Whatever happened to the domestic division of labour? A theoretical analysis of fertility and participation in developed and developing countries.

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Abstract

Decisions concerning fertility, the domestic division of labour, and the education of children are explained using a two-stage game-theoretical model. The analysis examines the effects of family law (cost of obtaining a divorce, alimony, availability of quasi-marriages such as PACS in France, and Civil Partnership in the UK), legislation sheltering dowries from marital incursions, enforceability of bride-price contracts, and length and effective enforcement of compulsory education. The predictions are consistent with two empirical observations. One is that, in developed countries, mother and father tend to share market work and the care of the children equally between them, while, in developing ones, the father tends to specialize in market work. The other is that the sign of the cross-country correlation between fertility and female labour market participation, negative in the developing part of the world, has turned positive in the developed one. The model explains also why, in a developing country, well-meaning parents might give a daughter less education than a son of the same educational ability, even if they love daughters as much as sons, and there is no gender discrimination in the labour market. Compulsory education may remedy this, but at the price of some inefficiency.

Key-words: gender, education, female participation, fertility, civil partnership, marriage, divorce, alimony, dowry, bride-price, school-leaving age.

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

1 Introduction

The traditional division of labour, whereby father goes out to work, and mother stays at home to look 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, but the pace of change is uneven. Burda *et al.* (2006) report that the weight of share-alike couples is higher in North-America and Northern Europe, than in Central and Southern Europe. The present paper seeks to explain, among other things, these different patterns of time use with differences in the legal environment, and in education policy, as well as with differences in the skill premium. In particular, we look at the effects on marriage, fertility, labour market participation, and the destination of household income, of family law (cost of obtaining a divorce, alimony, availability of quasi-marriages such as PACS in France, and Civil Partenship in the UK), legislation sheltering dowries from marital incursions, enforceability of bride-price contracts, and length and effective enforcement of compulsory education.

The model predicts that (a) share-alike domestic arrangements are more likely in the economic and legal environment which are characteristic of the developed part of the world, and more so of North-America and Northern Europe, than in that which is typical of developing countries, and (b) share-alike couples are likely to have more children than traditional couples with the same preferences and endowments. Prediction (a) is consistent with observed cross-country differences in domestic patterns of time use. Prediction (b) provides a possible explanation for the fact that the cross-country correlation between fertility and female labour market participation, still negative across developing countries, has turned positive where developed countries are concerned since around 1975 (Brewster and Rindfuss, 2000).[1] The prevalence of the traditional division of labour explains also why, in a developing country, parents might give a daughter less education than a son of the same learning ability even if they have the former's interest at heart as much as the latter's, and there is no gender discrimination in the labour market.

The analysis demonstrates that share-alike arrangements are inefficient, because the couple will then have the wrong (likely too high a)

[1] 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.

number of children, and spend too little time (too much money) on each of them. This casts doubt on the empirical literature inspired by the so-called "collective model" of household decisions,[2] which seeks to recover the "sharing rule" from observed consumption or labour patterns under the assumption that the domestic allocation of resources is always efficient. It has also implications for education policy, in particular for the desirability of a minimum school-leaving age. The assumptions driving the present model are that (i) fertility is a decision variable, (ii) the wage rate increases with work experience, as well as with education, and (iii) 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. 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 of working age and sorted into couples, and the game is about fertility, time allocation, and the destination of household income.[3]

Manser and Brown (1980), McElroy and Horney (1981), and many others in their wake, are concerned with what, for us, is the second stage of the game. These papers assume that the game is cooperative, and that the equilibrium is reached by Nash-bargaining. The threat-point of the game, and thus the domestic balance of power, is exogenous. Fertility is out of the picture. Lundberg and Pollak (1996) extend this framework by identifying the threat-point of the cooperative game with the equilibrium of the Cournot-Nash game that the spouses could play as an alternative to Nash-bargaining. Given, however, that the Cournot-Nash equilibrium is determined by initial conditions, the threat-point of the Nash-bargaining game is still effectively exogenous. Lundberg and Pollak (2003), and Basu (2006), endogenize the threat-point by making the reserve utility of each partner depend on the player's own actions. The first of these two papers innovates also in that it models household decisions as a two-stage game. The second paper 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 in that the second stage may be cooperative or non-cooperative depending on the (exogenously given) cost of cooperation, but still takes the threat-point of the cooperative game as exogenous.

Another relevant literature is that concerned with the role of dowries

[2] See Bourguignon and Chiappori (1994).

[3] 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.

and bride-prices. This literature originates from Becker (1981), where the bride-price is seen as an up-front transfer from husband to wife, and the dowry as a negative bride-price. In Becker's view, these payments serve to clear the "marriage market". Were that true, we should then observe bride-prices only if there is excess demand for brides, dowries only if there is excess supply. In reality, however, we observe dowries and bride-prices at the same time, often in connection with the same marriage 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 payments should not be observed at the same time. Those authors model dowries as altruistic transfers, and the bride-price as an institution that may help to reduce the transactions cost of marital cooperation. But they assume that marriages will be cooperative anyway.

Botticini and Siow (2003) also regard the dowry as an altruistic transfer, but address the question why parents might give daughters a dowry, and sons a bequest. Their answer relates to "virilocal" societies, where a son remains part of his family of origin even after he is married, while a daughter joins her husband's family. If parents were to promise a share of the estate to each of their children, that would in fact weaken the incentive for 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 thus to be sought in the reduced importance of the agricultural sector, where virilocality is traditionally entrenched.[4] In a sense, Botticini and Siow (2003), and Zhang and Chan (1999), are complementary, in that the former focus on what for us is the first stage of the game, and the latter on what for us is the second. Fertility is exogenous in both papers.

In contrast with Lundberg and Pollak (2003), 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 a dowry, or in the form of a bequest, but between giving money or an education. As in Peters and Siow (2002), the choice of educational investment is made with an eye to how this will condition decisions at the second stage of the game. In that paper, however, the choice is made by the directly interested parties. In ours,

[4] 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.

by contrast, it is made by their parents. 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 nature of the game depends not an exogenously given cost of cooperation, but on the presence and effective enforcement of legislation and policies affecting either the bargaining power of the interested parties, or their ability to make credible promises.

