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NON-COOPERATIVE FAMILIES

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Abstract

In this paper we consider a non-cooperative model of a family's time allocation between market work and providing a homeproduced family public good. Private provision of the public good is hampered by two free rider problems. First, the person with the highest alternative cost of providing the public good free ride on the one with the lowest. Second, the 'poorer' of the spouses, in the sense of having low absolute productivities in both lines of work, free rides on the richer spouse. In aggregate, there is underprovision of the public good. We also show that neither equalization of utility nor voluntary monetary transfers is incompatible with a non-cooperative non-altruistic family model. Finally, we discuss the role for public provision of subsidized child care.

Keywords: Non-cooperative family games; family time allocation; household production; private provision of public goods.

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Non-cooperative families

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1. Introduction.

A basic insight from modern family economics is that family patterns are decisive for individuals' labor supply decisions. Fathers of small children could not work so much overtime as they often do, had not the mothers of these children worked part-time. Seminal contributors in this area are Gary Becker (1991) and Reuben Gronau (1972, 1977). At first sight these pictures of breadwinning fathers and housekeeping mothers might sound hopelessly dated in view of the gender revolution from the 1960s and onwards. But for instance Joshi (1988), describing the British experience, talks of women's 'changed dependency' rather than of economic liberation or independency. True, there has been an enormous increase in women's labor market participation over the last twenty years, but women for the most part have gone into a limited number of traditional female occupations, and they have to a large extent chosen part-time work. Joshi's conclusion is that women still choose labor market adaptions that are compatible with having the main responsibility for children. Fuchs (1989) reports a similar pattern of occupational segregation and part-time work for the US, and the experiences of most Western economies seem to be parallel. This suggests that it still is relevant to study models where specialization within the family is important for labor supply. However, such specialization no longer finds its expression in women not working, but in the more subtle way that both men and women work, but that women unlike men tend to sacrifice their career development for their children's needs. Hersch (1991) investigates the impact of nonmarket work on market wages, using US data. Her main results 'indicate that women's wages, but not men's, are reduced by time spent on

housework. Further, the time spent by women on housework is inversely related to her own earnings, but is not affected by the household's other income. Men's time on housework is unaffected by their wage or by other family income' (p. 159-160). These findings are at least compatible with the notion of a 'mummy track' in the labor market: Women typically take responsibilty for those types of housework that disrupts market work most (taking care of children cannot be postponed because an important meeting suddenly came up, repairing your car can). Therefore women with family responsibilities risk to be placed on a slower career track than men, or restricted to certain types of jobs - and market wages suffer.[1]

Gronau (1972), and many with him, has assumed that the family maximizes a 'family utility function' or a 'welfare function' over the utilities of family members. One can refer to such models as *harmony* models of marriage. Note however that this does not mean that there are no conflicting interests between family members, it only refers to the fact that the family has agreed on what welfare utility function to use, and in this sense agree on what choices to undertake. Around 1980 several authors chose to model family decision making as a Nash bargain (Manser and Brown 1980, McElroy and Horney 1981). If one likes, one can think of these models as *conflict* models of marriage, in the sense that it is bargaining power rather than weights in a welfare function that determines distribution within the family. However, it might be argued that the difference between maximizing family welfare and Nash bargaining is minimal from an empirical viewpoint. Both approaches predict Pareto optimality, and for an outside observer it is difficult to ascertain whether a given level of inequality in a family stems from one person carrying a large weight in the welfare function or from that person being powerful in bargaining. True, with Nash bargaining, outside options are apt to influence outcomes, which

[1]One way to view Becker (1985) is as an attempt to update the traditional economic model of a family's time use along lines as these.

would not be the case with welfare maximizing; here lies a possible route to distinguish empirically between the two models. (See Chiappori (1988, 1991), McElroy and Horney (1990), and McElroy (1990) for an exchange on this issue.)[2]

Gary Becker's approach to modelling family decisions have most often been to assume that family decisions are *efficient*. As we have seen, this approach encompasses both welfare maximizing and Nash bargaining families. Many writers who have used a family welfare function have surely only used this device to characterize efficient outcomes. For example, Apps and Rees (1988) state very clearly that they assume that family decisions are *as if* a welfare function is maximized. Distributional issues are interesting, but must not be dealt with in any paper on family economics. A recent paper investigating the empirical implications of the efficiency approach, is Chiappori (1992).

All of these approaches can be viewed as models of binding contracts, or alternatively, of efficient contracts implicitly enforced through repeated interaction. We find many good reasons for studying family economics with the spectacles of optimal contract theory (in one variant or another). After all, family life is usually a long term affair, so hopefully efficient outcomes are frequently reached. However, as a contrast to these models where efficiency is *assumed*, it should be interesting to study models that allow for inefficient family decision making. One way to introduce inefficiencies in family bargaining is merely to assume that contracting is incomplete, in the sense that there are some choice variables which cannot be contracted on, but are decided unilaterally by one of the spouses. For examples of this transaction cost approach, see Pollak (1985), Cohen (1992), Lommerud (1989), and Allen (1990).

[2]There is some ambiguity as to what should be treated as the threat points in family bargaining. For example McElroy (1990) seems to take it that the threat point is the utility as single. However, modern bargaining theory, notably Binmore, Rubinstein and Wolinsky (1986), emphasizes that the utility 'during conflict' should be treated as threat point - and of course, if a couple cannot reach an agreement as to what sofa to buy, this does not automatically lead to divorce.

