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ABSTRACT

Self-Enforcing Intergenerational Transfers and the Provision of Education*

Due to the presence of borrowing constraints in the market, the cost of educating the young members of a family is often borne by the adults. We consider intrafamily financing of human capital under the assumptions that individuals are selfish and binding contracts are not feasible. Cooperation among family members is possible through a family norm (a family 'social capital') which prescribes the obligations to be met at each stage in life and sanctions for those who deviate. We note that it is crucial that transfers to education are combined with intrafamily transfers to old family members. We characterize the set of self-enforcing transfers and show that there is a downward bias in the family provision of education. This gives a rationale for public action as a remedy for the lack of commitment between selfish family members. The analysis also points to a number of potential effects of education policy and public pensions on human capital formation.

JEL Classification: D91, H22 and I21
Keywords: education policy, human capital investments, intergenerational trade and self-enforceable transfers

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NON-TECHNICAL SUMMARY

Education is one of the fields in which the necessity of public intervention is usually taken for granted. Education policy invariably consists of one or more ways of subsidizing private educational expenditure. The perhaps most frequently mentioned argument for such interventions is the existence of credit market imperfections. If there are credit constraints, children may be unable to borrow against future income and therefore may need to rely on their parents to support their human capital investments. A well known problem with this is human capital investments may then depend on parental wealth.

Despite the fact that quite a lot of effort has been put into studying the effects of credit market constraints on human capital investments, very little attention has been given to the theoretical foundations for intrafamily financing of education. To pose the question in a somewhat provocative way: why would parents be willing to finance their children's human capital investments?

The most obvious answer is of course altruism. The empirical support for the existence of altruistic motives is however not overwhelming; indeed, some of the most influential studies have reached mixed conclusions, possibly favouring 'exchange' rather than altruism as a motive for intrafamily transfers.

A problem with intrafamily exchanges is, however, that they are generally not legally enforced, due to the fact that they occur over long periods of time and often in an in-kind form. In that case, the exchanges must be 'self-enforcing' – that is, it has to be in each party's self-interest to sustain them.

The term 'exchange' suggests that intrafamily transfers towards education may take the form of implicit 'loans' to be paid back by the children when they themselves reach adulthood. Indeed, one of our findings is that intrafamily transfers from adults towards the investments undertaken by the children will be combined with transfers, at a later stage, operating in the opposite direction. Hence the intrafamily transfers that we characterize will have the appearance of implicit loans.

This Paper thus considers the sustainability of intrafamily financing of human capital investments in an economy with 'selfish' (i.e. non-altruistic) individuals. Understanding how self-enforcing intrafamily financing of human capital investments operates may be of great importance for understanding how private spending education reacts to changes in education policy, tax policy and even public pension policy.

The basic structure of our model is as follows: a family is characterized by three overlapping generations of family members – young, adult and old. Young family members make investments in education, which are financed by

the adult family members. However, adult family members may also make transfers to their old parents.

While an education transfer goes from an *older* to a *younger* family member, a transfer from an adult to an old family member goes in the opposite: from a *younger* to an *older* family member. Indeed, one finding is that having transfers operating in both directions is necessary for education transfers to be sustainable.

A second main finding is that education investments will be suboptimally low when the sustainable transfers are restricted by the inability to have the intrafamily transfers formally enforced. Intuitively, how much an adult will contribute to the education of the young depends on the value that the adult places on being part of the family network. We argue that this relates to the value of having access to the family network as a means for transferring income from adulthood to old age. It may also include less tangible benefits such as any form of services or goods that can only be provided by family member.

Turning to policy we note that the limitations caused by the absence of legal enforcement of intrafamily transfers provides a novel rationale for education policy: to enhance the amount of education that can be supported through intrafamily financing. We highlight how education subsidies can be used for this purpose.

Finally we note a number of further results and possible extensions. We consider, among other things, the potential impact of public pensions. Since the sustainability of intrafamily financing of human capital investments hinges on there being transfers operating from adult to old family members, a change in public pension policy may have repercussions on private spending on education.

I Introduction

Education is one of the fields in which the necessity of public intervention is usually taken for granted. Education policy invariably consists of one or more ways of subsidizing private educational expenditure. This may take the form of compulsory education, freely provided by the government; of vouchers to be used to defray (part of) the cost of educating one's children in private schools; of price subsidies for higher education, and so on. A quick look at the available data confirms that public expenditures on education are indeed substantial; e.g. in the OECD countries public expenditure on educational institutions in 1996 was on average 4.9 percent of GDP.