As in Lundberg and Pollak (2003), and Basu (2006), the reserve utilities of the second-stage players depend on their actions. The threat-point of the cooperative game is consequently endogenous. In those papers, 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. In the present model, by contrast, certain actions have permanent effects. Once born, a child cannot be sent back. If a person withdraws from the labour market, even for a limited period, his or her career prospects will be permanently impaired. In contrast with all the papers mentioned, we treat the number of children as a decision variable.

2 The second stage of the game

Consider an adult female, f, and an adult male, m. If the two form a stable relationship ("union"), they may have children. In reality, women have children also without a stable partner, but this is irrelevant for our purposes, and will be ignored. 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, but nothing of substance changes if the elasticity of substitution is lower than infinity. 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 a lifetime is $v(c,t)$. The indirect utility function $v(.)$ is increasing and concave. Since concavity implies quasi-concavity, and given that c may include expenditure for 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. 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 number of work hours. The only difference across couples and countries is in the allocation of this total between domestic and market work. 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

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

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, $\alpha h_i \omega$.[5] Time-allocation decisions have permanent effects.

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

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,[6] 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,

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

where

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

is the opportunity-cost of a child, and

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

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

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.

> *Proposition 1. Efficient allocations are characterized by division of labour. If the woman's human capital endowment is sufficiently larger than the man's, it will be 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 him the main earner.*

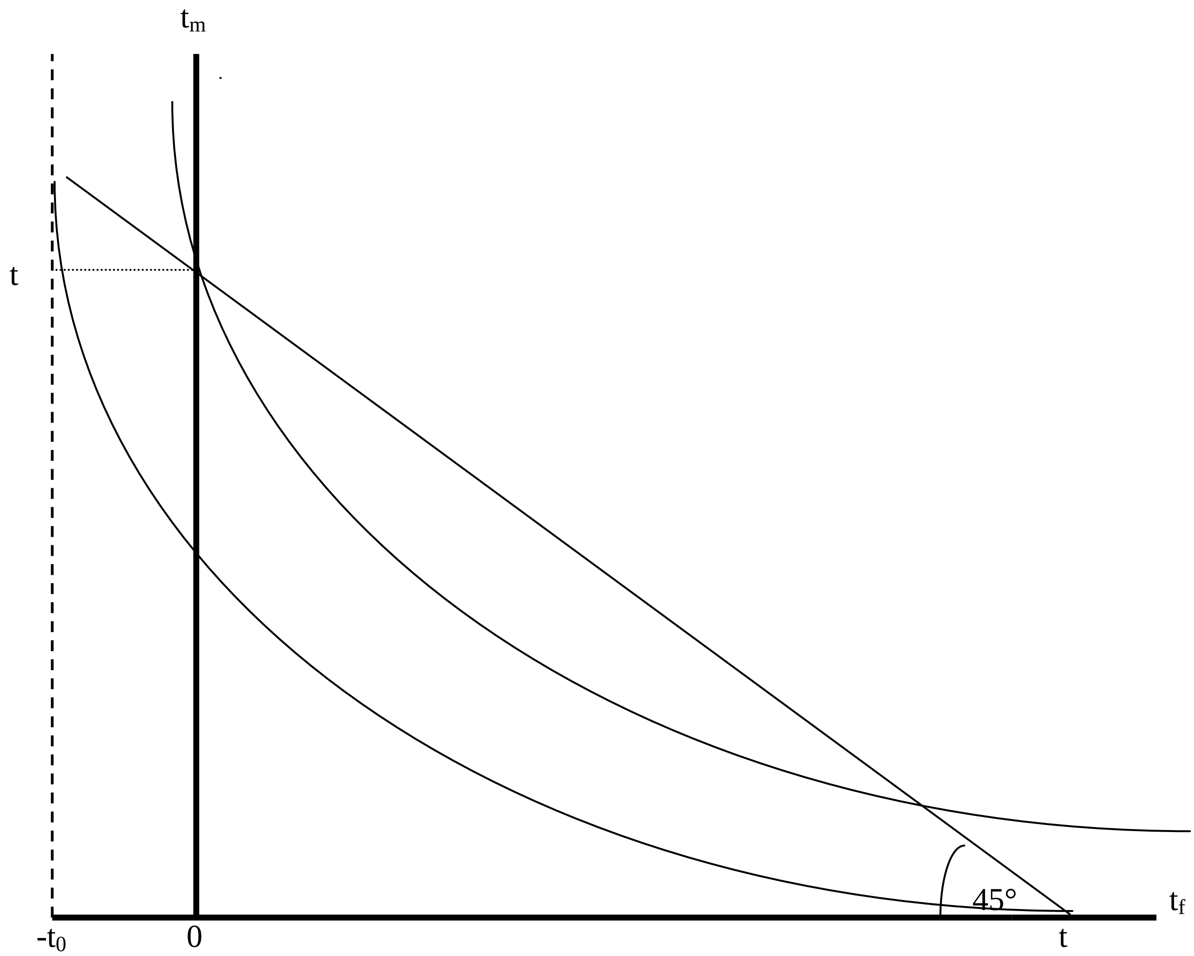

Figure 1. Efficient division of labour

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

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 2. The higher is the skill premium, the lower is the efficient quantity of children

2.2 Cooperative equilibrium

Consider first the case where f and m play a cooperative game. We shall assume that the equilibrium is reached by Nash-bargaining, but nothing of substance changes if we follow the more general approach of Basu (2006).[7] 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 reserve utility, subject to (6). Further assuming that the best alternative to the present union is singlehood, i's reserve utility will be

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

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 pictures are drawn under the assumption that the two parties have the same reserve, and will thus have the same equilibrium utility, but this need not be true in general. 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 (c^*, t^*, n^*). 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 depends on the location of point **R**. Therefore, $\left(U_f^B, U_m^B\right)$ depends on (R_f, R_m). By contrast, since (c^*, t^*, n^*) is independent of λ (see last subsection), the quantity and quality of children do not depend on (R_f, R_m). This clears the ground from any notion that the mother might use such bargaining power as she has to limit the former. and raise the latter.