A perhaps more satisfying approach to modelling family behavior in the absence of binding contracts, is the use of non-cooperative game theory; and this is the approach of the present paper. We feel a non-cooperative approach to family economics is warranted for several reasons. First, many decisions, as choice of education, career path, and the number of children, have a certain degree of irreversibility attached to them, so repeated interaction cannot be used to argue that efficiency is reached. Second, transaction costs can be high in much family decision making; 'providing a family public good' really consists of hundreds of different actions, so an optimal implicit contract must be very complex. Third, family members are often inexperienced bargainers, and strong emotions can be involved. These emotions need not be positive; quarrels are a part of life in many families, and the model to be developed here can even be applied to a divorced couple, tied together by the mutual concern for the well-being of the children.[3] Fourth, when an optimal implicit contract is not in place, it is often unambigous who has the right to take which decision. In the end people can decide over their own education, their own labor supply, their own earned money. All this seems to call for a non-cooperative approach. Of course, we would be hard pressed to argue that non-cooperation provides a full account of family life. However, as a contrast to the many cooperative models that have been developed, we think it interesting to investigate a fully non-cooperative framework. Moreover, in bargaining models the status quo point often is better described by the non-cooperative equilibrium in the family game rather than the utility as single. This means that a thorough understanding of non-cooperative family models is a necessary prerequisite for understanding cooperative bargaining models of the family.[4]

[3]Weiss and Willis (1985) provide a non-cooperative family model that precisely focuses on relationships in divorced couples with children.

[4]Both Ulph (1988) and Woolley (1988) have expressed exactly this point.

A few previous papers apply non-cooperative game theory in a family setting. One seminal paper is Leuthold (1968). The intent of this model is to study how income transfers influence the work decisions of the poor. As a family model, the model is rather simple, for instance with wage work and leisure as the only activities one can spend time on, and with no particular mention of household work. A driving force in this model is that income is assumed to be a family-specific public good, whereas leisure is a private good. Kooreman and Kapteyn (1990) discuss the empirical implementation of a Leuthold-type model, in relation to other family models.

Related work is found in Ulph (1988) and Woolley (1988). Ulph models a situation where household members behave in a non-cooperative manner over commodity demands; some of these commodities are private goods, some are family public goods. Labor supply choices are ignored in this model. An example of a question that can be studied within this framework is whether benefits such as child benefits are paid to the husband or the wife will have a significant impact on the pattern of household expenditure. In Woolley's model leisure and 'personal expenditures' are private goods, whereas 'household expenditures' represent pure public goods. She focuses on various forms of income transfers between spouses, and allows for the possibility - as does Ulph - that spouses, even though acting non-cooperatively, care for each other. The focus on transfers and altruism within the family makes these papers related to the by far most famous non-cooperative family model in existence, namely Gary Becker's work on the 'rotten kid' theorem (Becker 1974, 1981). Becker's result is that altruism by one family member can lead other selfish family members to act efficiently from the family viewpoint. Woolley's model include the rotten kid theorem as a special case; "...when one spouse is poor enough that she receives an income transfer from the other spouse, expenditure patterns are those predicted by Becker's 'rotten kid theorem'- expenditure reflect the preferences of the wealthier spouse"

(Woolley 1988, p. 36).[5]

Our paper has a different focus than these papers. It investigates, within a non-cooperative setting, how family members allocate their time between market work and household production, with the homeproduced good being a family-specific public good.[6] Household production is a neglected issue in the mentioned papers on non-cooperative families, but nevertheless a standard question in family economics.[7] A main emphasis in our work is on productivity in market work and in homeproduction and how these variables influence the equilibrium outcome. We touch on the issue of money transfers between spouses, but as opposed to for example Woolley, we will study transfers that are not based on any altruistic motive. Bragstad (1991) also presents a non-cooperative model of family time allocation between market work and household production. Nevertheless, that paper is rather different from ours. Bragstad's major emphasis is on how differences in preferences lead the one or the other spouse to provide the public good.

The remainder of this paper is organized as follows: Section 2 presents the basic model framework. Section 3 discusses how comparative and absolute advantages in market or household work determines who provides the family public good. A finding is that unlike in welfare maximizing models, absolute advantage plays an important role. Section 4 discusses monetary transfers between the spouses. The first theme is the incentive to transfer money to one's spouse in a truly non-cooperative setting without altruism. And indeed, such transfers can

[5]Also Bergstrom (1989) and Bruce and Waldman (1990) have extended the rotten kid model.

[6]There is a close link between non-cooperative family models and the literature on private provision of a public good. A key reference, albeit not the first paper in the tradition, is Bergstrom, Blume and Varian (1986).

[7] We think labor supply choices can be an example of decisions made early in the marriage, and then later proving to be rather irreversible, for many reasons. And as argued, perhaps for this type of decisions a non-cooperative framework is especially fitting.

take place and they can be Pareto-improving. Then we introduce income sharing as a 'minimalistic' marital contract, and study how this influences the analysis of sections 2 and 3. Section 5 uses our non-cooperative framework to evaluate the effect of public provision of a perfect substitute to the family public good. Section 6 summarizes the paper.

2. A model framework for non-cooperative family economics.

Consider a family consisting of two decision units, A (he) and B (she). Throughout we use subscripts and superscripts i=a,b to refer to either one of the two. Both persons get utility from consuming amounts of a purely private good, x_i, and of a public good, G, that is non-rival and non-exclusive in consumption.[8] Examples of the public good could be happy and well-educated children, a clean house, a beautiful garden. The utility functions of A and B,

(1) $$u(x_i, G)$$

are twice continously differentiable and strictly concave. Further, we assume that the private good is essential; $\partial u(0,G)/\partial x_i = \infty$. A person allocates his or her working time m between working in the outside labor market, $m-c_i$, and working at home and thereby contributing to the public good, c_i. We allow for the possibility that the spouses are differently productive in the two tasks. Suppose that h_i is the productivity in household production (providing the public good), that is, one unit of i's labor generates h_i units of the public good. The productivity in the labor market is described by the hourly market wage, w_i. Finally, we denote by $g_i = h_i c_i$ the amount

[8]But as hinted at in the introduction, the time allocation problem in families would be more precisely described as choosing between work that is compatible with having the main responsibility for children and work with good career opportunities. Our model could easily be reformulated in this direction.

of the public good i provides. Aggregate provision is $G = g_a + g_b$.[9]

The decision of A, who optimizes his choice of c_a under the Nash conjecture that his choice does not affect his wife's choice of c_b, can be descibed as follows:

(2) $$\max_{G} \; u(x_a, G)$$

s.t.

