renegotiation in the bargaining weight, a recursive formulation to the sequential problem above must account for these deviation in bargaining weight over time. The households value function must then be defined on the extended state space $\mathbb{R}_+^2 \times \Omega_t \times \{0, 1\}$ with its typical element denoted by $(\mathbf{M}_t, \omega_t, O_t)$. To see how a recursive formulation to the sequential problem above can exist, consider the Lagrangian form of the planner's problem at the time of marriage, where λ_1^j denotes the Lagrange multiplier associated with each spouses' participation constraint at the time of marriage, and suppose that marriage is sustainable at $t = 1$:[17]

[17]With a few algebraic manipulation, one can show that the Lagrangian admits the form given in expression 1.5

$$\max_{\mathbf{a}} \inf_{\lambda_1} \sum_{j\in\{H,W\}} \Big((\theta^j + \lambda_1^j)u(c_1^j, P_1^j; \xi_1) - \lambda_1^j V_1^{jO}(\omega_1)\Big)$$

$$+ \beta \sum_{j\in\{H,W\}} (\theta^j + \lambda_1^j) E_1 \left[\sum_{t=1}^{T} \beta^{t-1} \Big(u(c_{t+1}^j, P_{t+1}^j; \xi_{t+1})(1 - O_{t+1}) + V_{t+1}^{jO} O_{t+1}(1 - O_t)\Big)\right]$$

$$\text{subject to the participation constraints for periods } t = 2, \cdots, T \tag{5.5}$$

$$(1 - O_t)\left(E_t\left[\sum_{m=0}^{T-t} \beta^m u(c_{t+m}^j, P_{t+m}^j; \xi_{t+m})(1 - O_{t+m})\right.\right.$$

$$\left.\left. + \sum_{m=0}^{T-t} \beta^m V_{t+m}^{jO} O_{t+m}(1 - O_{t+m-1})\right] - V_t^{jO}\right) \geq 0 \text{ and } C_0 = 0.$$

Notice that this problem is not additively separable since minimizing the current-period participation constraint's Lagrangian affects future consumption, as renegotiations carry on to the subsequent periods. If participation constraints slack, then period 1's maximization problem can be treated separately from subsequent period's maximization (subject to the feasibility constraint). The clever insight by Marcet and Marimon is to specify a new state space/Pareto weight in period 2 and account for the evolution of this new weight via $M_2^j = \lambda_1^j$. It is no surprise then that the following simultaneously defined recursive value function, $V_t^R(\cdot)$ and the cooperative-state $O_t^R(\cdot)$ is analogous to the ones discussed in the sequential framework:

- At the terminal period, $V_T^R(\cdot) = V_T(\cdot)$ and $D_T^R(\cdot) = O_T(\cdot)$

- Suppose $V_{t+1}^R(\cdot)$ has been recursively defined. We define the recursive cooperative state at date t by $D_t^R(\omega_t, 1) = 1$ for every ω_t and $O_t^R(\omega_t, 0)$ if and only if there is a feasible allocation such that

$$\begin{aligned} \inf_{\lambda_t} \sum_{j\in\{H,W\}} \{\ & (\theta^j + M_t^i + \lambda_t^j)u(c_t^j, P_t^j; \xi_t) - \lambda_t^j V_t^{jO}(\omega_t) \\ & + \beta E_t[V_{t+1}^R(\mathbf{M}_{t+1}, \omega_{t+1}, O_{t+1}^R) | M_{t+1}^j = \lambda_t^j + M_t^j \ \forall j]\ \} \in \mathbb{R} \end{aligned} \tag{5.6}$$

- The value function in period t is recursively defined as:

$$\begin{aligned} & V_t^R(\mathbf{M_t}, \omega_t, O_t^R) = \\ & \sup_{\mathbf{c_t}, \mathbf{A_t}, P_t^W} \inf_{\lambda_t} \sum_{j\in\{H,W\}} (1 - O_t^R)\Big((\theta^j + M_t^i + \lambda_t^j)u(c_t^j, P_t^j; \xi_t) - \lambda_t^j V_t^{jO}(\omega_t) \\ & + \beta E_t[V_{t+1}^R(\mathbf{M}_{t+1}, \omega_{t+1}, O_{t+1}^R) | M_{t+1}^j = \lambda_t^j + M_t^j \ \forall j]\ ) + (\theta^j + M_t^i) D_t^R V_t^{jO} \end{aligned} \tag{5.7}$$