If the bargaining occurs after the children are born, n is a given constant. If it occurs when the children are grown up, c and t are constant too. Childbirth and child rearing thus create facts on the ground. As the main childcarer's wage rate will have increased less than the main earner's, if at all, the domestic balance of power will have tipped in favour of the latter. Once the children are born, moreso when they are no longer dependent on their parents, it will then be in the main earner's interest to renegotiate, from a position of greater strength, the distribution of consumption agreed before the children were born. Renegotiation

[7] For a more general analysis, see Basu (2006).

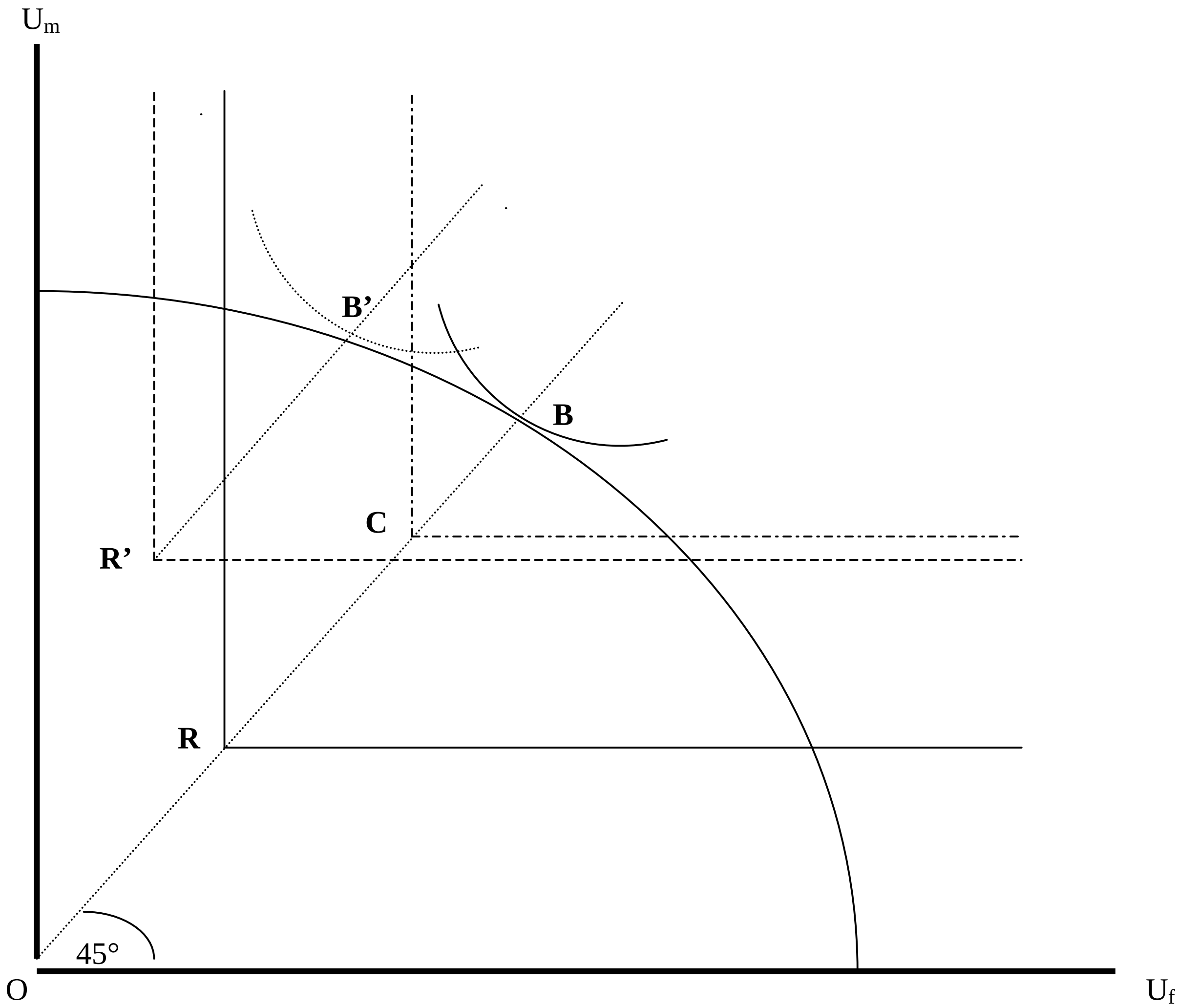

Figure 2. Ex-ante bargaining, ex-post bargaining and non-cooperative equilibria: If ex-ante agreements are not enforceable, the union is non-cooperative.

would not be possible if the original agreement were enforceable. But suppose that it is not, either because drawing a contract specifying each partner's rights and duties would be prohibitively expensive, or because non-compliance would be difficult to demonstrate before a court. Suppose, also, that the new round of bargaining occurs when the children are already out of the way, and the main earner's bargaining power is thus at its maximum.

The new equilibrium will then 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

$$L^*_m = 1 - t^*_m n^*.$$

As c^*, t^* and n^* are given constants, the bargaining is only about (a_f, a_m).

Assuming, for the time being, that the union can be dissolved at no cost to either party, i's ex-post reserve utility is 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 f is the main childcarer,

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

if m is. 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. **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.