(3) $$w_a\, m + (w_a/h_a)\, h_b c_b \geq x_a + (w_a/h_a)\, G,$$

(4) $$G - h_b c_b \geq 0,$$

(5) $$x_a \geq 0.$$

The inequalities (4) and (5) are simply non-negativity constraints for A's choice of private consumption and his contribution to the public good (the latter being equal to aggregate contribution G minus B's contribution). Inequality (3) is A's budget restriction. It states that his maximum market income $w_a m$ must be larger than or equal to his private consumption plus the cost of his contribution to the public good, $w_a c_a$, i.e., $w_a m > x_a + w_a c_a$. Moreover, person B contributes $h_b c_b$ to the public good. For A this has a market value of $(w_a/h_a)\, h_b c_b$. This is added to both sides of the budget constraint, and the relation $G = h_a c_a + h_b c_b$ is used. This yields A's *imputed income* $\omega_i = w_a + (w_a/h_a)\, h_b c_b$ on the left hand side and his *imputed expenditure* for the private and the public good on the right hand side. Notice that with this transformation of the budget restriction, the choice problem of A is seen as a problem of choosing x_a and the *aggregate* amount of the public good, instead of his own contribution to it. This type of reformulation is standard in Nash models of private provision of public goods. The decision problem of B is of equivalent type, and is arrived at by in A's problem substituting all a by b, and vice versa.

[9]This formulation implies that the spouses only care for the total amount of the public good, and not their own contribution *per se*. When the public good for instance is the bringing up of children parents might well feel bad when not contributing, even though the other parent contributes a lot. In the literature on charity a parallel phenomenon is referred to as the 'warm glow' of giving (Andreoni 1989).

The budget restriction (3) implies that money transfers between the spouses are precluded. Section 4 below will open up the possibility for such transfers. Except for the inequality constraints (4) and (5), these maximization problems for given contributions of the other do not differ from an ordinary two-good maximizing problem of a household with income ω_i and prices of 1 for the private good and (w_i/h_i) for the public good, and yields A and B's demands for private good consumption and for the public good. A Nash equilibrium is defined as a pair of contributions (c_a, c_b) such that $(x_a, h_a c_a + h_b c_b)$ solves (2), and $(x_b, h_a c_a + h_b c_b)$ solves the analogous problem for B.

Throughout the paper we make the following *normality assumption*. There is a single-valued demand function for the public good, $f^i(\omega)$ which solves (2) ignoring the inequality constraints (4) and (5). This demand function is a differentiable function of imputed income. The marginal propensity to consume the public good is greater than zero and smaller than h_i/w_i, that is, both the private and the public good are strictly normal goods.

Proposition 1.

If the demands for the private and the public good both are strictly normal, the Nash equilibrium exists and is unique for given productivities.

A proof is found in the appendix. The proof of existence is straightforward and follows the line of argument in Bergstrom, Blume and Varian (1986). The uniqueness result is somewhat different from the standard results in the literature on private provision of a public good in that productivities influence both the endowments and the relative price of the private and the public good.

3. Productivity differences and the family allocation of time.

In this section we investigate how differences in productivity parameters influence the time use of a family in Nash equilibrium. As a basis for comparison, we will first note the time allocation of a welfare maximizing family. Suppose the family seeks to maximize an additive utilitarian welfare function and that monetary transfers are allowed. Productivity parameters are still constants. It is then well-known that specialization according to comparative advantage results, in the sense that one spouse works entirely in the market or at home, while the other might work in both arenas. The one that perfectly specializes is the one with a comparative advantage in that line of work. Further, a transfer of money is used to equate marginal utilities of income; with identical concave utility functions income is equated.

In the present context, not only comparative advantage but also absolute advantage matters. In two propositions we try to isolate the 'comparative advantage effect' and the 'absolute advantage effect'. The 'comparative advantage effect' is perhaps somewhat of a misnomer, since it is not possible to change anybody's comparative advantage without changing at least one productivity parameter in absolute value. We increase A's wage, but at the same time lower his productivity in providing the public good. In this way we increase A's 'opportunity cost' or 'relative price' of providing the public good relative to B's, without, in a sense to be specified, making him 'richer' in the process. The following proposition applies

Proposition 2.

Consider an interior equilibrium $(x_a^*, x_b^*, g_a^*, g_b^*)$ for given values w_a, w_b, h_a, h_b. Suppose A's wage increases marginally to $\hat{w}_a$ and h_a drops to $\hat{h}_a$, such that if he chooses still to buy x_a^*, his remaining time is just sufficient to provide g_a^*, i.e., there exists a $c_a^0 \in [0, m]$ with $\hat{w}_a(m-\hat{c}_a^0) = w_a(m-c_a^*)$ and $\hat{h}_a\hat{c}_a^0 = h_a c_a^*$. Then for the new equilibrium $(\hat{x}_a, \hat{x}_b, \hat{g}_a, \hat{g}_b)$,

$\hat{x}_a > x_a$, $\hat{x}_b < x_b^*$, $\hat{G} < G^*$.