The perhaps most frequently mentioned argument for such widespread intervention is the existence of credit market imperfections. A large literature has demonstrated how asymmetric information and moral hazard can lead to equilibrium credit rationing (see e.g. Stiglitz and Weiss, 1981). If there are credit constraints children may be unable to borrow against future income and therefore may need to rely on their parents to support their human capital investments. Despite the fact that quite a lot of effort has been put into studying the effects of credit market constraints on human capital investments, very little attention has been given to the theoretical foundations for intrafamily financing of human capital investments. To pose the question in a somewhat provocative way: Why would parents be willing to finance their children's human capital investments? The most obvious answer is of course altruism (see e.g. Becker et al. (1990) for a formulation). The empirical support for the existence of altruistic motives is however not overwhelming; indeed, some of the most influential studies have reached mixed conclusions, possibly favouring "exchange" rather than altruism as a motive for intrafamily transfers.[1]

Suppose then that parents are not strongly altruistic towards their children. One can then argue that parents may simply lend the money to their children who, in return, promise to repay the loan when they grow up.[2] After all, if the investment is profitable there will be a surplus to be shared so the trade may be mutually beneficial; given that the parents have sufficient savings available they and the children could agree to make the (privately) efficient levels of investment and then bargain over how to split the surplus.[3] A number of authors have indeed taken this or similar routes, typically using overlapping generations models – see e.g. Cremer et al. (1992), Barham et al. (1995) and Balestrino (1997). However, none of these contributions deals explicitly with the question of how such an agreement would be enforced. There are reasons to expect formal contracts not to exist: intra-family transfers may generally be difficulty to verify, not least since they will occur over a long period of time and may even be in an in-kind form (see e.g. Cox and Rank, 1992). In the absence of formal legally enforceable contracts between parents and children, such agreements would, as pointed out by Cigno (1993), need to be self-enforcing. In other words, if intra-family loan agreements between non-altruistic individuals will have to do without formal contracts there is a potentially serious hold-up problem: why would a child repay a loan to her parents if she is not legally obliged to do so? The answer to this question may be the existence of family "social capital" which facilitates cooperation.[4] Parents may be willing to contribute to their children's' education if they expect that by doing so they will get something back and/or if they expect to be "punished" if they don't.

The idea that cooperation in overlapping generations games may take place also when agents are selfish goes back at least to Hammond (1975) (see also Cremer, 1986).[5] More closely related to our approach, Cigno (1993) pioneered the analysis of cooperation among generations of selfish individuals within a family and introduced the idea of a self-enforcing "family constitution", a set of rules such that all family members are better-off obeying rather than disobeying them. In Cigno's model, individuals live three periods, but earn an exogenous income only in period 2 (adulthood); their problem, therefore, is to devise a way of smoothing consumption optimally over the life-cycle. To this end, they can rely on three mechanisms, namely savings, pensions and the internal transfer system; importantly, to make use of the latter, they must decide to have children (fertility is taken to be endogenous). Using this approach, Cigno argues that increases in pension coverage are, contrary to conventional wisdom, not necessarily bad for savings, as they might crowd out family transfers first; and, relatedly, that such increases are instead likely to be bad for fertility, since a growing reliance on pensions (and savings) makes children less useful as an instrument for shifting income across periods. Our analysis differs from Cigno's in that we look mostly at the link from the adult to the young generation, and in particular the financing of education (there is no accumulation of human capital in Cigno's model); we introduce endogeneity of the wage rate, as well as of the labour supply, and we assume that the transfer to the young is made up of an investment in human capital plus a (subsistence) consumption transfer. By looking at the chain of transfers from this perspective, we will be able to dig out a host of new issues, concerning both the behavior of the family and the design of policy.

This paper thus investigates the scope for intra-family financing of human capital investments in an economy with credit market constraints and where intra-family financing has to be self-enforcing due to the impossibility of writing enforceable loan contracts within the family. To do this we use a simple overlapping generations model in which the population is partitioned into families. The adults finance the education of the family's children; in return the children make a transfer to their parents when they themselves become adults. In effect, to complement the internal transfers to human capital investments each family sets up an internal pay-as-you-go system.

We study the problem at its extreme by assuming that the family members have no altruistic motives nor any other emotional attachments to each other. A middle-aged individual has two obligations towards the family: to support the education of the children and to transfer income to the old family members. We characterize the set of self-enforceable stationary intra-family transfers and show that there is a downward bias in the intra-family provision of human capital when the self-enforceability requirement bites. The intuition for this is that it is not possible to require a middle-aged family member to make a very large transfer since she will then be better off not honoring her obligations.