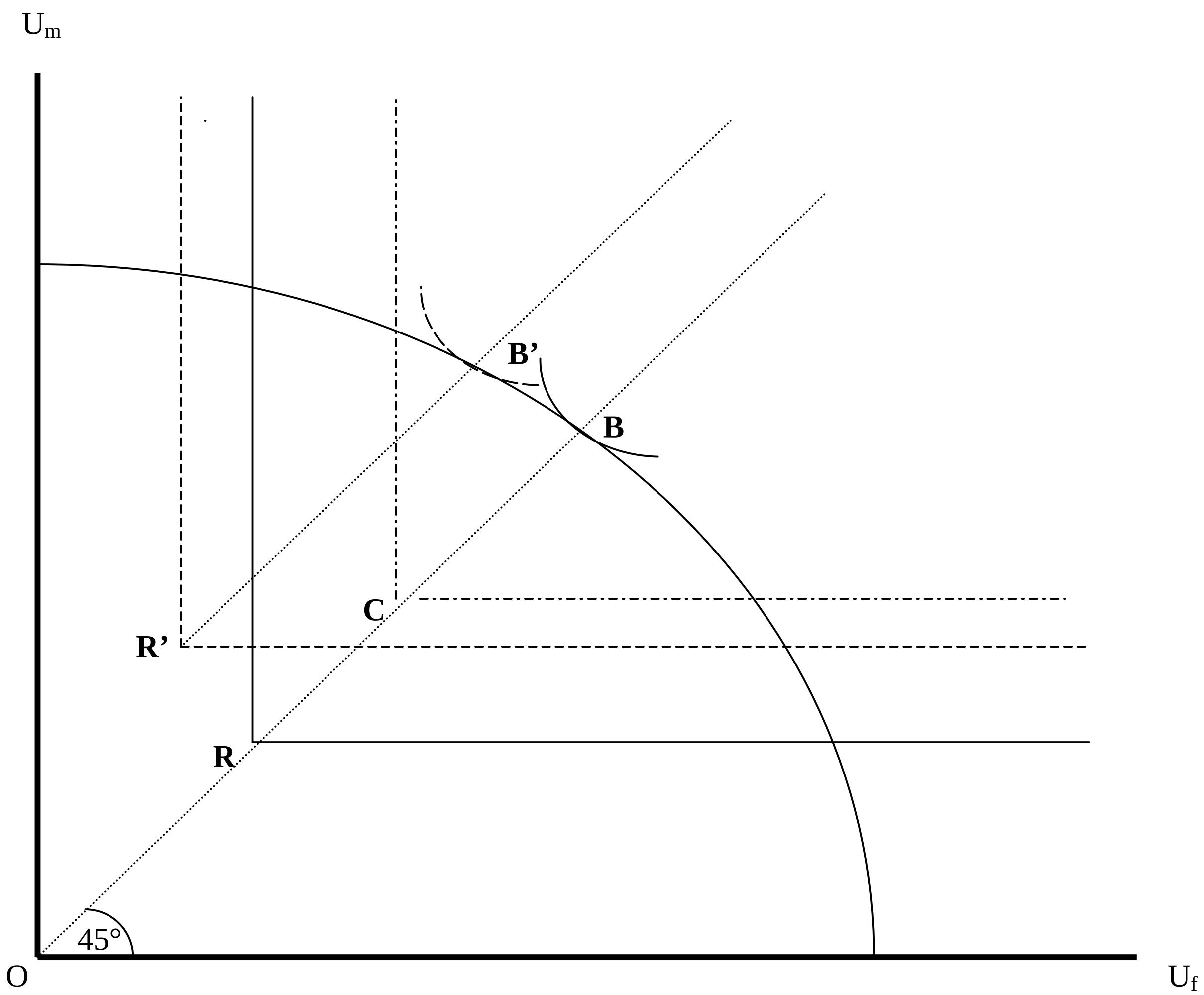

Figure 3. Ex-ante bargaining, ex-post bargaining and non-cooperative equilibria: The union is cooperative even if ex-ante agreements are not enforceable.

Proposition 3. Bargaining equilibria are efficient conditional on endowments. The quantity and quality of children are the same irrespective of whether the bargaining takes place ex ante or ex post, but the distribution of consumption is more favourable to the main childcarer in the first case than in the second.

In view of propositions 1 and 2, this implies the following.

Corollary 3. In a cooperative equilibrium, (i) the partners specialize according to their comparative advantages, and (ii) the number of children is a decreasing function of the skill premium.

2.3 Non-cooperative equilibrium

Consider now the case where f and m play a non-cooperative game where each party retains control over his or her own earnings and assets,[8] and decides how much time and money to spend on the children's taking the other party's actions as parameters. The equilibrium will be Cournot-Nash. For reasons that will become apparent in the next sub-section, the game is plaid *before* the children are born.

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, 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 of their children, 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 her actual income. This choice will satisfy the first-order conditions

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

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

[8] 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.

and

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

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

$$a_m + nc_m = y_m \quad (25)$$

where

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

is m's actual income. This choice will satisfy

$$u'(a_m) = \beta n v_c(c,t) \quad (26)$$

and

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

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),

$$a_f^C = a_m^C. \quad (28)$$

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

$$U_f^C = U_m^C, \quad (29)$$

irrespective of (y_f, y_m).

In view of (21) – (25) and (28), the partner with the larger money endowment will bear the larger part of the monetary cost of the children,

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

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,

$$c_m^C = \frac{c^C}{2}. \quad (31)$$

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

$$L_f^C h_f \omega = L_m^C h_m \omega. \quad (32)$$

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.

> *Proposition 4. In a non-cooperative equilibrium, the partners earn and consume the same, and enjoy the same utility. If they started out with the same amount of money, they will take equal shares in the monetary cost of the children. If they started out with the same amount of human capital, they will share market and domestic work equally between them. As in a cooperative equilibrium, the number of children is a decreasing function of the skill premium.*

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 marginal cost of n may be lower than in the efficient allocation. Given diminishing MRS of c for n, it then follows that n may be inefficiently large. The intuition, here, is that the woman equates the benefit of having an extra child, not to the full cost of the child as would be efficient, but to her own share of this cost. Although the full cost of a child in the non-cooperative allocation is higher than the full cost of a child in the efficient allocation, it is then possible that the mother's share of the former will be lower than the whole of the latter. This is most likely to be the case if f and m have the same endowments. Substituting from (31) and (34), (24) does in fact become

$$\frac{v(c,t)}{v_c(c,t)} = \frac{c^C}{2} + \frac{t_0 + t^C}{2}\left[1 + 2\alpha\left(1 - \frac{t_0 + t^C}{2} n^C\right)\right] h_f \omega.$$

If that is the case, a non-cooperative mother will bear exactly half the full cost of having an additional child. Unless this cost is as large as twice its efficient level, the number of children will then be inefficiently large (conditional on endowments, and on all the other parameters including the skill premium).