Proof. For a proof we use a graphical framework developed by Buchholz (1990).

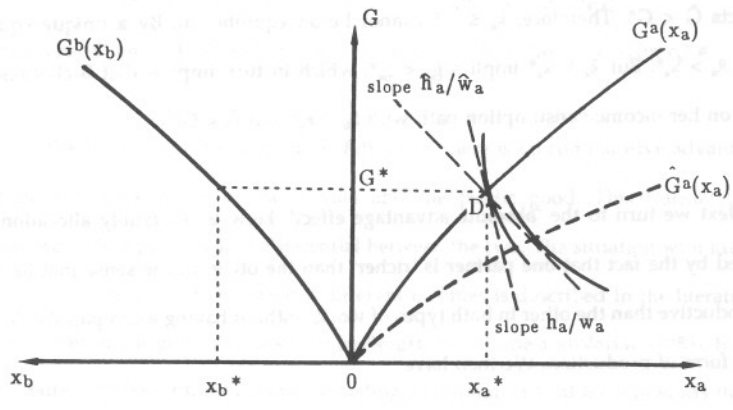

Figure 1.

The figure shows the income-consumption paths $G^i(x_i)$ for A and B for the original productivity values. The original equilibrium is determined by a G^* which just exhausts incomes of A and B for x_a^* and x_b^*. The change of w_a and h_a is such that if A chooses to consume x_a^* units of the private good given the new 'prices' $(\hat{w}_a, \hat{h}_a)$, he would provide the same amount of the public

good with his remaining endowment. This would imply an unchanged choice for B. However, given the new price ratio $\hat{w}_a/\hat{h}_a$, point D is not optimal for A anymore. The actual proof of $\hat{x}_a > x_a^*$, $\hat{x}_b < x_b^*$, and $\hat{G} < G^*$ is by contradiction. Suppose $\hat{x}_a \leq x_a^*$ in equilibrium. Then, by A's budget restriction, $\hat{g}_a \geq g_a^*$. Further, the increase of w_a/h_a leads to a new income-consumption path which is below the old one everywhere; remember that utility functions are strictly concave. Therefore, $\hat{x}_a \leq x_a^*$ requires $\hat{G} < G^*$ for $(\hat{x}_a, \hat{G})$ to lie on A's new income-consumption path. Now consider the effect on B. As A (weakly) increases his contribution to the public good, this means that B's imputed income (weakly) increases, which implies that she will choose a point further outwards on her income consumption path, i.e., she will choose $\hat{x}_b \geq x_b^*$ and $\hat{G} \geq G^*$. But this contradicts $\hat{G} < G^*$. Therefore, $\hat{x}_a \leq x_a^*$ cannot be an equilibrium. By a unique equilibrium existing, $\hat{x}_a > x_a^*$. But $\hat{x}_a > x_a^*$ implies $\hat{g}_a < g_a^*$, which in turn implies that B chooses a point inwards on her income-consumption path with $\hat{x}_b < x_b^*$ and $\hat{G} < G^*$.■

Next we turn to the 'absolute advantage effect'. How is the family allocation of time influenced by the fact that one partner is 'richer' than the other, in the sense that he or she is more productive than the other in both types of work, without having a comparative advantage in either form of production. We then have

Proposition 3.

If $w_a/h_a = w_b/h_b = w/h$, then the equilibrium can be of three types.

(*i*) $c_a = c_b = 0$.

(*ii*) Only the individual with the higher productivity in market work provides the public good.

(*iii*) Both provide towards the public good, and $(x_a, G) = (x_b, G)$ in equilibrium.

Proof. (*i*) is a degenerate case with $(w/h)\, u_x^i(w_i m, 0) > u_G(w_i m, 0)$ for i = a,b. (*ii*) is a case where absolute levels of productivity are so different that one of the spouses (say B) is so poor that, given A's provision characterized by

(6) $$(w/h)\, u_x^a(w_a(m-c_a), h_a c_a) = u_G^a(w_a(m-c_a), h_a c_a),$$

still

(7) $$(w/h)\, u_x^b(w_b m, h_a c_a) \geq u_G^b(w_b m, h_a c_a).$$

Finally, the interesting case (*iii*), in which both provide. In this case, we have

(8) $$(w/h)\, u_x^a(w_a(m-c_a), h_a c_a + h_b c_b) = u_G^a(w_a(m-c_a), h_a c_a + h_b c_b)$$

(9) $$(w/h)\, u_x^b(w_b(m-c_b), h_a c_a + h_b c_b) = u_G^b(w_b(m-c_b), h_a c_a + h_b c_b).$$

Conditions (8) and (9), with strict concavity of u, imply $w_a(m-c_a) = w_b(m-c_b)$.■

The intuition of this result is as follows. If there is no comparative advantage, both face the same relative prices of the private and the public good. This translates the absolute advantage into a pure income differential between the two. The situation with identical relative prices, identical utility functions but different incomes is described in the literature on private provision of public goods, for instance by Bergstrom, Blume and Varian (1986). In this case both contribute the total of their income exceeding a common critical level towards the provision of the public good. The parallel to Proposition 3 should be clear.

To sum up, in the strategic family model two factors influence an individual's possibility to free ride. First, the person with the higher opportunity cost of providing the family public good will successfully free ride on the person with the lower opportunity cost. Second, the poorer of the spouses, in the sense of having low productivity values in both lines of work, will free ride on the richer.

