A THEORETICAL ANALYSIS OF THE EFFECTS OF LEGISLATION ON MARRIAGE, FERTILITY, DOMESTIC DIVISION OF LABOUR, AND THE EDUCATION OF CHILDREN

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Abstract

Decisions concerning marriage, fertility, participation, and the education of children are explained using a two-stage game-theoretical model. The paper examines the effects of (i) family law (cost of obtaining a divorce, alimony, availability of quasi-marriages such as PACS in France, and civil partnership in the UK), (ii) legislation concerning the assignment of property rights over total goods and assets acquired within marriage, (iii) enforceability of bride-price contracts, and (iv) length and effective enforcement of compulsory education. The predictions are consistent with two empirical observations. One is that, the tendency in developed countries is towards mother and father sharing market work and the care of the children equally between them, while the predominant pattern in developing countries is for the father to specialize in market work leaving the care of the children to the mother. The other is that the sign of the cross-country correlation between fertility and female labour market participation, negative until the mid-1970s, has turned positive where developed, but not developing countries are concerned since that date. The model provides a gender-neutral explanation of why girls in developing countries tend to get less education than boys of the same educational ability, and of why a substantial minority of women in some developed countries work and earn more than their male partners. We also derive and discuss the implications of a number of normative propositions.

JEL Code: D13, J12, J13, J24, K39.

Keywords: gender, education, labour participation, fertility, civil partnership, marriage, divorce, alimony, dowry, bride-price, school-leaving age.

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1 Introduction

The traditional division of labour – father goes out to work, mother looks after the children – is still the prevalent domestic arrangement where developing countries are concerned. In developed countries, by contrast, the trend is towards man and woman taking equal shares in market and domestic work, with a substantial minority of households practicing the liberated division of labour which sees the woman as the main earner. The present paper seeks to explain these and other behavioural patterns in terms of the legal (as well as of the economic) environment in which men and women are called upon to take their decisions. In particular, we examine theoretically the effect of (a) family law (cost of obtaining a divorce, alimony, availability of quasi-marriages such as PACS in France, and Civil Partnership in the UK), (b) legislation concerning the assignment of property rights over assets acquired in the course of married life, and the disposal of dotal goods, (c) enforceability of bride-price contracts, and (d) compulsory education, on the decision to marry, have children and participate in the labour market, and on the distribution of household income.

The decision process is modelled as a two-stage game. At the first stage, the players are parents of school-age children, and the game is about educational investment. At the second stage, the players are the children themselves, now grown-up, and the game is about fertility, time allocation, and the destination of household income.[1] Depending on the environment, the second-stage players may or may not form unions. Given that a union is formed, the partners may or may not marry, and either share market and domestic work equally between them or specialize. The model's main predictions are that (i) the traditional division of labour is more likely in the economic and legal environment which characterizes the developing part of the world, and share-alike arrangements in that which is typical of a developed country; (ii) share-alike couples are likely to have more children than couples (with the same preferences and endowments, and facing the same skill premium) practicing the traditional division of labour; (iii) the probability that the woman will be the main earner rises with the minimum school-leaving age. A subsidiary prediction is that (iv) the parties to a match may have either the same or complementary "traits" (initial money and human capital endowments). In the first case, the partners will share market and domestic work equally between them. In the second, they will specialize, not necessarily in the traditional way. Prediction (i) is consistent

[1] If the second-stage players marry and have children, there will be also a third stage, and so on. But these further stages are not modelled explicitly.

with evidence reported in Sanchez (1993) for developing countries, and Burda *et al.* (2006) for developed ones. Taken together with (ii), it is consistent also with evidence in Brewster and Rindfuss (2000) that the cross-country correlation between fertility and female labour market participation, negative until about 1975, has turned positive in the developed but not in the developing part of the world since that date. Prediction (iii) is consistent with evidence in Bureau of Labor (2004), Drago et al. (2004), and Stancanelli (2007), that up to quarter of women in countries where the minimum school-leaving age has long been high earn more than their male partners. Prediction (iv), finally, is broadly consistent with evidence in Pencavel (1998), and in the sociological literature.

We also establish that efficiency in the domestic allocation of resources requires the traditional division of labour, and that the imposition of a minimum school-leaving age distorts not only education, but also matching decisions. The first of these results casts doubt on the empirical literature, inspired by the so-called "collective model" of household decisions,[2] which seeks to recover the domestic "sharing rule" from observed consumption or labour patterns under the assumption that the domestic allocation of resources will always be efficient. The second implies that making school attendance compulsory up to a certain age may not be the best way to promote education. The assumptions driving these results are that the wage rate increases not only with education, but also with work experience, and that a new-born child requires at least a certain minimum amount of specifically maternal time. The latter is the only gender asymmetry envisaged in the paper.

Our approach has many distinguished antecedents. Mnookin and Kornhauser (1979) first, and then Gray (1998) and Clark (1999), opened the way to the use of game-theoretical concepts in the study of the effect of legislation on marital behaviour. Manser and Brown (1980), McElroy and Horney (1981), and many others in their wake, were concerned with what, in our model, is the second stage of the game. These seminal papers assume that the game will be cooperative, and that the equilibrium will be reached by Nash-bargaining. The threat-point of the game, and thus the domestic balance of power, is exogenous. Lundberg and Pollak (1996) extend this framework by identifying the threat-point of the Nash-bargaining game with the equilibrium of the Cournot-Nash game that the partners could play as an alternative. Given that the Cournot-Nash equilibrium is determined by initial conditions, however, the threat-point of the Nash-bargaining game is still effectively exogenous. Lundberg and Pollak (2003), and Basu (2006), endogenize the

[2] See Bourguignon and Chiappori (1994).

threat-point by making the reserve utility of each partner depend on his or her actions. The first of these two papers innovates also in that it models household decisions as a two-stage game, the second in that it goes beyond Nash-bargaining by providing a general characterization of household equilibrium. Del Boca and Flinn (2005) also has a two-stage structure, and innovates on the previous literature by allowing the second stage to be either cooperative or non-cooperative depending on the cost of cooperation. But both the cost of cooperation, and the threat-point of the cooperative game, are exogenous.

Another relevant set of papers is concerned with the role of dowries and bride-prices. This literature goes back to Becker (1981), where the bride-price is seen as an up-front payment by the groom to the bride, and the dowry as a negative bride-price. In Becker's view, these payments serve to clear the "marriage market". Were that true, however, we should observe bride-prices if there is excess demand for brides, dowries if there is excess supply. In reality, we observe dowries and bride-prices at the same time, often in connection with the same match. As noted in Zhang and Chan (1999), this is because a dowry is not a negative bride-price, but an intergenerational transfer from the bride's parents to the bride herself. There is thus no reason why the two should not go hand in hand. The last two authors model dowries as altruistic transfers, and the bride-price as an institution that may help to reduce the transactions cost of drawing up a marriage contract, but they do not allow for the possibility that the transactions cost might still be too high to reach an agreement, or that the agreement might not be honoured. Botticini and Siow (2003) also regard the dowry as an altruistic transfer, but address a different question, namely why parents might give daughters a dowry, and sons a bequest. Their answer relates to "virilocal" societies where a man remains part of his family of origin even after he is married, while a woman joins her husband's family. If parents were to promise a share of the estate to each of their children, that would then weaken the incentive for their sons to contribute to the accumulation of family wealth. According to those authors, the reason for the demise of the dowry in developed countries is to be sought in the reduced importance of the agricultural sector, where virilocality is traditionally entrenched.[3] In a sense, Botticini and Siow (2003), and Zhang and Chan (1999), are

[3] A similar approach is that of Rammohan and Robertson (2006). The matter of concern, here, is not the incentive for children to contribute to wealth production and accumulation in the family of origin, but the desire to preserve lineage. The paper establishes theoretically and finds evidence that the probability of moving away from the parental home reduces transfers (in the form of educational expenditure) to daughters, but not to sons.

complementary in that the former focuses on what for us is the first, and the latter on what for us is the second stage of the game.

In contrast with all the papers cited, we treat the number of children as a decision variable. This is what allows us to establish the sign of the association between fertility and female participation. In contrast with Lundberg and Pollak (2003), and Del Boca and Flinn (2005), the players in our model change at each stage of the game. In contrast with Botticini and Siow (2003), the choice facing first-stage players is not between giving a child money in the form of dowry, or money in the form of bequest, but between giving money or an education. Like Del Boca and Flinn (2005), we allow the second stage of the game to be either cooperative or non-cooperative. In contrast with that paper, however, the choice of game is determined by the presence or otherwise of legislation affecting either the domestic bargaining power of the interested parties, or their ability to make credible promises, and of policies restricting the educational choices of first-stage players. As in Lundberg and Pollak (2003), and Basu (2006), the reserve utilities of the second-stage players depend on their actions. There, however, the actions do not (or, rather, are modelled as if they did not) have lasting consequences. If the action stops, the consequence disappears. In principle, therefore, the game could be plaid over and over again with the same initial conditions. Here, by contrast, certain actions have lasting effects. Once born, a child cannot be sent back. If a person withdraws even temporarily from the labour market, his or her career prospects will be permanently impaired. One of the implications of these irreversibilities is that the threat-point of the Nash-bargaining game cannot be identified with the Cournot-Nash equilibrium as in Lundberg and Pollak (1996).

2 The second stage of the game

Take a woman, f, and a man, m, both of marriageable and working age. If the two form a stable relationship ("union"), they may decide to have children.[4] We shall assume that a child requires at least t_0 units of specifically maternal time; this is the only gender asymmetry we are going to envisage. In most of the analysis, we shall also assume that, above t_0, the father's and the mother's time are perfect substitutes in the upbringing of a child; nothing of substance changes if the elasticity of substitution is "large" but finite. Let t be the amount of time in excess t_0, and c the amount of goods or money, that a child receives from his or her parents. The maximum utility that this child can achieve over

[4]In reality, many women have children without a stable partner. As we are interested in resource allocation in two-adult households, however, we shall overlook single mothers.

a lifetime is $v(c,t)$. The indirect utility function $v(.)$ is increasing and concave. Since concavity of the indirect utility function implies quasi-concavity of the direct utility function, and given that c may include expenditure for the services of professional child minders, as well as for educational services, we are thus assuming that bought-in child care is not a perfect substitute for parental attention.