The intra-family transfers are regulated by an implicit "family norm" – a system of obligations and expectations. This raises the question of who "designs" the norm and if it can ever be "redesigned". We therefore briefly discuss the sustainability of intra-family transfers by considering the notion of a "renegotiation-proof" norm.

If the requirement that intra-family transfers should be self-enforceable generates a downward bias in the intra-family investments in human capital there may be a role for policy. The interesting question is if it is possible to design a policy which relaxes the self-enforceability constraint and increases the sustainable level of intra-family human capital investments; we will show that this indeed the case.

The paper is outlined as follows. Section II outlines the model. Section III determines the limits to cooperation. Section IV discusses the renegotiation problem and also characterizes the constrained efficient outcome. Section V shows how policy can target the incentive problem that arises from the lack of formal contracts. Section VI discusses a number of extension and Section VII concludes.

II The Model

We consider a closed economy with an infinite, discrete time horizon and a population that is partitioned into a large number of identical infinitely lived dynasties. Since each dynasty is small in relation to the rest of the economy they all take wages, interest rates and government policies as given. Each dynasty consists of three generations of members – children, adults and old – and is assumed to be so large that there is no uncertainty about the number of children per adult: each dynasty grows at a constant exogenous rate n, i.e. we take fertility to be exogenous. Let N_t denote the number of adults at time t; then $N_{t+1} = (1 + n) N_t$. The young individuals are assumed to be passive; they simply receive, from the adults, a subsistence consumption transfer $b > 0$ that we assume is enforced by law. Adults on the other hand decide how much to contribute to the financing of the children's education and to the transfers to the old; they also decide how much to work and how much to save. Old individuals simply consume their savings (if they have any) and whatever is transferred to them. In order to highlight the conflicting aspect of the interaction between generations, we make the assumption that the agents are totally selfish. Since utility of a young family member is the fixed utility of the subsistence transfer b, we can ignore it and focus on what each agent consumes as adult and as old; the utility of agent i is therefore written as $\mathcal{U}_i = U\left(x_i^1\right) + U\left(x_i^2\right)$ where x_i^1 and x_i^2 are i's consumption when adult and old respectively and $U(\cdot)$ is increasing and concave.[6]

The environment within which an agent is called to take her economic decisions is described by the government's policy plus the interest rate and the wage rate. The rationale for policy is discussed in Section V. For now, we simply postulate the existence of proportional taxes (subsidies if negative) on labour income, τ, and educational expenditure, σ. The interest rate, r, is assumed to be fixed. This is an innocuous assumption in the current context since, in the equilibria of interest, savings will be zero. In order to generate positive savings, one would need to postulate e.g. a precautionary motive for savings (see Section VI). In that case one could also make the interest rate endogenous so as to allow for general equilibrium effects. The hourly wage for an individual who has received the education level e is $w(e) > 0$ where $w(\cdot)$ is increasing and strictly concave with $w(0) > 0$, $w'(e) \to \infty$ as $e \to 0$ and $w'(e) \to 0$ as $e \to \infty$.

Let l_i denote individual i's labour supply, s_i her private savings, e_i^r her received education, e_i her contribution to the education of the family's children, d_i^r the transfer she receives as old, d_i her contribution to the transfers to the old family members. The agent's life-time utility can then be written as (we will drop subscripts whenever possible)

$$(1) \qquad \mathcal{U} = U\left((1-\tau)\, w(e^r)\, l - s - (1+\sigma)\, e - d - \phi(l) - (1+n)\, b\right) + U\left((1+r)\, s + d^r\right),$$

where $\phi(l)$ is the monetary equivalent of the disutility of labour with $\phi(0) = 0$, $\phi' > 0$ and $\phi'' > 0$. While the transfers e and d are governed by a "family norm" (see below) we will assume that the individual can optimize over labour supply and savings. This assumption is made to keep the description of the family norm as simple as possible. There is, however, no conflict of interest within the family on how savings and labour supply should be chosen; given that agent i has been prescribed by the family norm to transfer e_i and d_i and to receive e_i^r and d_i^r, the savings s_i and the labour supply l_i will affect only agent i's own utility. Hence in order to maximize agent i's utility (and to minimize the risk that she will deviate from the family norm) she should be free to choose her labour supply and savings. The chosen labour supply (which we assume is always "interior") it is uniquely determined by the following first-order condition:

$$(2) \qquad (1-\tau)\, w(e^r) = \phi'(l).$$

Due to the assumed form of the utility function there are no income effects on the labour supply; l depends only on the net wage, $(1-\tau)\, w$.