These predictions coincide with those of the welfare maximizing family model in that there is a tendency for the public good to be provided by the person with a comparative advantage in the production of it. However, also absolute advantage matters for the family's time allocation. This is *not* the case in the reference welfare maximizing model described in the beginning of this section. Further, recall that the welfare maximizing model leads to full specialization when productivity parameters are constants. In general, we obtain no such result for the strategic model. The reason is clear. In the welfare maximizing model the person specializing in home production receives a monetary transfer that equates the money incomes of the two. This is not so in the strategic model. If your spouse free rides on your provision of the public good, full specialization will mean that one spouse will get little of the private good. But note further that the strategic model entails a possibility for full specialization *without* comparative advantage. In case (*ii*) of Proposition 3 only the richer spouse provides all of the public good, whereas the other specializes in market work.[10]

One should perhaps be more careful to apply models of rational behavior to the mating process in society than to family labor supply decisions. We note in the passsing, though, that the strategic model has different implications for marriage matching than the reference welfare maximizing model. Both models predict that people will marry people of comparable 'wealth' (here determined by the value of absolute advantages) as themselves. In both models it is adventageous to try to marry somebody as rich as possible, but when everybody thinks this way, the result is that people marry others of 'comparable worth'. The two models, however, yield different predictions about how comparative advantage affects the sorting process. In the welfare maximizing model there is tendency that marriages are formed with large comparative

[10]In the reference welfare maximizing model the absence of comparative advantage makes the spouses indifferent as to who shall provide the public good, so specialization can occur by chance. The least psychic cost from too large a degree of specialization makes non-specialization the natural outcome.

advantages, as this maximizes the gains from the division of labor. In the strategic model people prefer spouses with a comparative advantage in household production. When all think like this, marriages with little comparative advantage results. The key difference between the models is again that in the strategic model people providing the most of the family public goods are not adequately compensated. Therefore there is less division of labor, and people try not to be the one who loses out in the strategic family game.

4. Monetary transfers.

So far this paper has considered a strategic family model in which money transfers between the spouses are ruled out. Money transfers seem common in marriages, though. Woolley refers some empirical investigations about budgeting systems in families. Even though money transfers or pooling of income are in fact rather common, it should perhaps be stressed that 'independent management' of money is not uncommon.

This section will first show that transfers of money can occur within a family also within a purely non-cooperative model, even in the absence of any 'caring' between the spouses. Empirical evidence for transfers within families therefore does not contradict the non-cooperative approach. We will also investigate the consequences of allowing the spouses to enter a minimalistic contract saying that outside income is to be shared fifty-fifty. Income pooling will prove to allow the spouses to realize a first best allocation of time. We will emphasize, though, that it is only 'income pooling' in a rather strict sense that achieves this outcome.

But before we pursue these issues, note that in the non-cooperative model without money transfers, there is also a strong tendency to utility equalization. This is best seen by considering

Proposition 3. It tells us that in a family without comparative advantages, both partners will have the same utility levels. This is not effectuated through transfers of money, but by the richer spouse undertaking the lion's share of the production of the family public good.[11]

Voluntary transfers.

We now lift the restriction that no monetary transfers take place. Suppose that the Nash equilibrium is one in which productivities are sufficiently different to make, say, B contribute, while A does not contribute. A sufficient condition for this is

(10) $$(w_a/h_a)\, u_x^a(w_a m,\, G) > u_G^a(w_a m,\, G)$$

(11) $$(w_b/h_b)\, u_x^b(w_b(m-(G/h_b)),\, G) = u_G^b(w_b(m-(G/h_b)),\, G).$$

Proposition 4.

Suppose that the private provision equilibrium is characterized by (10) and (11), with only B contributing. A small unconditional transfer from A to B increases B's equilibrium provision of the public good and increases the aggregate provision of G. The transfer can be a strict Pareto improvement.

Proof. Suppose that A transfers one unit of income to B. Suppose that B still assumes that A will not contribute in the equilibrium. Then, by strict normality, B will increase her provision of G by $\partial f^b(w_b m)/\partial\omega_b \in (0,\, h_b/w_b)$. This shifts A's budget restriction vertically upwards by $\partial f^b(w_b m)/\partial\omega_b$. By continuity of u, in $(x_a, G) = (w_a m,\, G + \partial f^b(w_b m)/\partial\omega_b)$ inequality (10) still holds if the amount transferred is small. The possibility of a Pareto improvement is shown by way of

[11]This finds close parallels in the literature on the private provision of public goods. See, e.g., Bergstrom, Blume and Varian (1986) and Boadway, Pestieau and Wildasin (1989).

an example. Suppose $\partial f^b(\omega)/\partial\omega_b = (h_b/w_b) - \delta$, with $\delta > 0$, but small. Suppose further that

(12) $$h_a/w_a < u_x^a/u_G^a < (h_b/w_b)-\delta$$

in equilibrium. Consider now a transfer of a marginal unit of income from A to B. By Proposition 2 this increases B's contribution by $\partial f^b(\omega)/\partial\omega_b$ and leaves A not contributing. B's utility clearly increases by the transfer. A's utility changes by

(13) $$du^a = -u_x^a + u_G^a\, \partial f^b/\partial\omega_b = -u_x^a + u_G^a[(h_b/w_b)-\delta].$$

By (12), we then have

(14) $$du^a > -u_G^a[(h_b/w_b)-\delta] + u_G^a[(h_b/w_b)-\delta] = 0.\blacksquare$$

In words, one spouse might for purely strategic reasons choose to transfer money to the other. The receiving spouse will react to a gift of money by increasing her provision of the public good. If this increase is big enough, the transfer will prove to bring about a Pareto improvement. This in turn means that the transfer will be voluntarily given and received.[12] Non-cooperative family games with transfers must be thought of as two-stage games. In a first stage the spouses decide on monetary transfers. In the second stage a game of the sort presented in sections 2 and 3 takes place.