> *Proposition 5. Non-cooperative unions are not efficient conditional on endowments. The partners spend relatively too little time, and too much money, on each of their children. They may also have too many children. The latter is likely to be the case if the parents have the same endowments.*

In view of Proposition 4, this has the following implication.

> *Corollary 5. Other things being equal, the number of children is likely to be higher if the parents share domestic and market work equally between them, than if they specialize.*

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 that person's 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 been plaid as an alternative to bargaining. In our framework, however, actions have permanent effects, and we must thus distinguish between ex-ante and ex-post equilibria. The former cease to be available the moment a child is born, and cannot thus affect the outcome of the game the couple will play after that event. Given that the union in formed, however, the ex-ante Cournot-Nash equilibrium helps to determine whether the union is formed and, if it is, whether the ex-post game will be cooperative or non-cooperative (rather than the outcome of either).

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

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

Since R_i is linear in ω, while $U_i^{B'}$ and U^C are concave, a rise in the value of this parameter will make it less likely that (35) is satisfied. A reason why a union is formed in the cases illustrated by Figure 2 and Figure 3, but not in that illustrated by Figure 4, could then be that the skill premium is smaller in the former than in the latter. Assuming heterogeneity of preferences and endowments across pairs, we can state this property in probabilistic terms.

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 the case illustrated by Figure 3, but not in that illustrated by 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 the woman's endowment basket contains less money, and consequently more human capital, 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 then suffer more if she accepted to be the main childcarer in the case illustrated by Figure 2, than in that illustrated by Figure 3.

> *Proposition 6. The probabilities that (i) a union is formed, and (ii) the equilibrium is cooperative given that the union is formed, are decreasing functions of the skill premium.*

2.4.1 Dowries and bride-prices

Given that the main childcarer is traditionally the woman, the second part of Proposition 6 provides a rationale for the time-honoured institution of the dowry.[9] It also justifies the special restrictions that many 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, and thus make it more likely that the union will be cooperative.

> *Corollary 6. Legislation protecting dowries from marital incursions raises the probabilities that (i) a union is formed,*

[9] 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).

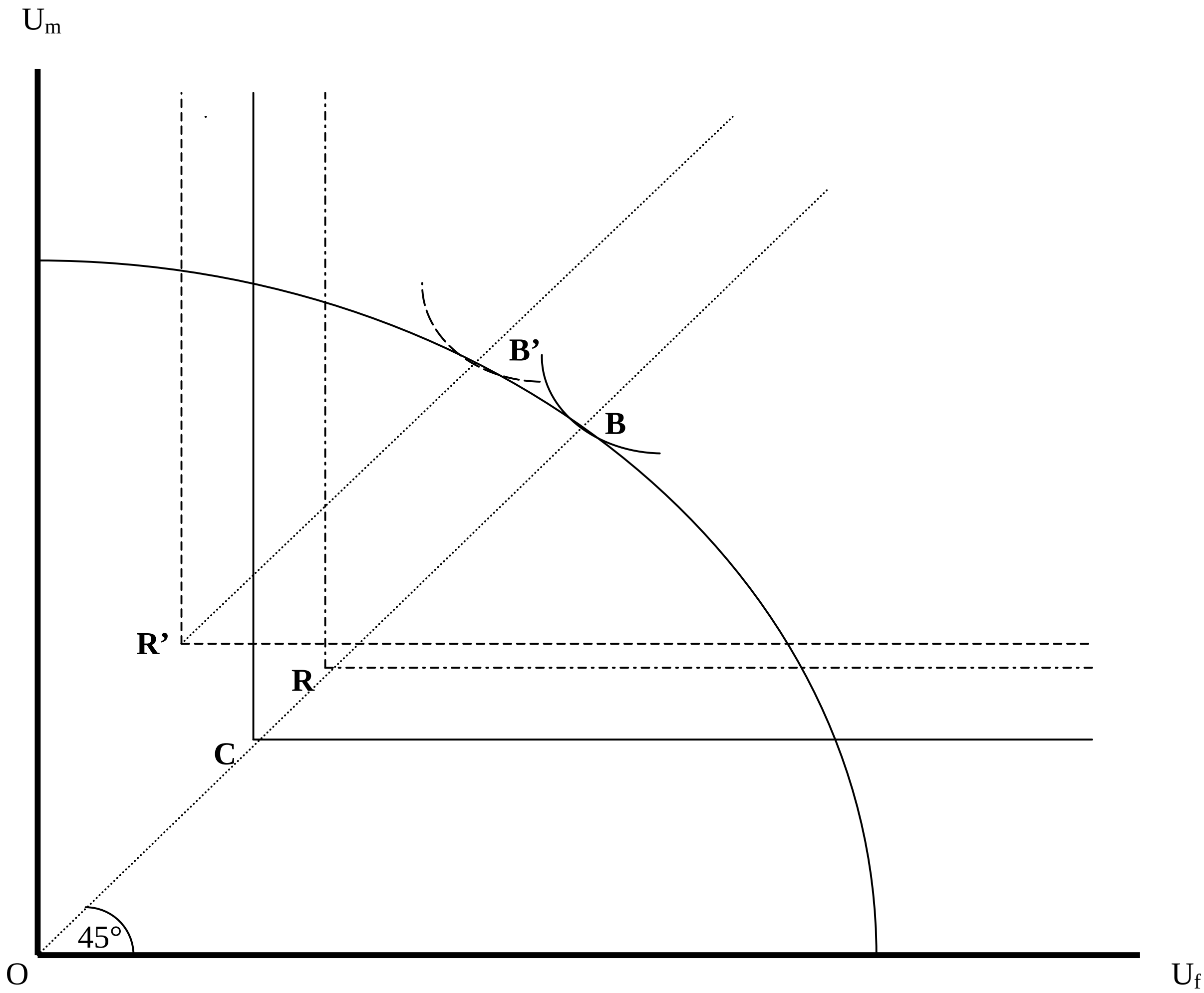

Figure 4. Ex-ante bargaining, ex-post bargaining and non-cooperative equilibria: No union is formed.

and (ii) the equilibrium is cooperative given that the union is formed.