Given our focus on the allocation of the couple's total work time, we shall treat leisure as a constant.[5] We shall then write i's utility ($i = f, m$) as

$$U_i = u(a_i) + \beta n v(c,t), \ 0 < \beta < 1, \tag{1}$$

where a_i denotes i's consumption, and n the number of children. The function $u(.)$ is increasing and concave. The constant β may be interpreted as a measure of i's love of children. Since $u(.)$ and β are the same for both f and m, we are in effect saying that fathers love their children as much as mothers do. Since children are not differentiated by sex, we are also saying that parents love daughters as much as sons. Allowing for mothers to be more child-loving than fathers, of for either parent to prefer sons to daughters, as in some of the developing economics literature, would give much of the game away, without changing the results qualitatively. One of our aims is indeed to generate some of the predictions made by this literature without resorting to such ad-hoc assumptions. Since the term $\beta n v(c,t)$ is common to both f's and m's utility, children are a local public good. Following Becker (1981), we shall often refer to n as the "quantity", and $v(c,t)$ as the "quality", of this good.

At this stage of the game, i is endowed with b_i units of a saleable asset ("money"), and h_i units of human capital. We shall assume that h_i reflects natural talent, and education received at the previous stage, and that it is always positive. At the present stage, human capital accumulates at the rate αh_i, where α is a positive constant, per unit of labour. This formulation implies that better educated workers learn from experience more quickly than less well educated ones. For simplicity, we shall assume that there is no more scope for education. The wage rate of a person who is endowed with h_i units of human capital, and works for L_i units of time, is

$$w_i = (1 + \alpha L_i) h_i \omega, \tag{2}$$

[5]This has some empirical justification. Using data from Germany, Italy, the Netherlands and the USA, Burda *et al.* (2006) show that the partners put in the same total number of work hours. The only difference across couples and countries is in the allocation of this total between domestic and market work

where ω is the market rate of remuneration of human capital. Since ω determines the wage spread between more and less qualified or experienced workers, we shall refer to this parameter as the "skill premium". By using the same values of α and ω for f and m, we are in effect saying that there is no gender discrimination in the labour market. Notice that withdrawing from the labour market for one unit of time reduces i's lifetime earnings not only by the wages forgone, $h_i\omega$, but also by the wage growth forgone, $\alpha h_i\omega$.[6] Time-allocation decisions have permanent effects.

Let t_i be the amount of time, other that t_0, that i spends with each child. Assuming that t_f and t_m are perfect substitutes,

$$t = t_f + t_m.$$

Assuming that the amount of time for which the mother cannot be replaced by the father in the care of a child is short in comparison with the total,[7] and that the sum of the two is not so large that a woman could not look after two children single-handed if she were so inclined,

$$t_0 < t$$

and

$$t_0 + t \leq \frac{1}{2}.$$

Normalizing at unity the total amount time of available to each partner for market and domestic work, f's labour supply is given by

$$L_f = 1 - (t_0 + t_f)\, n, \tag{3}$$

and m's by

$$L_m = 1 - nt_m. \tag{4}$$

2.1 Conditional efficiency

An allocation $(a_f, a_m, t_f, t_m, c, n)$ is efficient conditional on endowments if it maximizes some weighted average of f's and m's utilities,

$$\Lambda = \lambda U_f + (1 - \lambda)\, U_m,\ 0 \leq \lambda \leq 1, \tag{5}$$

where U_i is given by (1), subject to the couple's combined budget constraint,

$$\sum_{i=f,m} a_i + (c + z)\, n = y^F, \tag{6}$$

[6] The same would be true if we assumed that, instead of accumulating with work experience, human capital depreciates without it.

[7] How short depends on legislation and school of pediatric thought (from as little as three months, to as much as three years).

where

$$z = \left(\left(t_0 + t_f\right)\left[1 + \alpha\left(1 - n\left(t_0 + t_f\right)\right)\right] h_f + t_m\left[1 + \alpha\left(1 - nt_m\right)\right] h_m\right)\omega$$

is the opportunity-cost of a child, and

$$y^F = \sum_{i=f,m}\left[b_i + \left(1 + \alpha\right) h_i\omega\right]$$

the couple's full income. We may think of λ as of f's domestic welfare weight. Since U_i is independent of t_i, we can carry out this optimization in two steps. First, we find the (t_f, t_m) which minimizes z for each (n, t). Second, we look for the (a_f, a_m, t, c, n) which maximizes Λ for an arbitrarily given λ.

The solution to the cost-minimization problem is illustrated in Figure 1. The straight line with absolute slope equal to unity is an isoquant. The convex-to-the-origin curves with absolute slope

$$-\frac{dt_m}{dt_f} = \frac{1 + \alpha\left[1 - 2n\left(t_0 + t_f\right)\right]}{1 + \alpha\left(1 - 2nt_m\right)}\frac{h_f}{h_m},$$

diminishing as t_m is substituted for t_f, are isocosts. Convexity of isocosts implies that the solution will be at a corner. For any (h_f, h_m, n, t) satisfying

$$\frac{h_f}{h_m} \leq \frac{1 + \alpha}{1 + \alpha\left[1 - 2n\left(t_0 + t\right)\right]}, \tag{7}$$

the opportunity-cost of parental time is minimized at the point

$$t_f = t,\ t_m = 0, \tag{8}$$

where f supplies all the child-care time, and m specializes completely in market work. Were this the case, the woman could end up with less human capital than the man even if she started out with the same or more.

Conversely, for any (h_f, h_m, n, t) satisfying

$$\frac{h_f}{h_m} > \frac{1 + \alpha}{1 + \alpha\left[1 - 2n\left(t_0 + t\right)\right]}, \tag{9}$$

the opportunity-cost is minimized at the point

$$t_f = 0,\ t_m = t, \tag{10}$$

where m supplies all the child-care time in excess of the minimum that can only be provided by f. Notice that the mother cannot specialize completely in market work.

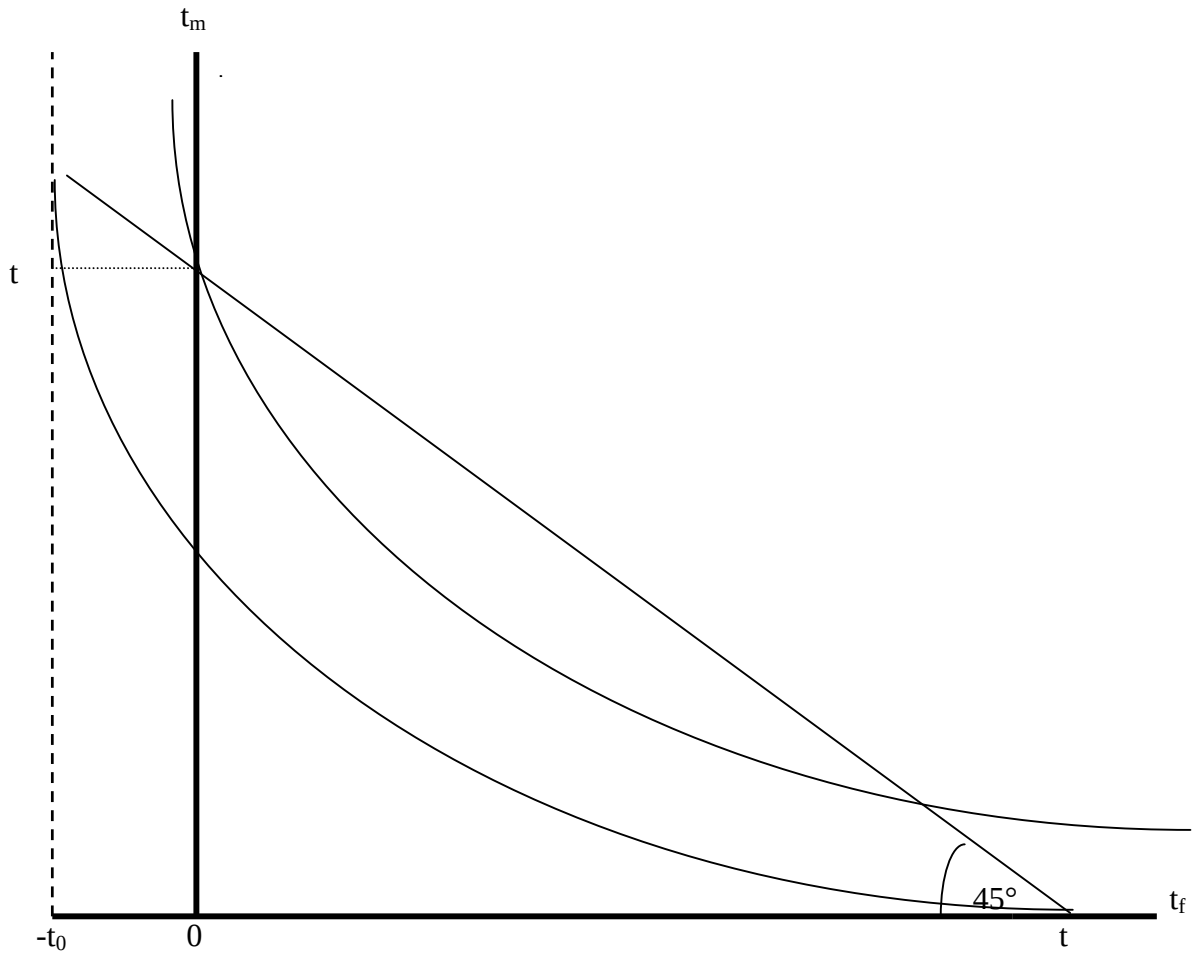

Figure 1. Efficient division of labour

If we relax the assumption that t_f and t_m are perfect substitutes, the cost-minimizing solution need not be at a corner. Provided there is sufficient substitutability, however, there will still be some degree of specialization (and, if the elasticity of substitution is greater than unity, it may still be efficient for m to specialize completely in market work). This runs counter to the commonsense argument that, the easier it is for the father to replace the mother in the care of the children, the more time will he spend with them. Let us then go back to the assumption that t_f and t_m are perfect substitutes.

A conditionally efficient allocation maximizes (5) subject to (6). Therefore, it satisfies

$$\lambda u'(a_f) = \beta n v_c(c,t) = (1-\lambda) u'(a_m) \tag{11}$$

and *either* (7),

$$\frac{v_t(c,t)}{v_c(c,t)} = (1 + 2\alpha[1 - (t_0 + t)n]) h_f \omega, \tag{12}$$

$$\frac{v(c,t)}{v_c(c,t)} = c + (t_0 + t)(1 + 2\alpha[1 - (t_0 + t)n]) h_f \omega, \tag{13}$$

or (9),

$$\frac{v_t(c,t)}{v_c(c,t)} = [1 + 2\alpha(1 - nt)] h_m \omega, \tag{14}$$

$$\frac{v(c,t)}{v_c(c,t)} = c + [1 + 2\alpha(1 - nt_0)] t_0 h_f \omega + [1 + 2\alpha(1 - nt)] t h_m \omega. \tag{15}$$

The conditions in (11) tell us that the weighted marginal utility of each parent's private consumption must be equated to the marginal utility of money spent on children. Since $u'(.)$ is a decreasing function, they thus imply that, the higher is λ, the greater will be a_f relative to a_m. Notice that λ does not figure in any of the other conditions, and cannot thus affect (c^*, t^*, n^*). Since the RHSs of (13) and (15) are increasing in ω, and given diminishing MRS, it is clear that n^* is a decreasing function of ω.