Income sharing as a minimalistic contract.

In this subsection we will for a moment leave the fully non-cooperative framework. We will allow A and B to enter a rudimentary contract, so we enter the world of incomplete contracting. More precisely, we take it that the spouses decide to pool all money income. The empirical

[12]The strategic giving result here is distinct from that found in Bernheim, Shleifer and Summers (1985). Their model of strategic bequests assume that, for instance, a parent can commit on how much to let children inherit and to a rule on how the inheritance is to be divided between them. Our form of strategic giving takes place with no possibility for commitment whatsoever.

studies on budgetary systems in families suggest that 'shared management' is in fact rather common. However, one should be careful in interpreting the 'shared management' of these studies as necessarily being the same as we refer to as income pooling. In fact, a mutual bank account can give the husband the opportunity non-cooperatively to spend even his wife's income on drink and betting.[13] [14] The enforcement problems also with an income pooling agreement can be substantial.

Nevertheless, suppose for the moment that, unlike in the rest of the paper, in the marriage A and B equate their earnings from market work. This means their consumption of the private good is symmetric:

(15a) $$x_a = x_b = 1/2\ [w_a(m-c_a) + w_b(m-c_b)].$$

By simple manipulations this can be rewritten as

(15b) $$w_a m + w_b m + [(w_a/h_a) - (w_b/h_b)]\ h_b c_b = 2x_a + (w_a/h_a)\ G.$$

This is the new budget constraint for A (with a similar one for B) when maximizing $u(x_i, G)$.[15]

We now have

[13]The studies Woolley refer to in fact give a rather mixed picture of what sort of budgetary system families use. A vague impression is that there is a move away from systems where the wife either gets a household allowance or receives the whole of the husband's wage towards predominantly 'shared management' in some form, but also towards independent management.

[14]Allen (1992) seeks to use pressures from the marriage market to explain why the split is fifty-fifty, *given* that some sharing contract is in place.

[15]To understand (15b), take as a starting point equation (3), the budget constraint when income was *not* pooled. At the left hand side of this was A's full income (total market value of time endowment) plus the money value to A of the 'gift' A receives from B in the form of B's public good provision. At the right hand side were A's expenditure on market goods and the total expenditure on public goods (evaluated at A's opportunity cost of providing the good). Now add to equation (3) at the right hand side B's money income $w_b m - (w_b/h_b)\ h_b c_b$, and at the left hand side the cost of B's private good consumption. Then we arrive at (15b), A's budget restriction under pooled income.

Proposition 5.

A marriage contract with built-in sharing of outside earnings leads to perfect specialization according to comparative advantage.

A proof is found in the appendix. Proposition 5 is very intuitive. In the reference welfare maximizing model there is specialization. The reason specialization did not in general occur in the strategic model was that the one specializing in public good provision would in the absence of transfers get no market goods. With income pooling, of course, this is no longer the case.

Proposition 6.

A marriage contract with built-in sharing of outside earnings leads to an efficient allocation of time.

Again, a proof is found in the appendix. This result is suggested already by Proposition 5. The specialization described in that result corresponds to the time use pattern of the reference welfare maximizing model with binding contracts. It is readily shown that the provision of the public good satisfies the Samuelson-Lindahl rule both for the case with and without comparative advantages. The intuition behind Proposition 6 is readily captured. For natural reasons the person providing a family public good only gets half of the benefits created. When income is pooled, he or she gets only half of the benefits from the only other possible activity, namely market work, as well. Then there is no distortion of time use.

Summing up this section, evidence that money transfers take place within marriages or that spouses have equalized their utility, does not repudiate the strategic family model. On the

contrary, such phenomena are integral parts of non-cooperative family economics. Income pooling agreements, on the other hand, takes us back to the efficient model. We would, however, like to underline that to achieve the first best, we must have income pooling in a rather strict sense: *All* benefits from *all* activities other than providing the public good must be shared fifty-fifty. Working in the market might for instance have hard-to-share advantages as consumption at work (conference travels and the like) and human capital accumulation[16]. Moreover, we would like to remind the reader that our model has not included leisure as a good; leisure being precisely a difficult-to-share private good. With some benefit from some activity other than household production not being shared, not even income pooling will fully alleviate the underprovision problem.[17]

5. Public policy.

In the truly non-cooperative family model, family-specific public goods are underprovided. This underprovision might seem to call for public policy measures; especially since one particularly important such public good is the welfare and education of children. Government policies influence the private provision of public goods game within a family in many ways. For example, taxes and subsidies affect non-cooperative family decisions. The focus here shall be on government provision of a perfect substitute to the family-specific public good, for instance public child care and education.

The strategic family model implicitly assumed that there is no available market good that is a perfect substitute to the family public good. If this had been the case, our model would have

[16]Human capital accumulation will lead to higher income in the future. With a positive probability of divorce, this income element is not *in expectation* equally shared (Lommerud 1989).

[17]Recall that Leuthold (1968) modelled a situation where income was pooled, but were his and her leisure were private goods.

been reduced to a simpler structure where spouses decide on how to allocate their money on private and public *market* goods.[18] It is, of course, very difficult to argue that the government has access to a production technology for instance for child care superior to that available to the private sector. We will therefore assume that the government produces (a perfect substitute to) the family public good at a cost disadvantage relative to the family members themselves. This then explains why private firms do not market such goods. The assumption of a government's cost disadvantage also seems realistic for many family public goods. For instance, publicly provided child care must compensate for the absence of parental love in the upbringing of children.