, where the feasibility asset accumulation restricts the evolution of ω_{t+1} conditional on the

households action via:

$$\begin{aligned}(1+r)(A^H_{t+1}+A^W_{t+1}) = A^H_{t+k}+A^W_t+(y^W_t-g_t)P^W_t+y^H_t-x_t \\ A^j_t \geq 0 \text{ for } j\in\{H,W\}, \text{ and } x_t = F(c^H_t, c^W_t)\end{aligned} \tag{5.8}$$

In this formulation, forward-looking constraints are absent, and the only constraints are that of the asset accumulation and the additional constraint governing the evolution of $\mathbf{M_t}$. In particular, the recursive value function embeds these forward-looking constraint into the continuation value via the $M^j_{t+1} = M^j_t + \lambda^j_t$ for each j. The marriage sustainability condition and recursive formulation may seem at odds to the formulation described in section 2.6 and in the computational appendix. One can use the complementary slackness condition, however, to show that this condition is equivalent to the following condition.

There is a feasible consumption allocation for which

$$u(c^j_t, P^j_t; \xi_t) + \beta E_t[V^j_{t+1}(\mathbf{M_{t+1}}, \omega_{t+1}, D^R_{t+1})|M^j_{t+1} = M^j_t + \lambda^j_t] \geq V^{jO}_t,$$

where $V^j_{t+1}(\mathbf{M_{t+1}}, \omega_{t+1}, O_{t+1})$ denotes each spouses' continuation values if they were to remain remarried at time t. We first formally define $V^j(\cdot)$. At the terminal period,

$$V^j_T(\mathbf{M_T}, \omega_T, O_T) = \begin{cases} V^{jO}_T(\omega_T) \text{ if } O_T = 1 \\ V^{jM}_T(\mathbf{M_T}, \omega_T) \text{ if } O_T = 0 \end{cases}$$

where $V^{jM}_T = u(\hat{c}^j_T)$ and $\hat{c}^j_T$ is a solution to the terminal-period marriage problem if marriage is sustainable. For an arbitrary period, one can recursively define V^j_t as follows:

$$V^j_t(\mathbf{M_t}, \omega_t, O_t) = \begin{cases} V^{jO}_t(\omega_T) \text{ if } O_t = 1 \\ u(\hat{c}^j_t) + \beta E_t[V^j_{t+1}(\mathbf{M_{t+1}}, \omega_{t+1}, D^R_{t+1})|\hat{a}_t] \text{ if } O_t = 0 \end{cases}$$

where $\hat{a}$ denotes solves the recursive problem in (1.8).

Proof. Since both problems coincide in the terminal period, we have by the complementary slackness condition that

$$V^R_T(\mathbf{M_T}, \omega_T, O_T) = \sum_{j\in\{H,W\}} (\theta^j + M^j_T)V^j_T(\mathbf{M_T}, \omega_T, O_T)$$

Suppose, for the sake of an inductive argument that $V^R_{t+1}(\mathbf{M_{t+1}}, \omega_{t+1}, O_{t+1}) = \sum_{j\in\{H,W\}}(\theta^j + M^j_{t+1})V^j_T(\mathbf{M_{t+1}}, \omega_{t+1}, O_{t+1})$. Plugging in this identity into the household recursive problem described by equation (1.8) and with some algebraic manipulation, one can reframe the household

problem as:

$$
\begin{aligned}
&V_t^R(\mathbf{M_t}, \omega_t, O_t^R) = \\
&\quad (1 - O_t^R) \{ \max_{a_t} \inf_{\lambda_t} \sum_{j \in H,W} (\theta^j + M_t^j) \left(u(c_t^j, P_t^j; \xi_t) + \beta E_t \left[V_{t+1}^j(\cdot) | M_{t+1}^j = M_t^j + \lambda_t^j \right] \right) \\
&\quad + \sum_{j \in H,W} \lambda_t^j \left(u(c_t^j, P_t^j; \xi_t) + \beta E_t \left[V_{t+1}^j(\cdot) | M_{t+1}^j = M_t^j + \lambda_t^j \right] - V_t^{jO} \right) \} + O_t^R V_t^{jO}(\omega_t)
\end{aligned}
\tag{5.9}
$$