> *Proposition 1. Conditionally efficient allocations are characterized by division of labour. If the woman's human capital endowment is sufficiently larger than the man's, it is efficient for her to be the main earner, and him the main childcarer. Otherwise, it will be efficient for her to be the main childcarer, and for him to be the main earner. The conditionally efficient number of children is a decreasing function of the skill premium.*

Corollary 1. If a woman starts out with the same amount of human capital as her partner, and the couple's time is allocated efficiently conditional on endowments, she will end up with less human capital than him.

2.2 Cooperative equilibrium

Consider first the possibility that f and m play a cooperative game, and that the equilibrium is reached by Nash-bargaining. Nothing of substance changes if we follow the more general approach of Basu (2006). If the bargaining takes place before the children are born, the equilibrium maximizes

$$\Pi = (U_f - R_f)(U_m - R_m), \tag{16}$$

where R_i is i's ex-ante reserve utility, subject to (6). Further assuming that the best alternative to the prospective union is singlehood,

$$R_i = u\left(y_i^F\right), \tag{17}$$

where

$$y_i^F = b_i + (1+\alpha) h_i \omega$$

is i's full income,

The properties of this equilibrium can be illustrated with the help of either Figure 2 or Figure 3. The point **R**, with coordinates (R_f, R_m), is the threat-point of the game. The concave-to-the-origin curve is the utility-possibility frontier defined by $(1)-(4)$ and (6), given the endowments. The continuous, convex-to-the-origin curve is a contour of Π. The equilibrium point **B**, with coordinates $\left(U_f^B, U_m^B\right)$, lies on the utility-possibility-frontier, and is thus conditionally efficient. Where on the frontier it will lie depends on the location of **R**.[8] Therefore, $\left(U_f^B, U_m^B\right)$ depends on (R_f, R_m), but (c^*, t^*, n^*) does not. This clears the ground from any notion that the mother might use such bargaining power as she has to limit the quantity, and raise the quality, of children.

Drawing up a premarital contract which specifies each party's rights and duties need not be prohibitively costly. The problem with such a contract is rather that it may be either unenforceable, because the law does not recognize it, or prohibitively costly to enforce, because non-compliance is difficult to demonstrate before a court. In either case, any ex-ante contract or understanding will be liable to ex-post renegotiation. Let j denote the main childcarer, and k the main earner $(j, k = f, m)$.

[8] The pictures are drawn under the assumption that the two parties have the same ex-ante reserve utility, and will thus have the same equilibrium utility, but this need not be true in general.

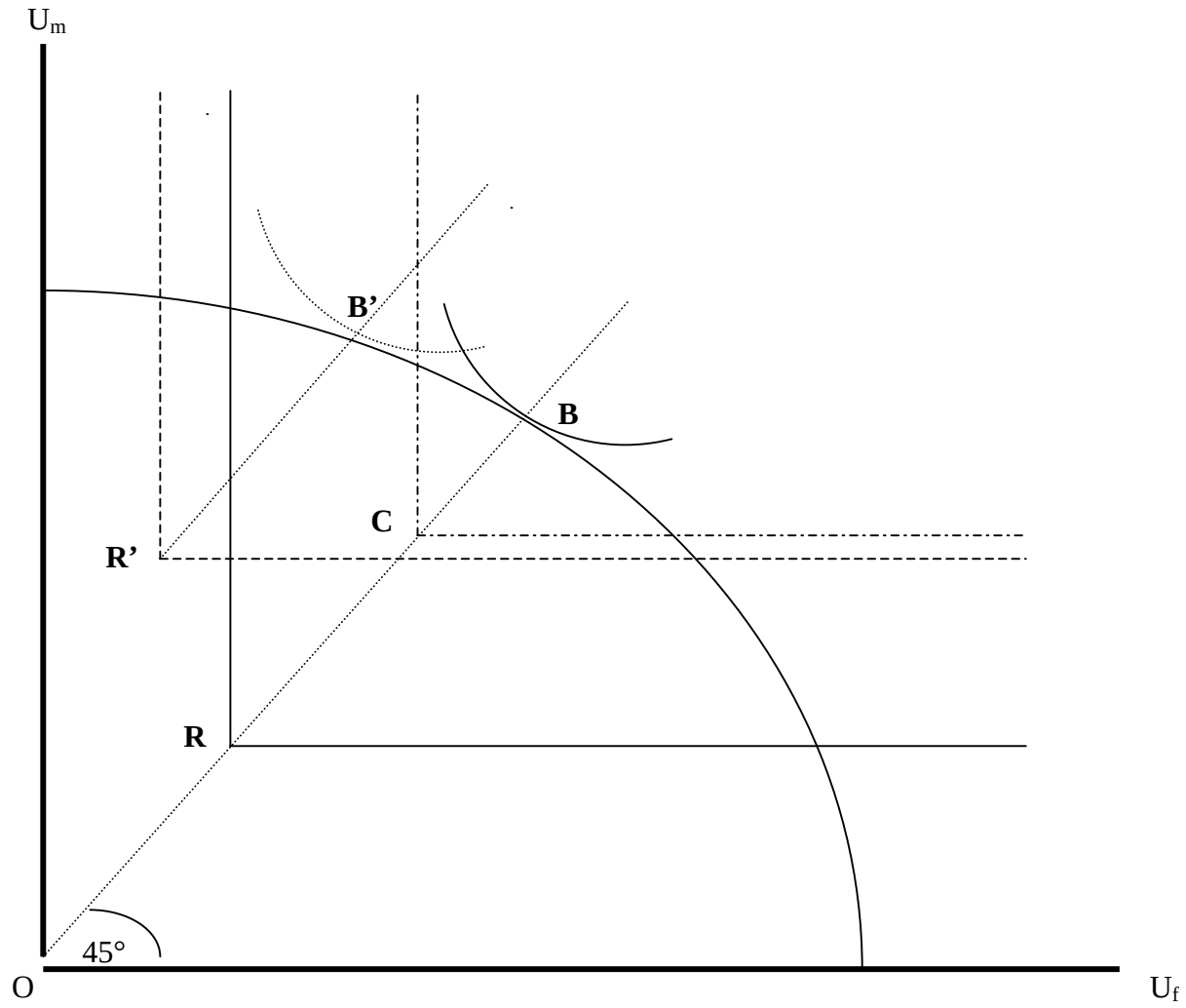

Figure 2. Ex-ante bargaining, ex-post bargaining and non-cooperative equilibria: If ex-ante agreements are not enforceable, the union is non-cooperative.

Once the children are born, n is a given constant. When the children are no longer dependent on their parents, (c,t) is constant too. It is clearly not in k's interest to renegotiate (a_f, a_m) until (n,c,t) is a by-gone, and j has permanently lost $\alpha(t_0+t)nh_f$ units of potential human capital if $j=f$, or αnth_m if $j=m$. The new round of bargaining will then occur only when the children are out of the way.

The new equilibrium will maximize

$$\Pi' = \left(U_f - R'_f\right)\left(U_m - R'_m\right), \tag{18}$$

where R'_i is i's ex-post reserve utility, subject to the couple's ex-post budget constraint,

$$c^* n^* = \sum_{i=f,m} \left[b_i - a_i + L_i^*\left(1+\alpha L_i^*\right)h_i\omega\right], \tag{19}$$

$$L_f^* = 1 - \left(t_0 + t^* - t_m^*\right)n^*$$

and

$$L_m^* = 1 - t_m^* n^*.$$

Assuming, for the time being, that the union can be dissolved at no cost to either party, i's ex-post reserve utility will be given by his or her utility in the event of divorce,

$$R'_i = u\left(b_i + L_i^*\left(1+\alpha L_i^*\right)h_i\omega\right) + \beta n^* v\left(c^*, t^*\right). \tag{20}$$

Therefore,

$$\frac{R'_f}{R'_m} < \frac{R_f}{R_m}$$

if the main childcarer is f,

$$\frac{R'_f}{R'_m} > \frac{R_f}{R_m}.$$

if the main childcarer is m. In either case, the main childcarer will be vulnerable to the main earner's opportunistic ex-post bargaining.

The equilibrium in the case where the woman is the main childcarer can again be illustrated with the help of either Figure 2 or Figure 3. Since the human capital endowment required to qualify as the main earner is higher for a woman than for a man, the case illustrated is the one that is most likely to occur. **R'**, with coordinates $\left(R'_f, R'_m\right)$, is the ex-post threat-point. The dotted, convex-to-the origin curve is a contour of Π'. **B'**, with coordinates $\left(U_f^{B'}, U_m^{B'}\right)$, is the ex-post bargaining equilibrium. Since **R'** lies North-West of **R**, **B'** lies North-West of **B**, and is thus less favourable to f. In view of Proposition 1 and Corollary 1, this establishes the following.