Warr (1982) and Bergstrom, Blume and Varian (1986) showed that, applied to the strategic family model, when both individuals have the same opportunity cost of providing the public god, and this also is the government's opportunity cost, then government provision that does not alter the number of private contributors and is financed by lump-sum taxes on the contributors, is crowded out on a one-to-one basis. Denote the government provision by g_g, and say, for instance, that the tax is levied on A. In this case the lump-sum tax to be paid by A is $L = (w_a/h_a)\, g_g$. If g_g is smaller than A's equilibrium contribution, $h_a c_a$, for $g_g = 0$, then the additional government provision of the public good is perfectly crowded out by reductions in A's private contribution.

The natural assumption is, as argued, that the government supplies the public good at a cost disadvantage. The following result applies:

[18]Recall that that was basicly the format of Ulph (1988) and Woolley (1988).

Proposition 7.

When the government's opportunity cost of providing (a perfect substitute to) the family-specific public good is larger than that of any of the family members, and the government provision is small enough not to alter the set of contributors, then government provision financed by lump-sum taxation of the family members is *more* than 100% crowded out.

Proof. Suppose $w_g/h_g > \max\{w_a/h_a, w_b/h_b\}$. Suppose government chooses $dg_g > 0$ and finances it by a tax in units of monetary income, $dT = (w_g/h_g)\, dg_g$. Aggregate provision goes down, as can be shown by a contradiction. Suppose $dG \geq 0$. Then $d(g_a+g_b) > -dg_g$. But, as $dT = (w_g/h_g)\, dg_g > \max\{(w_a/h_a)\, dg_g, (w_b/h_b)\, dg_g\}$, this implies that x_i has to drop at least for one family member. For this person i the condition $u^i_x(x_i, G+dG) = u^i_G(x_i, G+dG)$ is violated for $dG > 0$. This is a contradiction.■

The crowding out problem is aggravated by the fact that government is less efficient in providing the family good. If the government wants to influence the total provision of the public good, it first has to crowd out private contributions completely. Additional spendings will then increase total provision. Such a policy can become very expensive. A tentative policy conclusion would be as follows: Underprovision of child care is something the government naturally wants to do something about. Because of crowding out, though, this paper lends no support to a policy of providing subsidized day care centers for everybody. Such a policy would of course also benefit the many families that have overcome the problems of non-cooperation. Rather, an alternative policy more in line with the analysis of this paper is to single out 'problem families' where the parents provide little or next-to-nothing child care, and use the resources to better the situation for the children in these families. The mere fact that parents contribute little towards

the upbringing and education of their children makes the crowding out problem relatively cheap to overcome.

6 Conclusions

The bulk of economic family models assume that family decisions are efficient, meaning that implicit optimal contracts somehow can be enforced. As a contrast to this dominant tradition, we think there are good reasons to develop non-cooperative family models, where family members act strategically. Many family decisions are to some degree irreversible. Repeated interaction then cannot be used to argue that efficiency is reached. The optimal family contract might be quite complex; there are many tasks whose execution by whom, how, and when is to be described, many streams of income and benefits are to be divided between the spouses. In short, transactions costs may be substantial. Positive emotions among the contracting parties might reduce the scope for opportunism (Lommerud 1989, Frank 1987, 1988), but there are also families where the emotions involved are less positive. Private provision of public goods games might be played for example by spouses at or beyond the brink of divorce, tied together by the mutual concern for children. Finally, we think the outcome of non-cooperative behavior in the family poses the natural threat point in family bargaining models. Even if one believes in efficient bargaining, a thorough understanding of non-cooperative family games therefore becomes essential.

The basic framework of this paper is that people use their time either to earn market income, which is a private good, or to provide a family public good. In Nash equilibrium there is underprovision of the family public good (child care being an important example). As in efficient models there is a tendency that the person with a comparative advantage in household

production for the most part performs that task. However, in a strategic model we expect less drastic specialization between the spouses, since the one specializing in household production is not adequately compensated by the other. In the strategic model, contrary to the efficiency model, there is also a tendency that absolute advantages matter, in the sense that the 'richer' spouse provides more of the public good.

In a perfectly non-cooperative framework voluntary transfers of money may well take place, simply because they are Pareto improving. There is also a strong tendency to utility equalization in the non-cooperative model, because the richer spouse contributes more towards the public good. This shows that empirical evidence that there are transfers and utility equalization in families does not repudiate the strategic model. Full income pooling, in the sense that *all* incomes and benefits obtained by time uses other than towards the provision of the public good, is however shown to bring us back to an efficiency framework.

Especially if the underprovided family-specific public good is child care, a government might want to interfer. The problem is that public provision of a perfect substitute to the family public good is likely to be crowded out by reductions in contributions from family members. Under natural assumptions crowding out will be more than 100%. Our tentative policy conclusion is that a government should not try to increase the level of child care in all families, for instance by across-the-board subsidies of day care centers, but instead pursue a policy of singling out problem families where children receive very little care, and use available resources to improve the situation of these children.

We see our model just as a starting point for research in non-cooperative family economics. What if parents, realistically, not only care for their children's well-being, but also about their own contribution towards this end *per se*? How will people strategically try to influence their productivity in the market and at home, knowing that a non-cooperative family

game awaits them in the future? How will taxation influence non-cooperative families? All this we view as promising future research questions.

Appendix.

Proof of Proposition 1.

Existence (analogous to Bergstrom, Blume and Varian (1986)).

Define $D = \{(g_a, g_b) | \ 0 \le g_a \le h_a m, \ 0 \le g_b \le h_b m\}$. D is convex and compact. Given the assumptions about A's and B's unconstrained demand for the public good, $f^a(\omega)$ and $f^b(\omega)$, contributions are determined as

$$g_a = \max \{f^a(\omega) - h_b c_b, 0\}$$

$$g_b = \max \{f^b(\omega) - h_a c_a, 0\}$$

and are continous functions from D to itself. By Brouwer's fixed point theorem, a fixed point exists, and this fixed point is a Nash equilibrium.■

Uniqueness.