We will focus on "stationary" (and "symmetric") equilibria – equilibria in which all family members make the same transfers and all contributed transfers are distributed evenly across all (non-deviating) family members. Note that if all agents transfers (e, d) and all transfers are distributed evenly each agent receives the education $e^r = e/(1+n)$ when young and receives the transfer $d^r = (1+n)\,d$ when old. In such a stationary equilibrium the lifetime utility of the representative agent is

$$
\begin{aligned}
(3) \qquad \mathcal{U}(s, l, e, d) \;\equiv\; & U\left((1-\tau)\,w\left(\frac{e}{1+n}\right) l - (1+\sigma)\,e - d - s - \phi(l) - (1+n)\,b\right) + \\
& + U\left((1+r)\,s + (1+n)\,d\right).
\end{aligned}
$$

The lifetime utility $\mathcal{U}(\cdot)$ is assumed to be strictly concave.

III The Limits to Cooperation

The purpose of this section is to characterize the set of allocations that can be achieved in equilibrium. Questions about the incentives to design (and redesign) a norm are thus left aside until the next section.

Due to the overlapping structure of the family it may be possible to sustain cooperation even in the absence of binding contracts. To explore this we consider the role of a family "norm", by which we mean a recommendation for what transfers each family member should make depending on the actions of previous family members. However, since there are no binding contracts, any stable norm will have to be self-enforceable. To capture this we will use the standard non-cooperative *Subgame Perfect Equilibrium* (SPE) concept. A typical family member i takes an action (e_i, d_i) as adult (in addition to choosing labour supply and private savings). A *history* at time t is the collection of all actions made by family members prior to time t. A *strategy for agent* i is a rule for selecting an action at each possible history. A *norm* (or *strategy profile*) is simply a collection of individual strategies, one for each family member. A norm is said to be a SPE if no agent can increase her utility after any history by choosing an action different from that prescribed given that the other family members adhere to the norm.

As usual, the players' equilibrium payoffs are not affected by continuation payoffs following histories to which the equilibrium assigns zero probability. Therefore, in order to determine the limits to cooperation one can make use of strategies where a deviation triggers a switch to continuation equilibrium which is the worst possible for the deviating player (Abreu, 1988). Moreover, the worst possible continuation equilibrium is any continuation equilibrium in which she receives no transfer when old. Since all players adopting the strategy "never transfer anything" is trivially a subgame perfect equilibrium (from any history) which involves no transfers to the old this can then be used to obtain the required characterization.

We can then use a simple trigger strategy, which we following the literature, can refer to as $GRIM\,(e,d)$. This strategy prescribes that agent i should make the transfers (e,d) if everyone has done so in the past; however, if someone in the past has failed to transfer (e,d) then agent i should not make any transfers at all.[7]

Definition 1 $GRIM\,(e,d)$. *Agent i should, as adult, contribute $e_i = e$ to the education of the children and $d_i = d$ to the transfers to the old family members if all family members have done so in the past. However, if someone in the past has failed to transfer (e,d), then agent i should not make any transfers at all, $e_i = d_i = 0$.*

We can now check if all agents adopting $GRIM\,(e,d)$ constitutes an SPE; this requires checking the agents' incentives in two types of subgames: first, in subgames where cooperation is still on-going and, second, where cooperation has broken down. Thus suppose that all agents have adopted $GRIM\,(e,d)$ and that no one has deviated in the past. By transferring (e,d) agent i can achieve the expected utility

$$u\,(e,d) \equiv \max_{s,l}\, \mathcal{U}\,(s,l,e,d)\,. \tag{4}$$

Any other choice of action will trigger a switch to a continuation where all future transfers are cancelled. Clearly, if the agent plans to deviate, her best deviation then involves making no transfers at all; the maximum utility of deviating is therefore (we use the tilde throughout to represent variables and functions pertaining to a deviating agent)

$$\tilde{u}\,(e) \equiv \max_{s,l} \left\{ U\left((1-\tau)\, w \left(\frac{e}{1+n}\right) l - s - \phi\,(l) - (1+n)\, b \right) + U\left((1+r)\, s\right) \right\}. \tag{5}$$

Abiding by the strategy in this type of subgame is a best response if and only if $u(e,d) \geq \tilde{u}\,(e)$. It is therefore useful to define the following set,

$$SE \equiv \{(e,d) \mid u\,(e,d) \geq \tilde{u}\,(e)\}\,. \tag{6}$$

Consider then the second type of subgame. Since the other players have adopted $GRIM\,(e,d)$ agent i does not expect to receive any transfer when old irrespectively of which action she chooses so it is indeed a best response for her not to make any transfers. Hence it follows that all agents adopting $GRIM\,(e,d)$ constitutes a SPE if and only if $(e,d) \in SE$. The significance of using $GRIM$ lies in the fact that it allows us to recover the *entire* set of stationary subgame perfect equilibrium outcomes; in particular, the following more general result holds.