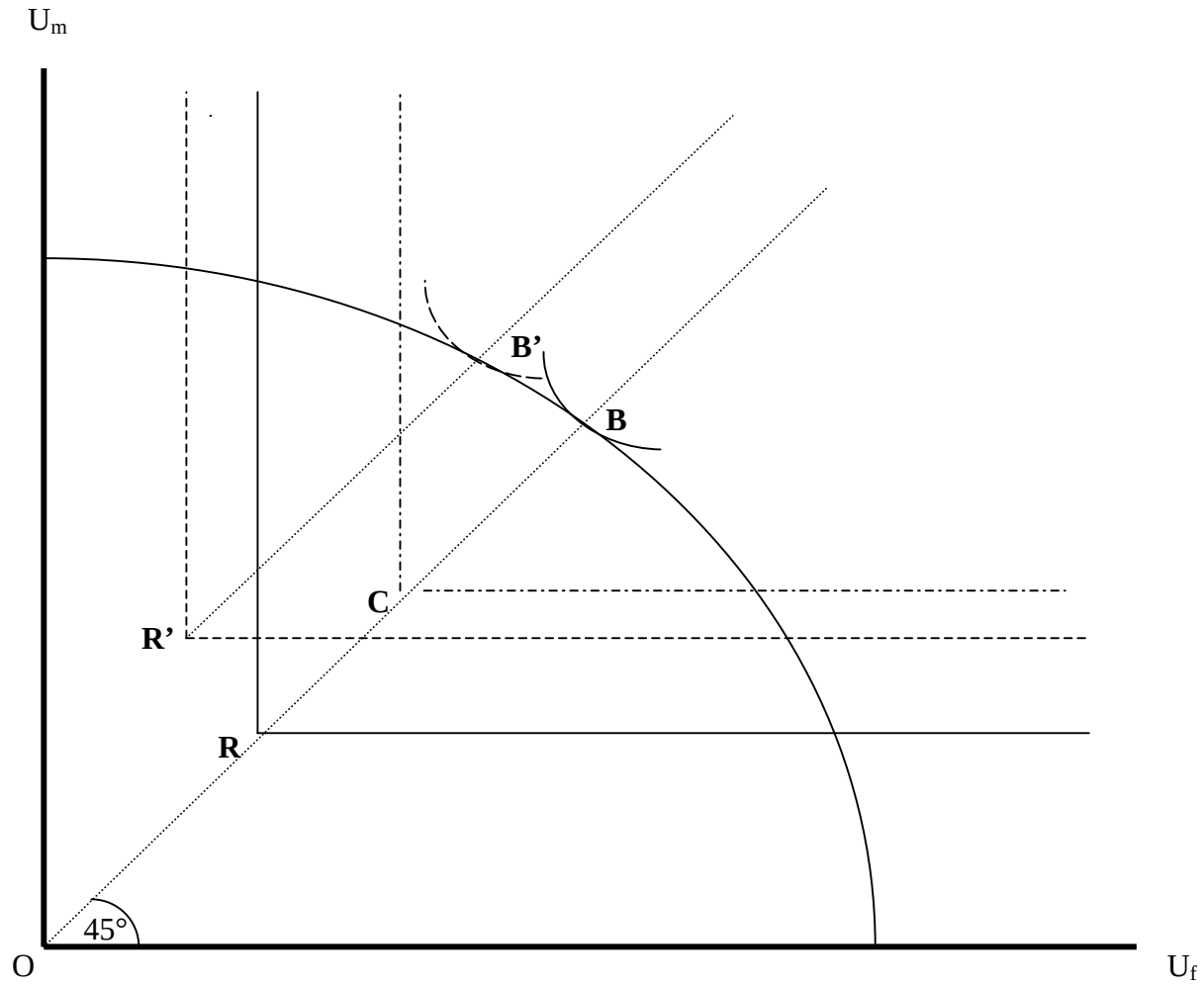

Figure 3. Ex-ante bargaining, ex-post bargaining and non-cooperative equilibria: The union is cooperative even if ex-ante agreements are not enforceable.

Proposition 2. Cooperative equilibria are efficient conditional on endowments. The main childcarer is better-off if ex-ante contracts are enforceable, than if they are not enforceable.

Corollary 2. In a cooperative equilibrium, the partners specialize according to their comparative advantages. The number of children is a decreasing function of the skill premium. If the partners have the same human capital endowment, the woman earns less than the man.

2.3 Non-cooperative equilibrium

Consider next the case where f and m play a non-cooperative game. Now each party retains control over his or her own earnings and assets,[9] and decides how much time and money to spend on the children, taking the other party's actions as parameters. The equilibrium is Cournot-Nash.

Realistically assuming that the woman has ultimate control over her fertility (but nothing of substance changes if we grant this prerogative to the man), f chooses (c, t, n) to maximize her own utility, still given by (1), subject to her own budget constraint,

$$a_f + (c - c_m) n = y_f \tag{21}$$

where c_m is the amount of money that m spends on each child, and

$$y_f = b_f + [1 - (t_0 + t - t_m) n] [1 + \alpha (1 - (t_0 + t - t_m) n)] h_f \omega.$$

is f's income. The solution will satisfy the first-order conditions

$$u'(a_f) = \beta n v_c(c, t), \tag{22}$$

$$\frac{v_t(c, t)}{v_c(c, t)} = (1 + 2\alpha [1 - (t_0 + t - t_m) n]) h_f \omega \tag{23}$$

and

$$\frac{v(c, t)}{v_c(c, t)} = c - c_m + (t_0 + t - t_m)(1 + 2\alpha [1 - (t_0 + t - t_m) n]) h_f \omega. \tag{24}$$

The man chooses (c_m, t_m) to maximize his own utility, subject to

$$a_m + n c_m = y_m \tag{25}$$

[9] As a minimum, this will involve keeping a separate bank account. If the couple is legally married, and it is possible to choose (as in certain countries) between a joint or a separate property regime, it will also involve opting for the latter.

where

$$y_m = b_m + (1 - nt_m)\left[1 + \alpha\left(1 - nt_m\right)\right] h_m \omega$$

is m's income. The solution will satisfy

$$u'\left(a_m\right) = \beta n v_c\left(c, t\right) \tag{26}$$

and

$$\frac{v_t\left(c, t\right)}{v_c\left(c, t\right)} = \left[1 + 2\alpha\left(1 - nt_m\right)\right] h_m \omega. \tag{27}$$

In the Cournot-Nash equilibrium, the RHS of (22) is equated to that of (26), and the RHS of (23) to that of (27). Let a superscript C identify the value of a variable in this equilibrium. In view of (22) and (26),

$$a_f^C = a_m^C. \tag{28}$$

Since the children are local public goods, (28) implies that f and m enjoy the same utility,

$$U_f^C = U_m^C, \tag{29}$$

irrespective of endowments.

In view of $(21) - (25)$ and (28), the partner with the larger money endowment bears the larger part of c,

$$c_m^C n^C - \left(c^C - c_m^C\right) n^C = b_m - b_f. \tag{30}$$

If f and m happen to have the same money endowment,

$$b_f = b_m,$$

they will then take equal shares in the monetary cost of the children,

$$c_m^C = \frac{c^C}{2}. \tag{31}$$

In view of (23) and (27), f and m earn the same amount of money,

$$L_f^C h_f \omega = L_m^C h_m \omega. \tag{32}$$

If they happen to have the same human capital endowment,

$$h_f = h_m,$$

they will then supply the same amount of labour,

$$L_f^C = L_m^C. \tag{33}$$

and the same amount of child-care time,

$$t_m^C = \frac{t_0 + t^C}{2}. \tag{34}$$

Since the RHS of (24) is increasing in ω, n^C is decreasing in ω like n^*.

Proposition 3. In a non-cooperative equilibrium, the partners earn and consume the same, and enjoy the same utility, irrespective of endowments. The number of children is a decreasing function of the skill premium. If the partners have the same money endowment, they take equal shares in the monetary cost of the children. If they have the same human capital endowment, they share market and domestic work equally between them.

Comparing the RHSs of (23) and (27) with those of (12) and (14), we can see that the marginal cost of t is higher than in the efficient allocation. Given diminishing MRS of c for t, the couple will then spend relatively too little time, and too much money, on each child. The intuition is straightforward. As the partners do not exploit their comparative advantages in the use of time, the opportunity-cost of child-care time is not minimized. As a consequence, children are raised with the wrong mix of parental time and market inputs.

Comparing the RHS of (24) with that of (13), we can also see that the woman equates the marginal benefit of n to her own, rather than to the couple's joint marginal cost. We know that the couple's joint marginal cost is inefficiently large. But the woman's share of this cost is nonetheless likely to be smaller than the couple's efficient joint marginal cost. This is particularly obvious in the case where f and m have the same money endowment. As each partner will then bear exactly half the joint cost of having an extra child, this joint cost would have to be at more than double its efficient level for it to be true that the marginal cost to the woman is as large as the efficient marginal cost to the couple. Given diminishing MRS of c for n, it is then likely that n^C will be inefficiently high.

Proposition 4. Non-cooperative equilibria are conditionally inefficient. The partners do not exploit their comparative advantages in the use of time, spend relatively too little time (too much money) on each of their children, and are likely to have too many children.

In view of the first part of Proposition 2, this has the following implication.

Corollary 4. For any given set of endowments, and any given skill premium, parents are likely to have fewer children if they cooperate, than if they do not.

2.4 Will a union be formed, and will it be cooperative?

Will f and m form a union? If they do, will the union be cooperative or non cooperative? Lundberg and Pollak (1996) assume that the partners will form a cooperative union, and stay together come what may. Having ruled out separation, these authors cannot then identify a person's ex-post reserve utility, as we do, with his or her utility in the event of separation. Instead, they identify it with that person's equilibrium utility in the Cournot-Nash game that the couple *could* have plaid as an alternative to bargaining. In our framework, however, this equilibrium ceases to be available the moment f and m engage in a cooperative game. Therefore, the Cournot-Nash equilibrium cannot affect the outcome of the Nash-bargaining game. But it helps to determine which of the two games will be plaid if the union is formed, and whether the union will be formed.

The union will be formed if and only if it gives f *and* m at least the same utility as singlehood,

$$\max\left(U_i^{B'}, U^C\right) \geq R_i,\ i = f, m. \tag{35}$$

This condition is satisfied in the case illustrated by Figure 2 or Figure 3, but not in that illustrated by Figure 4. Since R_i is linear in ω, while $U_i^{B'}$ and U^C are concave, this may mean that the the skill premium is higher in Figure 4, than either Figure 2 or Figure 3. Given that the union is formed, the game will be cooperative if and only if

$$U_i^{B'} \geq U^C,\ i = f, m. \tag{36}$$

This condition is satisfied in Figure 3, but not in Figure 2. Why? In both cases, **R** lies on the 45° line, indicating that f and m have the same ex-ante reserve utility. In both cases, **R'** lies to the left of **R**, implying that it is efficient for f to be the main childcarer. The only difference between the two pictures is in that the horizontal distance between **R'** and **R** is greater in Figure 2 than in Figure 3. If f and m have the same preferences, a reason for this difference could be that h_f is larger, and b_f consequently (as R_f is equal to and R_m) smaller, in the case illustrated by Figure 2 than in that illustrated by Figure 3. As human capital accumulates with labour market experience, while money is independent of it, the woman's bargaining power would in fact suffer more if she accepted to be the main childcarer in the case illustrated by Figure 2, than in that illustrated by Figure 3. Another reason could be that ω is higher, and human capital consequently more valuable, in the first than in the second case.