, where ω_{t+1} satisfies to the asset-accumulation constraint given in equations (4.10). From this expression, one sees that the recursive problem is equivalent to the following constrained optimization problem whenever marriage is sustainable whenever $O_t^R = 1$:

$$
\begin{aligned}
&\max_{a_t} \sum_{j \in H,W} (\theta^j + M_t^j) \left(u(c_t^j, P_t^j; \xi_t) + \beta E_t \left[V_{t+1}^j(\cdot) | M_{t+1}^j = M_t^j + \lambda_t^j \right] \right) \\
&\qquad \text{subject to the asset-accumulation constraint (4.10)} \\
&\qquad \text{and the participation constraint:} \\
&\qquad u(c_t^j, P_t^j; \xi_t) + \beta E_t \left[V_{t+1}^j(\cdot) | M_{t+1}^j = M_t^j + \lambda_t^j \right] \geq V_t^{jO} \text{ for } j \in \{H, W\}
\end{aligned}
\tag{5.10}
$$

Hence, by invoking the complementary slackness condition once again and by induction, we see that the relation $V_t^R(\mathbf{M_t}, \omega_t, O_t) = \sum_{j \in \{H,W\}} (\theta^j + M_t^j) V_t^j(\mathbf{M_t}, \omega_t, O_t)$ holds for any period t, which concludes what needs to be shown. Hence, the representation of the value function given in (4.12) is valid. □

An equivalence result

We now formally state our equivalence result:

Proposition 5.1. *For every $t = 1, \cdots, T$ and $(\mathbf{M_t}, \omega_t.O_t) \in \mathbb{R}_+^2 \times \Omega_t \times \{0, 1\}$, we have that*

$$V_t(\mathbf{M_t}, \omega_t, O_t) = V_t^R(\mathbf{M_t}, \omega_t.O_t).$$

Moreover, the cooperative states coincide $O_{t+1}(\omega_t, O_t) = O_{t+1}^R(\omega_t, O_t)$ for every $t = 1, \cdots, T-1$.

Proof. The result is trivial for the terminal period. Suppose, for the sake of an inductive argument, that $O_{t+1}(\omega_t, O_t) = O_{t+1}^R(\omega_t, O_t)$ and

$$V_{t+1}(\mathbf{M_{t+1}}, \omega_{t+1}.O_{t+1}) = V_{t+1}^R(\mathbf{M_{t+1}}, \omega_{t+1}.O_{t+1})$$

for every $(\mathbf{M_{t+1}}, \omega_{t+1}.O_{t+1})$.

Consider the sequential value function in period t and suppose that $O_t = 1$. With some algebraic manipulation and by the law of iterated expectation, we have:[18]

$$
\begin{aligned}
V_t(\mathbf{M_t}, \omega_t, 1) = \max_{\mathbf{a^t}} \inf_{\lambda_\mathbf{t}} & \sum_{j\in\{H,W\}} \Big((\theta^j + \lambda_t^j) u(c_t^j, P_t^j; \xi_t) - \lambda_t^j V_t^{jO}(\omega_t)\Big) + \\
& \beta E_{t+1} \Bigg(\sum_{j\in\{H,W\}} (\theta^j + M_{t+1}^j) E_t \Bigg[\sum_{k=0}^{T-(t+1)} \beta^k u(c_{t+1+k}^j, P_{t+1+k}^j; \xi_{t+1+k})(1 - O_{t+1+k}) \\
& + \sum_{k=0}^{T-(t+1)} \beta^k V_{t+1+k}^{jO} O_{t+1+k}(1 - O_{t+k}) \Bigg] \Bigg) \\
& \text{s. t. the participation constraints from periods } t+1, \cdots, T,\ M_{t+1}^j = M_t^j + \lambda_t^j \\
& O_{t-1} = 0 \text{ and feasibility constraints}
\end{aligned}
\tag{5.11}
$$

Notice that conditional on next periods deviation in the bargaining weight ($\mathbf{M_{t+1}}$), the second summand does not depend on the current-period Lagrange multipliers $\lambda_\mathbf{t}$. Hence, the specified contracts for periods $t+1, \cdots, T$ can be chosen independent of $\lambda_\mathbf{t}$ when one conditions on the value of next periods weight $\theta^j + M_{t+1}^j$. In particular, let $\mathbf{a^t} = (\mathbf{c_t}, \mathbf{A_t}, P_t^W, \mathbf{a^{t+1}})$, then, conditional on $\mathbf{M_{t+1}}$, the order of of max min between $\mathbf{a^{t+1}}$ and $\lambda_\mathbf{t}$, respectively, can be interchanged. This implies the following equivalent description of the household problem:

$$
\begin{aligned}
V_t(\mathbf{M_t}, \omega_t, 1) = \max_{(\mathbf{c^t}, \mathbf{A^t}, P_t^W)} \inf_{\lambda_\mathbf{t}} & \sum_{j\in\{H,W\}} \Big((\theta^j + \lambda_t^j) u(c_t^j, P_t^j; \xi_t) - \lambda_t^j V_t^{jO}(\omega_t)\Big) + \\
& \beta E_{t+1} \Bigg(\max_{\mathbf{a^{t+1}}} \sum_{j\in\{H,W\}} (\theta^j + M_{t+1}^j) E_t \Bigg[\sum_{k=0}^{T-(t+1)} \beta^k u(c_{t+1+k}^j, P_{t+1+k}^j; \xi_{t+1+k})(1 - O_{t+1+k}) \\
& + \sum_{k=0}^{T-(t+1)} \beta^k V_{t+1+k}^{jO} O_{t+1+k}(1 - O_{t+k}) \Bigg] \Bigg) \\
& \text{s. t. the participation constraints from periods } t+1, \cdots, T,\ M_{t+1}^j = M_t^j + \lambda_t^j \\
& O_{t-1} = 0 \text{ and feasibilty constraints}
\end{aligned}
\tag{5.12}
$$

, where interchanging the max and expectation operator is permissible since contracts are state-

[18] For the sake of brevity, we leave the algebraic manipulation out of this appendix. Nevertheless, we want to note that it uses the following identity, which holds immediately by construction of the cooperative state:

$$(1 - O_t)(1 - O_{t+1}) = (1 - O_{t+1}) \text{ for every } t = 1, \cdots, T-1$$

contingent.

By our inductive hypothesis, we have that $V_t(\mathbf{M_t}, \omega_t, 1) = V_t^R(\mathbf{M_t}, \omega_t, 1)$. Notice that by the claim discussed at the end of the preceding section we have concurrently shown that $D_t^R = 1$. The case when $O_t = 0$ is trivial so that by induction we have shown what is needed.

□

Implication to the marriage problem

The equivalence result in this appendix (Proposition 4.1) show that marriage problem discussed in section 2 corresponds to an efficient household contracting problem in every period t. Given this equivalence, a household that behaves ex post efficiently is weakly better off if the corresponding sequential problem affords a more flexible set of contracts in each period. In a community property regime, both spouses split the assets equally, which adds an additional constraint on the the law of motion governing each spouses' feasible asset accumulation. The set of feasible contracts that reflect this additional constraint must then be a subset of the initial set of feasible contracts discussed above if outside option valuation are invariant to the regime choice. Consequently, contracts maximized over this more restricted set of contracts can never be strictly preferred by the household, and separation of property is weakly preferred by an ex post constrained efficient household in each period if $V_t^{jO}(\cdot)$ do not differ across the two regimes. We formally state this insight in the following proposition, which readily follows from proposition 4.1:

Proposition 5.2. *Consider the ex post efficient marriage problem that allow for renegotiation (discussed in section 2). Separation of property is the constrained-efficient allocation of the household problem in each period t provided $V_t^{jO}(\cdot)$ are invariant to regime the choice.*

Proof. Consider the household contracting problem above at an arbitrary time period t with a new feasibility constraint. In particular, households maximize over state-contingent contracts $\mathbf{a^t}$ satisfying the following conditions:

$$(1+r)(A_{t+k+1}^H + A_{t+k+1}^W) = A_{t+k}^H + A_{t+k}^W + (y_{t+k}^W - g_{t+k})P_{t+k}^W + y_{t+k}^H - x_t \tag{5.13}$$

$$A_{t+k}^j \geq 0,\ A_T^j = 0, A_{t+k+1}^H = A_{t+k+1}^W \tag{5.14}$$

$$x_{t+k} = F(c_{t+k}^H, c_{t+k}^W) \text{ for } k = 0, \cdots, T-t \text{ and } j \in \{H, W\} \tag{5.15}$$

Clearly, any contract $\mathbf{a^t}$ satisfying equations 5.13-5.15 is a feasible contract (in the original definition given above where the restriction $A_{t+k+1}^H = A_{t+k+1}^W$ is omitted for every $k = 0, \cdots, T-t$). Thus, the associated value function for this new sequential household contracting problem, say $\tilde{V}_t(\mathbf{M_t}, \omega_t, O_t)$, satisfies the following inequality: $\tilde{V}_t(\mathbf{M_t}, \omega_t, O_t) \leq V_t(\mathbf{M_t}, \omega_t, O_t)$ for any $(\mathbf{M_t}, \omega_t, O_t)$ provided outside options do not differ across the two regimes. Consider the household recursive formulation above, where the feasibility on asset accumulation restricts the evolution

of ω_{t+1} conditional on the households action via:

$$(1+r)(A^H_{t+1}+A^W_{t+1}) = A^H_{t+k}+A^W_t+(y^W_t-g_t)P^W_t+y^H_t-x_t$$

$$A^H_{t+1}=A^W_{t+1}, A^j_t \geq 0 \text{ for } j\in\{H,W\}, \text{ and } x_t=F(c^H_t,c^W_t)$$