Proposition 1 *There exists a SPE with an equilibrium path along which all agents transfer (e,d) if and only if $(e,d) \in SE$.*

Proof. See the Appendix.

Two simple fact about the set SE can immediately be established. First, zero transfers can always be achieved in an equilibrium. This follows trivially since the "never transfer anything" strategy always constitutes an SPE. Second, and more importantly, positive transfers can only be supported if $n > r$; moreover, in this case a positive education transfer $e > 0$ must be accompanied by a positive transfer to the old, $d > 0$ (else an agent has no reason not to deviate as adult since she is not expecting to receive any transfer as old anyway).

To see the why $n > r$ is necessary for positive transfers to be sustainable, it is useful to define

$$d(e) \equiv \arg\max_{d \geq 0} \; u(e, d) \tag{7}$$

as the optimal old-age transfer. Intra-family transfers represent a way to organize consumption smoothing over the lifecycle which competes with financial savings; $d(e)$ is therefore positive if and only if $n > r$ (zero otherwise) i.e. if the implicit return on intrafamily transfers exceeds the return on financial savings. Since the transfer d does not affect the utility obtained by a deviating agent (see (5)), it follows that conditional on $e > 0$, if any transfer to the old d makes the pair (e, d) self-enforceable $d(e)$ must be such a transfer. Completing the chain of logic it then follows that when $r > n$, $d(e) = 0$ which immediately rules out $e > 0$.

On the other hand, when $n > r$ it is efficient for the family to set up an internal pay-as-you-go system (and, correspondingly, there will be no financial savings). In that case it is also possible to ask the adults to support the education of the children since the threat to cancel any transfer to a deviator (when old) is credible. Indeed for the case of $n > r$ it is interesting to consider the largest self-enforceable education transfer, henceforth denoted $\overline{e}$.

A simple characterisation of $\overline{e}$ can be obtained by noting that the maximum payment by an adult, $(1 + \sigma)\overline{e}$, is completely isomorphic to a standard "compensating variation". To see this more formally, note that since an agent always chooses labour supply optimally, we can start by optimising out l; thus define

$$y(e^r) \equiv \max_l \{(1 - \tau) w(e^r) l - \phi(l) - (1 + n) b\} \tag{8}$$

as the (net-of-labour-disutility) disposable income. Then define the following "indirect utility function",

$$V(y, r) \equiv \max_s \{U(y - s) + U(s(1 + r))\}. \tag{9}$$

The defining property of $\overline{e}$ is that it is the education transfer that makes an agent just willing to abide by the family norm; in other words, at $(e, d) = (\overline{e}, d(\overline{e}))$ an agent is indifferent between cooperating and deviating. This implies the following simple characterisation of $\overline{e}$,

$$V(\overline{y} - (1 + \sigma)\overline{e}, n) = V(\overline{y}, r) \quad \text{with} \quad \overline{y} = y \left(\frac{\overline{e}}{(1 + n)} \right). \tag{10}$$

The first equation (10) in states that an agent is indifferent between cooperating and deviating: by construction the l.h.s. is equal to $u(\overline{e}, d(\overline{e}))$ while the r.h.s. is equal to $\mathbf{u}(e)$; the second equation pins down the associated net income level. The first equation reveals that $(1 + \sigma)\overline{e}$ has the properties of a CV; in particular, $\overline{e}$ is strictly positive whenever $n > r$ and approaches zero as $r \to n$ (from below). The first equation also suggests that $\overline{e}$ is monotonic in n and r; however to guarantee this we have to assume that the income effect on $\overline{e}$ is small: from simple comparative statics it then follows that $\partial\overline{e}/\partial n > 0$ and $\partial\overline{e}/\partial r < 0$.[8]

Summarizing the main results we have found that self-enforceable education transfers can be sustained if and only if $n > r$. Moreover, the largest sustainable education transfer $\overline{e}$ generally increases monotonically in the difference $n - r$.