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 a transfer between dynasties. If it 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 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,

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

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. If the bride-price were paid directly to her, she could in fact enhance her ex-post bargaining power by allocating less than the efficient amount of time looking after her children, and more working for a salary. That being the case, her promise to deliver $(t_0 + t^*)\, n^*$ units of child-care time would not be credible unless her husband had the means of enforcing the deal. Or, alternatively, if the bride-price were paid to f's parents, and they had both an interest in (*e.g.*, because they have other daughters to marry, or for other reputational reasons) and the means of making sure that the promise is kept. This is consistent with the observation that bride-prices are used only in cultures where a husband is able enforce the deal by extra-legal means if need be, or parents exercise control over grown-up children (especially female) even after they are married.

This obviously implies that, in these countries, bride-price contracts are socially acceptable, and any law forbidding their enforcement can be more-or-less openly flouted.

It is clear that the availability of enforceable bride-price contracts makes it more likely that (36) is satisfied and, if the surplus generated by cooperation is large enough, that(35) is satisfied too.

> *Proposition 7. The probabilities that (i) a union is formed, and (ii) the equilibrium will be cooperative given that the union is formed, are higher 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. Many separations are a consequence of imperfect information (about the present partner, or about the availability of alternative ones), and often occur while the children are still dependent on their parents. In our perfect-information framework, however, separation (or, rather, the threat of separation) can have only one purpose, namely to deter opportunistic bargaining. The only party with a potential interest in using this weapon is thus the main childcarer, and the only time he or she will actually use it is when the children have ceased to be economically dependent. With the children out of the way, δ cannot then constitute child support,[10] but it may be construed as compensation for the damage suffered by the main childcarer's career prospects.

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

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

[10] 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).

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

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

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 exist. The alternatives to singlehood are then marriage, characterized by positive γ and δ, and de-facto union, characterized by γ and δ identically zero. Let $U_i^{B'}$ denote i's equilibrium utility in a cooperative ex-post equilibrium in the event of a de-facto union, and $U_i^{B"}$ in that of marriage. His or her utility in the event of non-cooperation is is independent of whether the union is a marriage, or de-facto. The necessary and sufficient condition for the union to be formed is now

$$\max\left(U_i^{B'}, U_i^{B"}, U^C\right) \geq R_i,\ i = f, m. \tag{41}$$

Given that (41) is satisfied, the union will be cooperative if and only if

$$\max\left(U_i^{B'}, U_i^{B"}\right) \geq U^C,\ i = f, m. \tag{42}$$

Given that (42) is satisfied, the union will be a marriage if and only if

$$U_i^{B'} \leq U_i^{B"},\ i = f, m. \tag{43}$$

The probability that (43) is satisfied increases with $(\delta - \gamma)$. Conditional on (43) holding true, the probability that (41) and (42) are satisfied also increase with $(\delta - \gamma)$. Therefore, the probability that f and m will form a union, that the union will be cooperative, and that the union will be a marriage, are all increasing in $(\delta - \gamma)$. If δ is sufficiently small relative to γ, (43) can hold only if de-facto unions attract social stigma or legal discrimination

Proposition 8. The probabilities that (i) a union is formed, (i) the equilibrium is cooperative given that the union is formed, and (iii) the couple is legally married, are larger if alimony awards are high relative to the cost of obtaining a divorce.

Corollary 8. If alimony awards are sufficiently low, a couple will marry only in the presence of social stigma or legal discrimination against de-facto couples.

The latter is consistent with the observation that de-facto unions are more common in developed countries where cohabitation without marriage is socially acceptable (as in North-America and most of Europe), and any residual discrimination over tax treatment, inheritance, adoption, housing tenure, recognition of a partner as next of kin if the other is hospitalized, etc. is disappearing (in Northern Europe) as a result of legislation permitting unmarried couples to register their union, and thereby to acquire the same rights as married ones.

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 on the next stage of the game. 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 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 will be such, that the second-stage players are 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.[11] Since the latter do not know who their son or daughter's future partner is going to be, however, direct negotiation is now 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. Normalizing the human capital of a totally uneducated person to unity, we may write $z(h_i - 1, \theta_i)$ 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 $z(.,.)$ is defined for

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

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

with $z_1(h_i - 1, \theta_i)$ positive and increasing, and $z_2(h_i - 1, \theta_i)$ 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,

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

These assumptions seem to be consistent with the sociological evidence. As we will see, they have also plausible equilibrium implications.

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,

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

where r is the interest factor.

Keeping in mind that efficiency requires either (8) and (9), or (10) and (9), an efficient allocation will satisfy (11) $-$ (13), and *either*

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

or

$$H_f = 1, \ \frac{(1+\alpha)\omega}{z_1(h_m - 1, \theta)} = r. \tag{49}$$

It can be easily checked that an allocation characterized by (10) and (9) cannot be a solution to our optimization problem.

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) imply 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 9. It may be efficient to give a girl less education than a boy 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, the allocation will be efficient with reference to the mini-society composed of f, m and their respective parents, but not with reference to society at large. By reducing the private cost of education, an educational subsidy would reduce the probability that (44) is binding, and could thus raise social welfare. 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), the first-stage player has only four undominated strategies. Recalling that c^*, t^* and n^* are functions 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

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

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

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

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

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

In case of de-facto union, γ and δ will be identically zero. As they do not figure in (53), however, these parameters do not affect first-stage decisions.