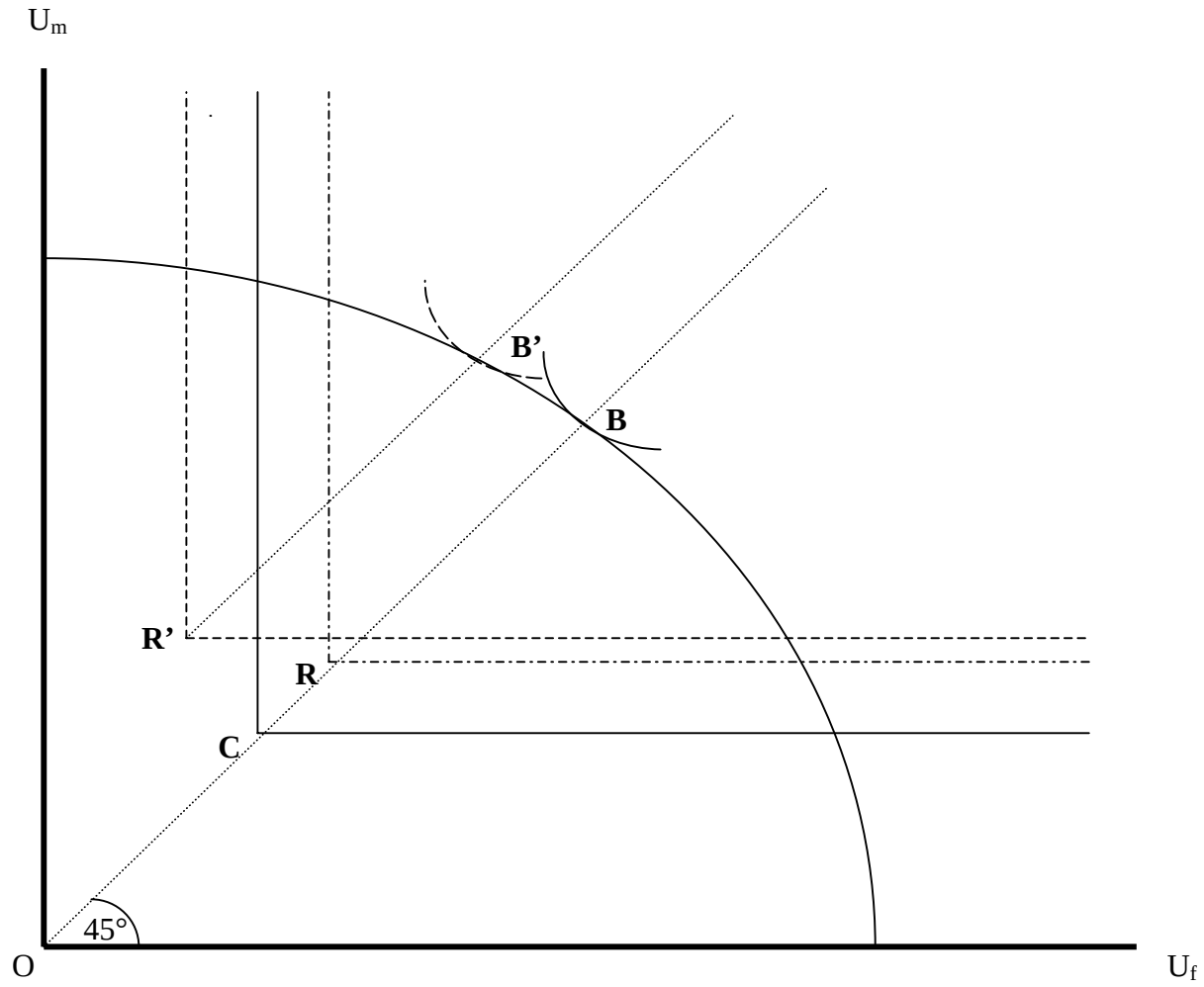

Figure 4. Ex-ante bargaining, ex-post bargaining and non-cooperative equilibria: No union is formed.

Allowing for heterogeneity (different pairs may have different endowments), we can express these results in probabilistic terms.

> *Proposition 5. The probabilities that (a) a union is formed, and (b) the equilibrium is cooperative conditional on a union being formed, are decreasing in the skill premium, and increasing in the ratio of money to human capital endowment of the person who would be the main childcarer in the cooperative equilibrium.*

2.4.1 Dowries and bride-prices

Given that the main childcarer is traditionally the woman, Proposition 5 provides a rationale for the time-honoured institution of the dowry.[10] It also justifies the special restrictions that some legal systems impose on the disposal of dowries. By putting these endowments beyond the reach of rapacious husbands, such restrictions do in fact strengthen the woman's hand in domestic negotiations. A somewhat different argument may be used to rationalize another archaic institution, the bride-price. While the dowry is an intergenerational transfer (from parents to daughter) within the same dynasty, the bride-price is in fact a transfer between dynasties. If the payment is actually received by the bride's parents, rather than by the bride herself, the former may decide to pass it on to the latter in the form of a dowry. There is thus no reason why dowries and bride-prices should not go hand in hand.

Suppose that it is conditionally efficient for f to be the main childcarer. If $U_m^{B'}$ is higher than U_m^C, m will be willing to pay a bride-price to secure f's cooperation. The most he would be prepared to spend is φ_m, implicitly defined by

$$u\left(a_m^{B'} - \varphi_m\right) = u\left(a_m^C\right) + \beta\left[n^C v\left(c^C, t^C\right) - n^* v\left(c^*, t^*\right)\right]. \tag{37}$$

The least she would be willing to accept is φ_f, implicitly defined by

$$u\left(a_f^{B'} + \varphi_f\right) = u\left(a_f^C\right) + \beta\left[n^C v\left(c^C, t^C\right) - n^* v\left(c^*, t^*\right)\right]. \tag{38}$$

In equilibrium,

$$\varphi_f = \frac{a_m^{B'} - a_f^{B'}}{2} = \varphi_m. \tag{39}$$

[10] Notice that this rationale is independent of whether the new couple will live with the bride's or the groom's parents. It is thus more general, but not necessarily in conflict with, the explanations provided by Botticini and Siow (2003), and Rammohan and Robertson (2006).

If f can credibly commit to delivering $(t_0 + t^*)\, n^*$ units of child-care time in exchange for half the difference between his and her consumption in the ex-post bargaining equilibrium, a mutually beneficial deal will then be struck, and the allocation will be conditionally efficient. The problem is that, as the bride-price is paid in advance, f will have no interest in delivering her side of the deal when the time comes because she can enhance her domestic bargaining power, or directly her consumption, by doing more market work. If the bride-price is paid directly to her, her promise to deliver $(t_0 + t^*)\, n^*$ units of child-care time will then be credible only on condition that her husband has the means of enforcing the deal, by force if need be. By contrast, if the bride-price is paid to f's parents, the latter may have an interest in making sure that the promise is kept (*e.g.*, because they have other daughters to marry, or for other reputational reasons). If they have also the means of bringing their daughter to heel (e.g., because culture and upbringing allows them to exercise control over her even after she is married), the promise will then be credible and the contract will go through. Notice that non-compliance with a bride-price contract is in any case not as difficult to demonstrate as non-compliance with a full pre-marital contract. Since the price is paid at front, all that needs to be shown is that the woman is spending "too much" of her time working for a wage (and keeping what she earns).

Therefore, dowry protection and enforceable bride-price contracts, relax (36) and (35).

> *Proposition 6. The probabilities that (a) a union is formed, and (b) the equilibrium is cooperative conditional on a union being formed, are higher if the law protects dowries from marital incursions, or if bride-price contracts are enforceable.*

2.4.2 Marriage, divorce and alimony

So far, we have assumed that a union can be dissolved at no cost, and that neither party expects to receive any kind of transfer from the other in the event of separation. That is not true, however, if the couple is legally married. Let γ denote the legal cost of obtaining a divorce. Let δ denote the lump-sum transfer, or the present value of the stream of periodical payments ("alimony"), that the main childcarer is entitled to receive from the main earner in the event of divorce. In reality, divorce is often a consequence of imperfect information (about the present partner, or about the availability of alternative ones). If that is the case, the parents will typically separate while they are still relatively young, and their children still dependent on them. In our perfect-information

framework, however, divorce (or, rather, the threat of divorce) can have only one purpose, namely to deter opportunistic bargaining. The only party with a potential interest in using this weapon is then the main childcarer, and the only time he or she will actually need to use it is, as we have seen, when the children have cease to be economically dependent. With the children out of the way, δ cannot then constitute child support,[11] but may be construed as compensation for the damage that domestic specialization has done to the main childcarer's career prospects. The effect of fuller compensation is then to strengthen the hand of the main childcarer in domestic negotiations by making his or her threat of divorce more credible.

Suppose that de-facto unions attract social stigma or legal discrimination such that the only effective alternative to singlehood is legal marriage. Let j denote the person who, in a cooperative equilibrium, would be the main childcarer, and k the one who would be the main earner. Their ex-post reserve utilities are now given by

$$R'_j = u\left(L_j^*\left(1+\alpha L_j^*\right)h_j\omega + \delta - \gamma\right) + n^* v\left(c^*, t^*\right)$$

and

$$R'_k = u\left(L_k^*\left(1+\alpha L_k^*\right)h_k\omega\right) + n^* v\left(c^*, t^*\right)$$

For any given γ, there is a threshold value of δ , implicitly defined by

$$u\left(a_j^{B'} - \gamma + \delta\right) - u\left(a_j^C\right) = \beta\left[n^C v\left(c^C, t^C\right) - n^* v\left(c^*, t^*\right)\right], \qquad (40)$$

such that j is indifferent between cooperating and not cooperating. As the threshold is clearly increasing in γ, the probability that the marriage will be cooperative is increasing in $(\delta - \gamma)$.

Alternatively, suppose that no such stigma or discrimination exists. The alternatives to singlehood are then marriage, characterized by positive γ and δ, and de-facto union, characterized by γ and δ identically zero. Therefore,

$$U_i^{B'} = V_i\left(\gamma, \delta\right).$$

The condition for a union to be formed (35) must then be re-written as

$$\max\left(V_i\left(\gamma,\delta\right), V_i\left(0,0\right), U^C\right) \geq R_i,\ i = f, m, \qquad (41)$$

and the condition for the equilibrium to be cooperative (36) as

$$\max\left(V_i\left(\gamma,\delta\right), V_i\left(0,0\right)\right) \geq U^C,\ i = f, m. \qquad (42)$$

[11] For an analysis of the effects of child-support orders on the behaviour of divorced parents with dependent children, see Del Boca and Flinn (1995).

The union will be a marriage if and only if

$$V(\gamma, \delta) \geq V(0,0), \ i = f, m. \tag{43}$$

All three of these conditions will be less stringent if δ is large relative to γ.