Let $\tilde{V}^R_t(\mathbf{M_t},\omega_t,O_t)$ be this recursive household problem's value function. By proposition 4.1, we have that $\tilde{V}^R_t(\mathbf{M_t},\omega_t,O_t)=\tilde{V}_t(\mathbf{M_t},\omega_t,O_t)\leq V_t(\mathbf{M_t},\omega_t,O_t)=V^R_t(\mathbf{M_t},\omega_t,O_t)$ for any $(\mathbf{M_t},\omega_t,O_t)$. □

Appendix B: The Single's Problem

A single person at each period is characterized by the states $\omega^H_t=(A^H_t,y^H_t)$ and $\omega^W_t=(A^W_t,y^W_t,h^W_t)$. We assume that singles do not get matched during retirement years so that the value for a person who remained single during the retirement years and the year preceding the first retirement year, which we denote by $V^{jS}(\omega^j_t)$, solves the following problem:

$$V^{jS}_t(\omega_t)=\max_{c^j_t} u(c^j_t,0)+\beta E[V^{jS}_{t+1}(\omega^j_{t+1})|\omega^j_t]$$

s.t. budget constraint when single:

$$A^j_{t+1}(1+r)+c^j_t=y^j_t+A^j_t$$

In periods preceding the retirement year, singles solve the following problem:

$$V^{jS}_t(\omega^j_t)=\max_{c_t} u(c^j_t,1)+\beta E[V^{j\max}_{t+1}(\omega_{t+1})|c^j_t,\omega^j_t]$$

s.t. budget constraint when single

Here we assume that singles always work and that $E[V^{j\max}_{t+1}(\omega_{t+1})|c^j_t,\omega^j_t]$ is the continuation value of a single couple, which takes into account the possibility of meeting another single individual in the next period and marrying such individual. During non-retirement years, single individuals meet with probability ν_t. Such a match can be described in terms of each person's single state and marital preference ξ_t (i.e., $\omega_t=(\omega^H_t,\omega^W_t,\xi_t)$) and will result in marriage if and only if for some $\theta\in[0,1]$ the following inequalities hold:

$$V^{jS}_t(\omega^j_t)<V^{jM}_t(\theta,1-\theta,\omega_t) \text{ for each } j\in\{H,W\} \tag{5.16}$$

This defines a set of marriage admissible matches:

$$\mathcal{M}_t=\{\omega|\ \exists\ \theta \text{ s.t. } \textbf{??} \text{ holds}\}$$

Similarly for each admissible match $\omega_t \in \mathcal{M}$ we may define the set of all admissible Pareto weights $\Theta_t^M(\omega_t) = \{\theta \in [0,1] |$ s.t. **??** holds$\}$ for each $\omega_t \in \mathcal{M}_t$. Hence, we define the continuation value for the years up to and including the retirement year $E[V_{t+1}^{j\max}(\omega_{t+1})|c_t^j, \omega_t^j]$ as follows:

$$
\begin{aligned}
&E[V_{t+1}^{j\max}(\omega_{t+1})|c_t^j, \omega_t^j] = (1-\nu_t)E[V_{t+1}^{jS}(\omega_{t+1}^j)|\omega_{t+1}^j] \\
&+ \nu_t \left(\int V_{t+1}^{jM}(\theta, 1-\theta, \omega_{t+1}) dF(\theta|\theta \in \Theta_{t+1}(\omega_{t+1})) dF(\omega_{t+1}|\omega_{t+1} \in \mathcal{M}_{t+1}, \omega_t^j, c_t) \right. \\
&\left. \int V_{t+1}^{jS}(\omega_{t+1}^j) dF(\omega_{t+1}|\omega_{t+1} \in \Omega_{t+1} \setminus \mathcal{M}_{t+1}, \omega_t^j, c_t) \right)
\end{aligned}
$$

Notice that the the value of marriage is integrated over the set of admissible Pareto weights conditional on the match. This distribution is assumed to be uniform with a support that depends on each person's outside option (See figure 2). The distribution of matches are also assumed to be uniform.