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 satisfies

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

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,

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

is at a maximum subject to (44) and

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

The solution satisfies

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

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,

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

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

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

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

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

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

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

If the second-stage equilibrium is the trivial one represented by point **R** of Figure 4, where f and m stay single, the first-stage equilibrium will be $\left(h_f^1, h_m^1\right)$. If it is the non-cooperative one represented by point **C** of Figure 2, the first-stage equilibrium will be $\left(h_f^2, h_m^2\right)$. If it is the cooperative one represented by point **B'** of Figure 3, where f is the main childcarer, the first-stage equilibrium will be $\left(h_f^3, h_m^4\right)$. Switching labels, the same diagram may be used to illustrate the case where the main childcarer is m, and the first-stage equilibrium is $\left(h_f^4, h_m^3\right)$. None of the other strategy pairs is a first-stage equilibrium.[12]

[12] 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.

Notice that, if the first-stage equilibrium is $\left(h_f^2, h_m^2\right)$, the partners 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 be endowed with relatively more money, and the other with relatively more human capital ("complementarity of traits").

> *Proposition 10. A first-stage equilibrium may be such that, at the second-stage, the players will (i) remain single, (ii) form a non-cooperative union, or (iii) form a cooperative one. If (ii), the partners will have the same traits. If (iii), they will have complementary ones.*

In view of the third part of Proposition 4, this implies the following.

> *Corollary 10. If the union is non-cooperative, the partners share domestic and market work equally between them.*

Comparing the efficiency conditions derived in the last subsection with the properties of the four first-stage equilibria, it is clear that only one of these, $\left(h_f^3, h_m^4\right)$, is efficient. Intuitively that is because:

$\left(h_f^1, h_m^1\right)$ leads f and m to remain single, and thus to forgo the opportunity of having children;

$\left(h_f^2, h_m^2\right)$ leads f and m to behave non-cooperatively, and thus to forgo the benefits of domestic division of labour;

$\left(h_f^4, h_m^3\right)$ leads f and m to behave cooperatively, but to specialize the wrong way (f in market, and m in domestic work).

> *Proposition 11. A first-stage equilibrium is efficient if and only if the associated second-stage equilibrium is cooperative, and the woman specializes in the care of the children.*

In the light of Proposition 9, this implies the following.

> *Corollary 11. In equilibrium, a girl may get less education than a boy of the same educational ability.*

Which of the four possible equilibria will actually occur depends on the external circumstances discussed in Subsection 2.4. Continuing to assume heterogeneity across couples, the larger is ω, the higher is the probability that the equilibrium will be $\left(h_f^1, h_m^1\right)$, and thus that no union will be formed. Given that a union is formed, the probability that it will be cooperative is higher if δ is large relative to γ, or if public opinion and the law discriminate against de-facto unions. The same factors make it more likely that the equilibrium will be $\left(h_f^3, h_m^4\right)$, rather than $\left(h_f^4, h_m^3\right)$.

3.3 Education policy

Education policy has typically two components. One is a minimum school-leaving age, the other is an education subsidy. We have already noted that the latter is beneficial because it helps to relax (44). therefore, a merit-based grant financed by a lump-sum tax will raise social welfare. A merit-based grant financed by an income tax will do so only if the efficiency cost of the labour distortion caused by the tax is not larger than the benefit, or in the presence of a sufficiently large education externality.

Suppose that education is made compulsory 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 the parents of such a child 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.

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 either f's parents will be effectively constrained in their choice of educational investment, and m's will not, or that both will be effectively constrained.[13] In either situation, $\left(h_f^3, h_m^4\right)$ will not be feasible. Since the other possible equilibria are inefficient, making school attendance compulsory up to a certain age will then reduce the probability that the union is efficient.

> *Proposition 12. An education subsidy may raise social welfare even in the absence of an education externality. Making school attendance compulsory up to a certain age can raise welfare only if there is an education externality.*

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 (and whether this should be a de-facto union, or a conventional marriage). Assuming that unions are formed by persons with the same social background, and the same aptitude for education, a match may be characterized by

[13] Since h_f^3 is lower than h_m^4, we cannot have that m's parents are effectively constrained, and f's unconstrained.

either complementarity or equality of "traits" (in the present context, money and human capital endowments when the union is formed). 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, and cannot consequently bargain with each another. There are four possible types of equilibrium. One is such that there will be no second-stage game (given their money and human capital endowments, the second-stage actors will choose to stay single). Another is such that the second stage will be non-cooperative, and that the partners will share domestic and market work equally between them. The remaining two are such that the second stage will be cooperative, with one of the partners specializing in domestic, and the other in market work. Irrespective of whether the equilibrium is cooperative or non-cooperative, the number of children is negatively affected by the skill premium.[14]

A first-stage equilibrium is 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 plays the role of main childcarer, and the man that of main breadwinner. It will not be efficient if the second-stage equilibrium is cooperative, but the main childcarer is the man, because the amount of educational investment required to induce this pattern of domestic specialization is larger than the one required to induce the opposite one (this carries the implication that it may be efficient to educate a girl less than a boy of the same educational ability). A first-stage equilibrium will be inefficient also if it leads either to no union, for in that case there is no provision of a local public good (children), or to a non-cooperative one, in which case the children are raised using relatively too much money and too little parental time, and there will likely be too many of them. This implies that a couple is likely to have more children (for any given set of preferences and endowments, and any given skill premium) if the legal and policy environment is such that they share domestic and market work equally between them, than if it induces them to specialize. It also casts doubt on the empirical literature inspired by the "collective model" of household decisions, which seeks to recover the domestic sharing rule from the observation of activities or items

[14] 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 of a child, and a negative one via the opportunity-cost. 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.

of consumption unequivocally attributable to either one or the other partner. The assumption underlying this literature is in fact that the domestic allocation of resources is always efficient.

Equilibrium selection depends on all the parameters of the model, including the economic, legal and policy environment in which the first and second-stage players are called to take their decisions. Assuming heterogeneity, the probability that a union will be formed is a decreasing function of the skill premium. Given that a union is formed, the probability that it will be efficient is higher if one or several of the following circumstances apply:

(a) Marriages are arranged by the bride's and the groom's parents.

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

(c) Bride-price contracts are enforceable.

(d) Alimony awards tend to be large relative to the cost of obtaining a divorce even if the children are no longer dependent.