> *Proposition 7. The probability that a union is formed, and the conditional probabilities that (a) the equilibrium is cooperative, and (b) the couple is married, are higher if alimony awards are large relative to the cost of obtaining a divorce.*
>
> *Corollary 7. If alimony awards are sufficiently low relative to the cost of obtaining a divorce, a couple will marry only if cohabitation without marriage attracts social stigma, or the law discriminates against unmarried couples..*

3 The first stage of the game

At the first stage of the game, i is still of school age, and i's parents choose (b_i, h_i) with an eye to the effects that this will have at the next stage. In an arranged-marriage setting, the parents of the would-be bride know the parents of the would-be groom, and can thus bargain with them. If the marriage is arranged when the directly interested parties are still very young, we can then envisage the prospective parents-in-law playing a Nash-bargaining game over how much money and education to give their respective children. If that is the case, the first-stage equilibrium will be efficient. Given that the second-stage equilibrium will be efficient conditional on money and human capital endowments if and only if it is cooperative, this implies that the outcome of the first-stage game is such, that the second stage-players will be induced to cooperate. In other social settings, unions are formed by the directly interested parties, usually at an age when the greater part of the education process is over. We shall assume that educational investments are decided by parents anyway.[12] Since the latter do not know who their son or daughter's future partner is going to be, however, direct negotiation is out of the question. We shall then postulate that the first-stage game is Cournot-Nash.

Let e_i be the total cost, assumed given, that i's parents are willing to bear on i's behalf. This assumption implies that the utility function of i's parents is separable in own consumption, and quantity and quality of children, just like i's. The cost of educating a child depends on the level

[12] See Peters and Siow (2002) for an analysis of the case where the children themselves decide how much to invest in their own education.

of education, and on the child's aptitude for learning. Normalizing the human capital endowment of a totally uneducated person to unity, we can write $z\left(h_i-1,\ \theta_i\right)$ for the cost of endowing i with h_i units of human capital. The constant θ_i is an educational ability parameter (ability to profit from education). The function $z\left(.,.\right)$ is defined for

$$h_i \geq 1, \tag{44}$$

with $z_1\left(h_i-1,\ \theta_i\right)$ positive and increasing, and $z_2\left(h_i-1,\ \theta_i\right)$ negative.

We shall assume that the potential parties to the union have the same family background, proxied by the amount of money that their parents are willing to spend on them,

$$e_f = e = e_m, \tag{45}$$

and the same educational ability,

$$\theta_f = \theta = \theta_m. \tag{46}$$

As we shall see, the equilibrium implications of these assumptions are consistent with some theoretical results already in the literature.

3.1 Efficiency

An efficient allocation $\left(h_f^{**}, h_m^{**}, a_f^{**}, a_m^{**}, t_f^{**}, t_m^{**}, c^{**}, n^{**}\right)$ maximizes (5), subject to (44), and to the resource constraint,

$$\sum_{i=f,m}\left[z\left(h_i-1,\theta\right)-\frac{L_i\left(1+\alpha L_i\right)h_i\omega-a_i}{r}\right]+\frac{cn}{r}=2e, \tag{47}$$

where r is the interest factor. It will thus satisfy $(11)-(13)$, and *either*

$$\frac{\left[1-\left(t_0+t\right)n\right]\left(1+\alpha\left[1-\left(t_0+t\right)n\right]\right)\omega}{z'\left(h_f-1,\theta\right)}=r=\frac{\left(1+\alpha\right)\omega}{z'\left(h_m-1,\theta\right)}, \tag{48}$$

or

$$\frac{\left[1-\left(t_0+t\right)n\right]\left(1+\alpha\left[1-\left(t_0+t\right)n\right]\right)\omega}{z'\left(h_f-1,\theta\right)}<r,\ h_f=1 \text{ and } \frac{\left(1+\alpha\right)\omega}{z_1\left(h_m-1,\theta\right)}=r. \tag{49}$$

Therefore, in view of Proposition 1, an allocation can be efficient only if it leads to the traditional division of labour.

The equations in (48) are portfolio conditions, stating that the marginal return to money spent on f's education must be equated to the interest factor, and thus to the marginal return on money spent on m's education. In view of (46), they thus imply that f should receive less

education than m. The equations in (49) tell us that, if f's human capital is pressing against its natural floor, the marginal return to money spent on her education will be lower than the interest factor, and thus lower than the marginal return to money spent on his education. The intuition is straightforward. As it costs the same to equip either f or m with any given amount of human capital, but the return is lower for f than for m, because she cannot specialize in market work as far as him, it cannot be efficient to spend as much for her education as for his. Therefore, h_f must be reduced until the return is equal to r or, if that is not possible, until h_f is at its natural minimum.

> *Proposition 8. It is efficient to give a boy more education than a girl of the same educational ability.*

If h_f is at a corner, and the marginal return to money spent on f's education is consequently lower than the interest rate, an allocation may be efficient with reference to the mini-society composed by f, m and their respective parents, but will be inefficient with reference to society at large. By reducing the private cost of education, an educational subsidy would then reduce the probability that (44) is binding. More about this later.

3.2 Equilibrium

As there are only four possible second-stage equilibria (the trivial one where f and m remain single, the one in which they form a non-cooperative union, and the two in which they form a cooperative union with either of them as the main childcarer), first-stage players have only four undominated strategies. Recalling that the first stage is non-cooperative, and that the conditionally efficient (c, t, n) is a function of (b_f, b_m, h_f, h_m), the undominated strategies available to f's parents are as follows.

h_f^1: Choose (b_f, h_f) so that f's utility as a single,

$$U_f = u\left(b_f + (1+\alpha)\, h_f \omega\right),$$

is at a maximum subject to (44) and

$$\frac{b_f}{r} + z\left(h_f - 1, \theta\right) = e. \tag{50}$$

The solution satisfies

$$\text{either } \frac{(1+\alpha)\,\omega}{z'\left(h_f - 1, \theta\right)} = r \text{ or } \frac{(1+\alpha)\,\omega}{z'\left(h_f - 1, \theta\right)} < r \text{ and } h_f = 1. \tag{51}$$

h_f^2: Choose (b_f, h_f, c, t, n) so that f's utility in the event of a non-cooperative union,

$$U_f = u\left(b_f + \left[1 - \left(t_0 + t - t_m\right) n\right]\left(1 + \alpha\left[1 - \left(t_0 + t - t_m\right) n\right]\right) h_f\omega - \left(c - c_m\right) n\right) + \beta n v\left(c, t\right),$$

is at a maximum subject to (44) and (50), taking (b_m, h_m, c_m, t_m) as parameters. The solution satisfies $(22) - (24)$ and

$$\text{either } \frac{\left[1 - \left(t_0 + t - t_m\right) n\right]\left(1 + \alpha\left[1 - \left(t_0 + t - t_m\right) n\right]\right)\omega}{z'\left(h_f - 1, \theta\right)} = r \text{ or } \frac{\left[1 - \left(t_0 + t - t_m\right) n\right]\left(1 + \alpha\left[1 - \left(t_0\right.\right.\right.}{z'\left(h_f - 1, \theta\right)} \tag{52}$$

h_f^3: Choose (b_f, h_f) so that f's utility in the event of a cooperative union where she is the main childcarer is at a maximum subject to (44) and (50), taking (b_m, h_m) as parameters. As this is equivalent to maximizing

$$R_f' = u\left(b_f + \left[1 - \left(t_0 + t^*\right) n^*\right]\left(1 + \alpha\left[1 - \left(t_0 + t^*\right) n^*\right]\right) h_f\omega - \gamma + \delta\right) + \beta n^* v\left(c^*, t^*\right),$$

the solution will satisfy

$$\text{either } \frac{\left[1 - \left(t_0 + t^*\right) n^*\right]\left(1 + \alpha\left[1 - \left(t_0 + t^*\right) n^*\right]\right)\omega}{z'\left(h_f - 1, \theta_f\right)} = r \text{ or } \frac{\left[1 - \left(t_0 + t^*\right) n^*\right]\left(1 + \alpha\left[1 - \left(t_0 + t^*\right) n^*\right]\right)\alpha}{z'\left(h_f - 1, \theta_f\right)} \tag{53}$$

h_f^4: Choose (b_f, h_f) so that f's utility in the event of a cooperative union where she is the main earner is at a maximum subject to (44) and (50), taking (b_m, h_m) as parameters. As this is equivalent to maximizing

$$R_f' = u\left(b_f + \left(1 - t_0 n^*\right)\left[1 + \alpha\left(1 - t_0 n^*\right)\right] h_f\omega\right) + \beta n^* v\left(c^*, t^*\right),$$

the solution will satisfy

$$\text{either } \frac{\left(1 - t_0 n^*\right)\left[1 + \alpha\left(1 - t_0 n^*\right)\right]\omega}{z'\left(h_f - 1, \theta_f\right)} < r \text{ and } h_f = 1 \text{ or } \frac{\left(1 - t_0 n^*\right)\left[1 + \alpha\left(1 - t_0 n^*\right)\right]\omega}{z'\left(h_f - 1, \theta_f\right)} = r. \tag{54}$$

Those available to m's parents are the following.

h_m^1: Choose (b_m, h_m) so that m's utility as a single,

$$U_m = u\left(b_m + \left(1 + \alpha\right) h_m\omega\right),$$

is at a maximum subject to (44) and

$$\frac{b_m}{r} + z\left(h_m - 1, \theta\right) = e. \tag{55}$$

The solution satisfies

$$\text{either } h_m = 1 \text{ or } \frac{\left(1 + \alpha\right)\omega}{z'\left(h_m - 1, \theta\right)} = r. \tag{56}$$

h_m^2: Choose (b_m, h_m, c_m, t_m) so that m's utility in the event of a non-cooperative union,

$$U_m = u\left(b_m + (1 - t_m n)\left[1 + \alpha\left(1 - t_m n\right)\right] h_m \omega - c_m n\right) + \beta n v\left(c, t\right),$$

is at a maximum subject to (44) and (55), taking (b_f, h_f, c, t, n) as parameters. The solution satisfies

$$\text{either } h_m = 1 \text{ or } \frac{\left(1 - t_m n\right)\left[1 + \alpha\left(1 - t_m n\right)\right]\omega}{z'\left(h_m - 1, \theta\right)} = r. \tag{57}$$

h_m^3: Choose (b_m, h_m) so that m's utility in the event of a cooperative union where he is the main childcarer is at a maximum subject to (44) and (55), taking (b_f, h_f) as parameters. As this is equivalent to maximizing

$$R'_m = u\left(b_m + (1 - t^* n^*)\left[1 + \alpha\left(1 - tn\right)\right] h_m \omega - \gamma + \delta\right) + \beta n^* v\left(c^*, t^*\right),$$

the solution satisfies

$$\text{either } h_m = 1 \text{ or } \frac{\left(1 - t^* n^*\right)\left[1 + \alpha\left(1 - t^* n^*\right)\right]\omega}{z'\left(h_m - 1, \theta_m\right)} = r. \tag{58}$$

Here too, γ and δ would be identically zero in case of de-facto union, but that would have no influence on first-stage behaviour.

h_m^4: Choose (b_m, h_m) so that m's utility in the event of a cooperative union where he is the main earner is at a maximum subject to (44) and (55), taking (b_f, h_f) as parameters. As this is equivalent to maximizing

$$R'_m = u\left(b_m + (1 + \alpha) h_m \omega\right) + \beta n^* v\left(c, t\right),$$

the solution satisfies

$$\text{either } h_m = 1 \text{ or } \frac{\left(1 + \alpha\right)\omega}{z'\left(h_m - 1, \theta\right)} = r. \tag{59}$$

There are four possible first-stage equilibria, one for each possible second-stage equilibrium:[13]

$\left(h_f^1, h_m^1\right)$ if the second-stage equilibrium is the trivial one represented by point **R** of Figure 4, where f and m remain single;

[13]It can be easily checked that none of the other strategy pairs is an equilibrium. For example, $\left(h_f^1, h_m^2\right)$ cannot be an equilibrium because the best response on the part of m's parents to f's endowing their daughter with h_f^1 units of human capital is to do the same for their son ($h_m^1 = h_f^1$). Were he to get the smaller amount h_m^2, and irrespective of whether f and m stay single, or form a union, his utility would in fact be lower than if he got h_m^1. And so on.