There are four possible sets C of contributors, C = {A,B}, {A}, {B}, { }. We first show that, for a given set of contributors, there is at most one equilibrium. This is immediate for {A}, {B} and { }. For {A,B,}, suppose there is an equilibrium. This requires $f^a = G^a = f^b$. Now, $\partial f^a/\partial(h_b c_b) < 1$ and $\partial f^b/\partial(h_a c_a) < 1$. Therefore, for all $G > G^*$, f^a and f^b are smaller than G.

Now we show that the four possible equilibria, associated with the four possible sets of contributors, are mutually exclusive. Equilibria for the different sets of contributors obey the following conditions:

An equilibrium with C = { } fulfills

(A1) $$(w_a/h_a)\, u_x^a(w_a m, 0) \ge u_G^a(w_a m, 0)$$

(A2) $$(w_b/h_b)\, u_x^b(w_b m, 0) \ge u_G^b(w_b m, 0).$$

An equilibrium with C = {A} fulfills

(A3) $$(w_a/h_a)\, u_x^a(w_a(m-c_a), h_a c_a) = u_G^a(w_a(m-c_a), h_a c_a)$$

(A4) $$(w_b/h_b)\, u_x^b(w_b m, h_a c_a) \ge u_G^b(w_b m, h_a c_a).$$

An equilibrium with C = {B} fulfills

(A5) $$(w_a/h_a)\, u_x^a(w_a m, h_b c_b) \ge u_G^a(w_a m, h_b c_b)$$

(A6) $$(w_b/h_b)\, u_x^b(w_b(m-c_b), h_b c_b) = u_G^b(w_b(m-c_b), h_b c_b).$$

An equilibrium with C = {A,B} fulfills

(A7) $$(w_a/h_a)\, u_x^a(w_a(m-c_a), h_a c_a + h_b c_b) = u_G^a(w_a(m-c_a), h_a c_a + h_b c_b)$$

(A8) $$(w_b/h_b)\, u_x^b(w_b(m-c_b), h_a c_a + h_b c_b) = u_G^b(w_b(m-c_b), h_a c_a + h_b c_b).$$

Notice that [(A1),(A3)], [(A2),(A6)], [(A1),(A7)], [(A5),(A7)], [(A4),(A8)] are mutually exclusive. Suppose that $h_b c_b|_{C=\{B\}} \ge h_a c_a|_{C=\{A\}}$. This makes (A4) and (A6) mutually exclusive. Suppose the reverse, (A3) and (A5) are mutually exclusive.■

Proof of Proposition 5.

The strategy of the proof is first to show that an interior equilibrium cannot exist, and then to eliminate corner solutions with the 'wrong kind' of specialization, that is, outcomes where the person specializing in household work is the one with a comparative disadvantage in this activity. We consider the case when B has a comparative advantage in household production, $w_a/h_a > w_b/h_b$.

With income pooling, an interior equilibrium will satisfy

(A9) $$u_G^a/u_x^a = w_a/2h_a$$

(A10) $$u_G^b/u_x^b = w_b/2h_b.$$

We can then show that there is no interior equilibrium. Suppose there is. An interior equilibrium demands

(A11) $$w_a/2h_a = u_G^a/u_x^a = u_G^b/u_x^b = w_b/2h_b.$$

This contradicts $w_a/h_a \ne w_b/h_b$. Therefore, the equilibrium outcome must entail full

specialization. Full specialization means that one individual only contributes to the public good and the other shares his time between the two activities, or that one individual only works in the market and the other does both activities.

We now show that some types of corner equilibria are eliminated. Suppose that in equilibrium A, the one with a comparative advantage in market work, is the only one contributing to the public good. Then

(A12) $$u_G^a/u_x^a \geq w_a/2h_a > w_b/2h_b \geq u_G^b/u_x^b = u_G^a/u_x^a.$$

The strict inequality follows from the assumption that only A provides, that is, B does not. Condition (A12) is an obvious contradiction.

Suppose now that in equilibrium A contributes $c_a = m$ and that B contributes only $c_b < m$. Then condition (A12) follows again, still being a contradiction.

The only two remaining possible cases are that either only the person with a comparative advantage in household production, B contributes to the public good (she might or might not also work in the market), or that B contributes her time budget and also A uses some time at household production.■

Proof of Proposition 6.

Suppose $w_a/h_a > w_b/h_b$. Consider the case where only B contributes, $c_b < m$. Then the marginal rate of transformation is defined by w_b/h_b. From maximization of (1) subject to (15b) we get

(A13) $$u_G^a/u_x^a = u_G^b/u_x^b = w_b/2h_b,$$

or,

(A14) $$u_G^a/u_x^a + u_G^b/u_x^b = w_b/h_b.$$

This is the Samuelson-Lindahl rule. The other corner outcomes, where B chooses $c_b = m$ and A chooses $c_a = 0$ or $c_a > 0$ are analogous.

Now remains only the case when there is no comparative advantage. Rule out the trivial case where $u_G^i(w_i m, 0) < (w_i/2h_i)\, u_x^i(w_i m, 0)$, that is, where nobody contributes. When $w_a/h_a = w_b/h_b = w/b$, the outcome fulfills

(A15) $$u_G^a/u_x^a = u_G^b/u_x^b = w/2h,$$

which can be restated as

(A16) $$u_G^a/u_x^a + u_G^b/u_x^b = w/2h + w/2h = w/h,$$

and which again is the Samuelson-Lindahl rule.■

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