(e) De-facto couples attract social stigma, or do not enjoy the same rights as married ones.

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

The skill premium is higher in developed than in developing countries, and the difference is increasing as a result of globalization.[15] Arranged marriages are unknown in developed countries, but commonplace in many developing ones. Legislation protecting dowries from marital incursions can be found in both developing and developed countries, but it is largely irrelevant in developed ones where 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 our argument that the purpose of this form of wealth transfer is to shelter a daughter from her husband's opportunistic bargaining. Another explanation, not incompatible with ours, has to do with the contraction of the agricultural sector. As already mentioned, 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.[16] This argument has some force, but seems unlikely to be a prime cause of the change in the pattern of domestic time use, and in the sign of the correlation between fertility and

[15] As developed countries have a comparative abundance of skilled workers, and developing countries of unskilled ones, exposure to trade raises the spread between the wage rates of skilled and unskilled workers in the former, but reduces it in the latter; see Wood (1998).

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

female participation, which occurred in developed countries long after agriculture had ceased to be a major sector of employment. If enforceable, a bride-price contract will favour marital cooperation because it allows a woman (or her parents) to credibly commit a certain amount of domestic work in exchange for an advance payment. Such contracts are illegal almost everywhere in the world. In many developing countries, however, they are socially acceptable, and any law prohibiting them widely disregarded.

The likelihood that the main childcarer will be awarded alimony by a divorce court (even if, by the time of the divorce, there are no dependent children) raises the probability that the partners will be legally married, and that the marriage will be cooperative, because it allows the potential beneficiary to use the threat of divorce as a deterrent against the other party's opportunistic bargaining. Legislation and sentencing practice vary a great deal from country to country. In the developed world, however, the general tendency is towards awarding alimony,[17] only if there are dependent children. Another difference between developed and developing countries is over the legal treatment of unmarried couples. The trend in the former is towards equality of treatment, but the pace of change is uneven. In some developed countries, unmarried couples are now able to record their union in a public register, and thereby to acquire exactly the same rights with regard to tax treatment, inheritance, adoption, housing tenure, recognition of a partner as next of kin if the other is hospitalized, etc. as married couples. The name given to these quasi-marriages varies from country to country,[18] but the substance is the same. Unlike a conventional marriage, a registered union can be terminated by either party without recourse to a court of law, and thus without any legal cost, or any question of compensation.[19] In other developed countries, marriage is still the only officially recognized form of union,[20] and the same is true almost universally of the developing

[17] At least in in no-fault cases. Some legislations do not even contemplate "fault" as a reason for divorce.

[18] *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.

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

[20] Resistance stems largely from the fact that the proposed new legislation does not make a distinction between heterosexual and homosexual unions. The possibility for a homosexual couple to register their union should not be confused, however, with the possibility for two person of the same sex to marry. Where available, homosexual marriage has exactly the same legal implications as heterosexual marriage, and is thus irrelevant to the present discussion.

world.[21] The minimum school-leaving age is higher, and more strictly enforced, in developed than in developing countries.

The theory thus predicts 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 characterize a developed one. This is consistent with evidence reported in the introductory section that the traditional division of labour, still the norm in the former, is losing ground to equal-sharing arrangements in the latter. Taken in conjunction with our other theoretical predictions, 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 ones, it is consistent also with the observation that the cross-country correlation between fertility and female participation, still negative in the developing world, has turned positive in the developed one. It is consistent, in particular, with the observation that both fertility and female participation are higher in North-America and Northern Europe, where the transition towards equal-shares arrangements is more advanced, than in Central and Southern Europe where it has only just begun. Fertility differences within the developing camp are accentuated by other factors, not considered in the present paper, such as generous fertility-related subsidies in Northern Europe, which reduce the monetary cost of having a child, labour market flexibility in North-America and parts of Northern Europe, which reduces the opportunity-cost by facilitating part-time employment while the children are young, and re-entry into the labour market once they have grown up, paid parental leave in most of Europe, which also reduces the opportunity-cost, etc.[22] Fertility is nonetheless lower in the developed world taken as a whole than in the developing one, because the skill premium is so much higher in the former than in the latter.[23]

The finding that efficiency requires the traditional division of labour is an inescapable implication of two crucial assumptions, namely 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 education). But efficiency does not necessarily require 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

[21] As already mentioned, the only exceptions so far are the City of Buenos Aires, and the Brazilian State of Rio Grande do Sul.

[22] For an analysis of these factors, see Adserà (2004).

[23] High infant mortality and, in most cases, the lack of a universal system of old-age security, also militate in favour of high fertility in developing countries.

maternal time. If this elasticity is lower than infinity, it may not be efficient to carry domestic specialization as far as the technology of child rearing permits. Second, if the skill premium is large, the efficient number of children will be small. Third, efficiency implies cooperation, and cooperation is likely to result in fewer children than non-cooperation. Paradoxically, therefore, a woman may 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. The finding that allocative efficiency is less likely to be achieved if the government makes it compulsory for children to attend school up to a certain age descends from the consideration that this policy will distort not only educational decisions, but also the subsequent choice of domestic arrangement. Some distortion may be justified if there is an educational externality. But we have shown that 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.

We obtained these results without having to assume that mothers like children more than fathers do, parents like sons more than daughters, or the labour market discriminates against women. We did make a number of simplifying assumptions common to most economic models, but these are not crucial to the results. One was to assume that parents are altruistic towards their children, but not towards each other. Allowing for reciprocal affection would not change the substance of our argument as long as each parent cared 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 this (i) does not yield direct utility, (ii) affects a person's domestic bargaining power only indirectly (by raising his or her earning capacity), and (iii) raises the productivity of market but not of domestic (child care) work. Relaxing these assumptions would make the predictions less sharp, but not change them qualitatively. Yet another simplifying assumption is that people do not care where their money comes from (*pecunia non olet*). If we assumed that people derive more satisfaction from their own earnings than from a transfer (whether from their own parents, or from the partner), that would tend to offset the advantage of domestic division of labour, and thus to make the results less sharp. 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 our results.

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