$\left(h_f^2, h_m^2\right)$ if the second-stage equilibrium is the non-cooperative one represented by point **C** of Figure 2;

$\left(h_f^3, h_m^4\right)$ if the second-stage equilibrium is cooperative, and f is the main childcarer, as at point **B'** of Figure 3;

$\left(h_f^4, h_m^3\right)$, if the second-stage equilibrium is cooperative and m is the main childcarer.

Equilibrium selection is affected by the external circumstances discussed in Subsection 2.4. Continuing to assume heterogeneity, we can then conclude that the larger is ω, the higher is the probability that f and m will choose to stay single, and thus that the first-stage equilibrium is$\left(h_f^1, h_m^1\right)$. Conditional on f and m forming a union, the higher is $(\delta - \gamma)$, the higher are both the probability that the second-stage game will be cooperative, and the probability that the union will be a conventional marriage. Both these conditional probabilities are higher also if society frowns upon de-facto unions, or the law discriminates against them. Conditional on a union being formed, and the second-stage game being cooperative, the probability that f will be the main childcarer, and thus that the first-stage equilibrium will be $\left(h_f^3, h_m^4\right)$ rather than $\left(h_f^4, h_m^3\right)$, is higher if dowries enjoy greater legal protection than money endowments in general, or if bride-price contracts are enforceable.

As γ and δ do not figure in the first-order conditions governing any of the first-stage strategies, the allocation associated with any given first-stage equilibrium is independent of these parameters. Together with all the other parameters of the system, however, γ and δ contribute to the selection of the second, and thus of the first-stage equilibrium. Suppose that the parameter configuration is such, that f and m will form a union. The values of γ and δ will then help determine whether the union is cooperative on non-cooperative (and, if the union is cooperative, who will be the main childcarer). Suppose that de-facto couples do not attract social stigma, and can costlessly escape any form of legal discrimination by recording their partnership in a public register (as is now possible in many parts of Europe). Since γ and δ are relevant only if the couple is married, the values of these parameters will then help determine whether f and m will marry or merely cohabit, but the allocation will be the same in either case.

Notice that, if the first-stage equilibrium is $\left(h_f^2, h_m^2\right)$, f and m will have the same money and human capital endowments ("assortative mating"). By contrast, if the first-stage equilibrium is either $\left(h_f^3, h_m^4\right)$ or $\left(h_f^4, h_m^3\right)$, one of the partners will enter the union with relatively more money, and the other with relatively more human capital ("complementarity of traits"). Becker (1981) predicts that partners will have complementary traits. Lam (1988) shows that, if individuals differ only in

their money endowment, there will be assortative mating. If they differ also in their wage rate, however, there can be either assortative mating, or complementarity of traits. Since, in the present context, wage rate differences reflect differences in human capital, our results are consistent with Lam's.[14]

> *Proposition 9. The first-stage equilibrium may be such that the second-stage players will remain single, or that they will form a union. If they form a union, the second-stage equilibrium may be either cooperative or non-cooperative. If it is cooperative, one of the partners will bring to the union relatively more money, and the other relatively more human capital. If it is non-cooperative, the partners will bring the same amount of money, and the same amount of human capital.*

In view of the third part of Proposition 3, the following will then be true.

> *Corollary 9. If the first-stage equilibrium is such that a union is formed, and that the second-stage equilibrium is non-cooperative, the partners will share domestic and market work equally between them.*

Comparing the properties of the four possible first-stage equilibria with the efficiency conditions derived in the last subsection, it is clear that only $\left(h_f^3, h_m^4\right)$ is efficient. Intuitively that is because $\left(h_f^1, h_m^1\right)$ leads f and m to forgo the opportunity of producing the local public good (children), $\left(h_f^2, h_m^2\right)$ to forgo the benefits of domestic division of labour, and $\left(h_f^4, h_m^3\right)$ to specialize the wrong way.

> *Proposition 10. A first-stage equilibrium is efficient if and only if the associated second-stage equilibrium is characterized by the traditional division of labour.*

In view of propositions 8 and 9, this implies that one of the four possible first-stage equilibria assigns boys more education than equally gifted girls.

> *Corollary 10. In equilibrium, a boy may get more education than a girl of the same educational ability.*

[14] Clark (2006) demonstrates that a sufficient condition for the uniqueness of stable matchings is that endowments (i) determine preferences, and (ii) form the basis for a person's attractiveness to the opposite sex. In our model, individuals have the same preference ranking, but their endowments determine both their attractiveness for members of the opposite sex, and the equilibrium choice of action.

3.3 Education policy

Education policy has typically two components. One is a minimum school-leaving age, the other is an education subsidy covering at least the compulsory schooling period. We have already noted that education subsidies are beneficial because they reduce the probability that (44) is binding for any i. The policy may then raise expected social welfare (will if it is financed by a lump-sum tax) even in the absence of an education externality. Let us now look at the effects of compulsion.

Suppose that i is obliged to attend school up to a certain age. Assuming that $z(h_i - 1, \theta_i)$ is essentially a reflection of the number of years for which a child of educational ability θ_i must attend school in order to achieve h_i, we may write the minimum school-leaving age constraint facing i's parents as

$$z(h_i - 1, \theta_i) \geq z_0, \tag{60}$$

where z_0 is a positive constant. The probability that this constraint will be binding increases with z_0 and θ_i.

Now take the (f, m) match. Suppose that, without (60), the equilibrium would be $\left(h_f^3, h_m^4\right)$. With (60), it is possible that f's parents will be effectively constrained in their choice of educational investment, and m's will not, or that they both will.[15] In either case, $\left(h_f^3, h_m^4\right)$ would cease to be a possible equilibrium. Since the possible ones are all inefficient in view of Proposition 10, the policy then reduces the probability that a union will be efficient. The intuition is straightforward, if parents are forced to keep a child at school longer than they deem optimal, that distorts not only their educational investment decision, but also the choice of partner that the child will make when he or she grows up, and therefore the future allocation of domestic resources.

> *Proposition 11. An education subsidy financed by a non-distortionary tax raises expected social welfare. Making school attendance compulsory up to a certain age can raise social welfare only if there is an education externality.*

This has a startling implication. If we start to raise the minimum school-leaving age, a number of cooperative unions will cease to be possible equilibria. Since the number of years of education required to qualify as the main earner in a cooperative union is lower for a man than for a woman of the same educational ability, the cooperative unions excluded first will be those characterized by the traditional division of labour. If

[15] Since h_f^3 is lower than h_m^4, we cannot have a situation where m's parents are effectively constrained, and f's are not.

we go on raising the minimum, we shall eventually reach a point where the only cooperative unions are those in which the woman is the main earner, and the man is the main childcarer. Ultimately, there will be no cooperative unions left, neither traditional nor liberated. Young people will either stay single, or form non-cooperative unions characterized by share-alike arrangements.

4 Discussion

Our story may be summarized as follows. At the first stage of the game, couples with school-age children decide how much money and education to give their offspring. At the second stage, their children, now grown-up, decide whether to stay single or form a union. If they do the latter, they may marry, or simply cohabit. The first stage of the game can be cooperative only in an arranged-marriage setting. If that is the case, the second stage will be cooperative too. Otherwise, the first stage cannot be anything other than non-cooperative, because the players do not know each another. Four types of equilibrium are then possible. One is such that the second-stage players will choose to stay single. Another is such that a union will be formed, and that the parties to the union will have the same money and human capital endowments ("assortative mating"). The remaining two are such that a union will be formed, but one of the partners will be endowed with more money, and the other with more human capital ("complementarity of traits"). This is consistent with theoretical results in Lam (1988). In the assortative mating case, the man and the woman will behave non-cooperatively, and take equal shares in market and domestic work. In the two complementarity of traits cases, by contrast, the parties will cooperate, and there will then be division of labour of either the traditional or the liberated kind. Evidence of this is reported in Pencavel (1998). Irrespective of whether the union is cooperative or non-cooperative, the number of children is negatively related to the skill premium.[16] For any given level of the skill premium, however, the parents are likely to have more children if the union is non-cooperative, than if it is cooperative.

Equilibrium selection depends on the skill premium, and on the legal environment. In an arranged-marriage setting, the future union will be efficient by construction. Outside such a setting, however, the probabil-

[16] Ferrero Martinez and Iza (2004) argue that, if bought-in child care is supplied by relatively low-skill workers, the skill premium reduces the relative price of this service. Its overall effect is consequetly the algebraic sum of a positive effect via the monetary cost, and a negative one via the opportunity-cost of a child. By not distinguishing between bought-in child care and other market goods, we have implicitly assumed that relative prices are little affected by the skill premium.

ity that a union will be formed, and the probabilities (a) that the couple will marry rather than simply cohabit, and (b) that the domestic allocation of resources will be efficient, conditional on a union being formed, are higher if one or several of the following circumstances apply:

(a) The skill premium is low.

(b) The law imposes special restrictions on the disposal of dotal goods.

(c) Bride-price contracts are enforceable.

(d) The main childcarer can expect compensation from the main earner in the event of divorce.

(e) Unmarried couples attract social stigma, or do not enjoy the same legal rights as married ones.

(f) The minimum school-leaving age is either low, or not strictly enforced.

Arranged marriages belong in the developing world. The skill premium is lower in developing than in developed countries, and the difference is increasing as a result of globalization and skill-biased technical progress. Legislation protecting dowries from marital incursions can be found in both developing and developed countries, but is largely irrelevant in the latter because a high skill premium makes an education more valuable than a dowry. This explanation of the demise of the dowry in developed countries descends from the argument that the purpose of this form of wealth transfer is to shelter a daughter from a husband's opportunistic bargaining. Another explanation, not incompatible with ours, has to do with the contraction of the agricultural sector. Botticini and Siow (2003) argue that the rationale for transferring wealth to a daughter in the form of a dowry, rather than by bequest, is related to the virilocal culture traditionally associated with family farming.[17] The argument has some force, but is unlikely to have contributed to any significant extent to the sign reversal in the correlation between fertility and female participation which occurred in developed countries towards the end of the 1970s, when agriculture had long ceased to be a major sector of employment. Bride-price contracts are illegal almost everywhere, but widely used in developing countries where it is socially acceptable for a husband to enforce such an arrangement by extra-legal means if need be, and parents exercise control over grown-up children (especially daughters) even after they are married.

Divorce legislation and jurisprudence vary from country to country. In developed ones, however, the trend is towards awarding alimony only if there are dependent children. Since the 1970s, many of these coun-

[17] See also the analogous lineage-related argument in Rammohan and Robertson (2006).

tries have also introduced "no-fault" divorce legislation which effectively entitles either spouse to unilaterally end a marriage by simply saying so before a judge. A possibly unforeseen consequence of this legislation is that divorce may lead to a re-assignment of property rights. In a joint-property regime, any assets acquired in the course of the marriage are held in the couple's joint names, and may me divided equitably by the court in the event of divorce. In a separate-property regime, by contrast, any assets acquired in the course of a marriage are the property of either one or the other spouse. If there was domestic division of labour, the main earner may have then acquired more assets than the main childcarer. At divorce, the latter will lose the benefit of any implicit transfers he or she was getting from the former while the marriage lasted, but will not get any of the assets held in the other party's name. The effect will then be the same as if the court had awarded alimony not to the main childcarer, but to the main earner (a negative δ). Clark (1999) examines the possibility that alimony might constitute compensation for the main childcarer. The emphasis, in that paper, is on the probability of divorce, and the result is that this probability will increase with the size of alimony awards.[18] In ours, by contrast, the emphasis is on the main childcarer's ability to use the threat of divorce as a weapon for obtaining implicit transfers from the main earner while the marriage lasts. One of our results is that a couple is more likely to both marry and behave cooperatively (hence, to specialize) if the post-divorce transfer to the main childcarer is large relative to the cost of obtaining a divorce, than if it is low or zero. This prediction is consistent with evidence in Gray (1998) that the introduction of no-fault divorce legislation in the US did not raise the incidence of divorce as some were expecting, but did raise female participation (and may have dissuaded some higher-wage women from marrying) in joint-property States. In Italy too, the introduction of no-fault divorce legislation has been followed by a rise in the number of de-facto unions, rather than in the number of divorces, and more recently by a rise in both fertility and female participation.

Another important difference between developed and developing countries is over the treatment of de-facto unions. In developing countries, unmarried couples do not usually enjoy the same rights as legally married ones. In some, they also face social disapproval. In developed countries, by contrast, cohabitation without marriage is socially acceptable, and the legislative trend is towards giving unmarried couples the same rights as married ones. Any residual form of legal discrimination has

[18] The paper analyzes also a model where alimony constitutes child support, rather than compensation for loss of earning capacity, and the result is then that the probability of divorce is decreasing in the size of alimony awards.

disappeared in many (mostly Northern) European countries with the introduction of legislation that permits unmarried couples to record their union in a public register, and thereby to acquire exactly the same rights as married ones in such matters as tax treatment, inheritance, adoption, housing tenure, recognition of the partner as next of kin if one is hospitalized, etc.[19] The name given to these quasi-marriages varies from country to country,[20] but the substance is the same. Unlike a marriage, a registered union can be terminated by either party without any legal cost, or obligation to the other party unless there are dependent children.[21] Like and even more than no-fault divorce, this institution is thus conducive to share-alike domestic arrangements. Finally, the minimum school-leaving age is higher, and more strictly enforced, in developed than in developing countries. Some, like France and the US, have had a high minimum (16) for a long time. Some Australian provinces have gone even higher (17). Consistently with the model's prediction, the US Bureau of Labor (2004) reports that, in almost a quarter of two-earner US households, the woman earns more than the man. For France, Stancanelli (2007) reports that, in 2002, the woman was either the only or the main earner in almost one out of five households where both spouses are aged less than 57. Similar figures are reported for Australia in Drago et al. (2004).

The theory thus implies that the traditional division of labour is more likely to prevail in the conditions which are characteristic of a developing country, than in those which are characteristic of a developed one. This is consistent with evidence reported in Sanchez (1993) for developing countries, and in Burda *et al.* (2006) for developed ones. Taken in conjunction with our other theoretical prediction that share-alike couples are likely to have more children (for any given set of preferences and endowments, and value of the skill premium) than traditional couples, it

[19] Similar moves are afoot also in other developed countries, but are running into opposition from conservative (especially Roman Catholic) quarters largely because the proposed new legislation does not make a distinction between heterosexual and homosexual unions, and gets confused in some people's minds with homosexual marriage. Wherever it is permitted, however, homosexual marriage carries exactly the same legal implications as heterosexual marriage. For present purposes, therefore, what matters is not whether the parties are of the same or different sex, but whether the union can or cannot be dissolved without court intervention, and without any question of compensation.

[20] *Eingetragene Lebenspartnerschaft* in Germany, *pact civil de solidarité et du concubinage* in France, *registrerat partnerskap* is Norway, *registrert partnerskap* is Sweden, civil partnership in the UK), etc.

[21] In some legislations, a court can mandate support for a former partner in financial distress. But this is unrelated to the amount of childcare the latter might have provided.

tallies also with evidence reported in Brewster and Rindfuss (2000) that the cross-country correlation between fertility and female labour market participation, negative until about 1975, has turned positive in the developed part of the world since that date,[22] but remains negative in the developing one. Of course, fertility and female participation are affected also by factors other than those examined here. Fertility is higher in developing than in developed countries not only because the skill premium is lower, but also because infant mortality is higher. This accentuates the difference between developing and developed countries. Within the developed camp, fertility and female participation are lower in countries where re-entry into the labour market after a period of absence is difficult, or where rigid work hours and insufficient child-care facilities make it difficult to reconcile parenthood with work.[23] This is an additional reason why fertility and female participation are positively correlated across developed countries. But neither low infant mortality, nor cross-country differences in labour market structure and public child-care facilities, explain why, in developed countries, the correlation between fertility and female participation changed sign when it did, or why the trend is towards equal-sharing arrangements.

The theoretical analysis establishes also a number of normative propositions. One is that a first-stage equilibrium will be efficient if and only if it leads to the formation, at the second stage of the game, of a cooperative union in which the woman is the main childcarer, and the man is the main earner. The intuitive explanation is that the gain from forming a union is due to two factors. One, common to both cooperative and non-cooperative unions, is associated with the domestic production of a local public good (children). The other, present only in cooperative unions, is associated with domestic division of labour. A first-stage equilibrium cannot then be efficient if it does not lead to a union because there will be no children. It cannot be efficient if it leads to a non-cooperative union because the couple will forgo the benefits of specialization, and fail to coordinate their decisions regarding tnumber and upbringing of children. The combined effect of these two failures is that non-cooperative parents will raise the wrong number of children with the wrong mix of money and own time. This casts doubt on the empirical literature inspired by the collective model of household decisions which

[22] As pointed out in Kögel (2004), this cross-country correlation should not be interpreted as a reflection of time-series correlation. Consistently with the line of reasoning followed in the present paper, that author finds that the change in the sign of the cross-country correlation observed in OECD countries is imputable, at least in part, to country heterogeneity.

[23] See Adserà (2004), and Burda *et al.* (2006).

seeks to recover the domestic sharing rule from the observation of activities or items of consumption unequivocally attributable to either one or the other partner under the assumption that the domestic allocation of resources will always be efficient. The intuitive explanation of why a first-stage equilibrium cannot be efficient if it leads, at the second stage, to the liberated division of labour is that equipping a woman with sufficient human capital to be the main earner costs more than equipping a man of the same educational ability. This carries the unpalatable implication that it is efficient to educate a boy more than an equally talented girl, but does not necessarily entail that the woman should spend most of her active life looking after her children. For a start, the extent to which it is efficient for the man to specialize in market work depends on the elasticity of substitution of paternal for maternal time. If this elasticity is large enough to justify some degree of specialization, but not so large that the father should specialize completely in market work, the efficient mix of maternal and paternal care time will not be all that unbalanced. Second, if the skill premium is large, the efficient number of children will be small. Third, for any given level of the skill premium, the efficient number of children is likely to be smaller than the one associated with equal-sharing arrangements. Paradoxically, therefore, a woman might have more time left to pursue a career if she is the main childcarer, than if she shares the care of the children equally with her partner.

Another normative result is that the imposition of a minimum school-leaving age reduces allocative efficiency. The intuitive explanation here is that the policy distorts not only educational decisions, but also the subsequent matching process, and choice of domestic arrangement. Some distortion may be justified if there is an educational externality. But the distortion may be smaller if, instead of making school attendance compulsory up to a certain age, the government induces parents to send their children to school voluntarily by offering them a sufficiently large education subsidy.

The crucial assumptions driving our results are that (i) a child requires at least a certain amount of specifically maternal time, and (ii) a person's earning capacity increases with work experience (as well as with education). We did *not* assume that mothers like children more than fathers do, that parents like sons more than daughters, or that the labour market discriminates against women. We did make a number of simplifying assumptions common to most economic models, but these are pretty harmless. One was to assume that parents are altruistic towards their children, but not towards each other. Allowing for reciprocal affection does not make any qualitative difference to the results as long as each parent cares for his or her own consumption at least a little more than for

the other's. Another set of simplifying assumptions concerns the effects of education, namely that it does not yield direct utility, that it affects a person's domestic bargaining power only indirectly (by raising his or her earning capacity), and that it raises the productivity of market but not of domestic (child care) work. Relaxing these assumptions makes the predictions less sharp, but does not change them qualitatively. Yet another simplifying assumption is that people do not care where their money comes from. If we assume that people derive more satisfaction from their own earnings than from a transfer (whether from their own parents, or from the partner), that will tend to offset the advantage of domestic division of labour. So long as a child requires at least a certain amount of specifically maternal time, and men and women have the same utility function, however, no amount of preference for earned money will make any qualitative difference to the results.

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