IV Privately Efficient Transfers

The previous section showed that, as long as $(e, d) \in SE$, it is possible for a family to devise a norm which induces all family members to transfer (e, d). Given that $n > r$ this still leaves a large set of possible outcomes. This raises the question of how to select an equilibrium. A frequently adopted approach (in general games) is to assume that the players can coordinate on a Pareto undominated equilibrium. In line with that approach it is natural to focus on one particular pair of self-enforceable transfers, namely that which maximizes the lifetime utility of the representative family member (denoted (e^*, d^*) below). The practice of restricting the attention to Pareto undominated outcomes however implicitly assumes communication and negotiation among the players. As pointed out by Farrell and Maskin (1989) and Bernheim and Ray (1989) it is questionable to assume that negotiation is possible only at *one* point in time (some fictive date 0); a more satisfactory approach is to assume that the players have the option of renegotiating the continuation at every stage of the game. This led the authors to introduce the concepts of *renegotiation-proofness* and *consistency*. The general idea is that a reasonable equilibrium strategy should have the property that it is never in the players' joint interest to abandon it (in any contingency), i.e. it should be "renegotiation-proof". A second approach, frequently adopted in overlapping-generations games, is to assume the existence of an initial cohort which "designs" the norm; this approach amounts to assuming negotiation only at some fictive date 0 and thus leaves the question open why subsequent generations cannot "redesign" the norm.

While fully adapting the renegotiation-proofness concept to the present context is beyond the scope of the current paper, we must note that selecting (e^*, d^*) as an equilibrium raises some renegotiation-related questions.[9] One source of potential problems can easily be identified: there is an inherent generational conflict that stems from the fact that the current family member are at different stages in their lives and thereby have different preferences over (stationary) intra-family transfers. The old family members care only about the size of the transfer d; similarly, the adults have already received their educational transfers and consider e simply as an expenditure. It therefore follows that if, at some point in time, the currently existing family members are negotiating over the selection of a pair of stationary transfers in the set SE only the children will favour (e^*, d^*) since they are the only ones who still have to go through the whole life-cycle. If renegotiation is possible it is therefore imperative that the children have strong bargaining power in this process. Exactly the same problem is also present if the norm is designed by some (fictitious) first generation of adults; the dynasty founders cannot be expected to select (e^*, d^*) unless their children have the power to veto any other choice.

The underlying problem is closely akin to the famous result by Browning (1975) that voting will lead to a level of public pensions in excess of that which would maximize the lifetime utility of the representative agent. In his case, as well as in ours, the problem is that bargaining power is provided to agents who have already passed through the first stages of their lives.[10]

Having noted these potential renegotiation-related problems, we will proceed by characterizing the set of self-enforceable transfers that maximize the life-time utility for the representative agent, (e^*, d^*). The main result here is that the efficient education transfers e^* coincides with the largest self-enforceable transfer $\overline{e}$ whenever the self-enforceability constraint binds.

Suppose then that $n > r$ so that there exist some strictly positive self-enforceable transfers, and consider the problem of maximizing $u(e, d)$ by choice of $(e, d) \in SE$. The first thing to note about this problem is that the transfer to the old does not affect the utility obtained by a deviating agent. Hence, no matter which education transfer e is chosen, is optimal to choose the transfer $d(e)$, defined in (7), to the old. Note that we are justified in ignoring the self-enforceability constraint here since if, given e, any transfer to the old is self-enforceable, then $d(e)$ is so.

We can therefore focus on the problem of maximizing $u(e, d(e))$ over the education transfer. For simplicity, suppose that the set of self-enforcing education transfers constitutes a closed interval $0 \leq e \leq \overline{e}$. (This simply amounts to assuming that SE does not have disjoint parts.) e^* is then the solution to the simple problem $\max_{0 \leq e \leq \overline{e}} u(e, d(e))$. From concavity of the objective function it follows immediately that the optimal education transfer coincides with the largest self-enforcing transfer, $e^* = \overline{e}$, whenever the self-enforceability constraint binds (and of course, in that case, $d^* = d(\overline{e})$).

In contrast, when the self-enforceability constraint does not bind e^* is determined by a simple marginal condition: in this case e^* is the solution to the unconstrained optimisation problem $\max_e u(e, d(e))$, the first-order condition of which simplifies to

$$(1 - \tau)\, l w' \left(\frac{e}{1 + n} \right) = (1 + n)(1 + \sigma)\,. \tag{11}$$

Recalling that the labour supply only depends on the net wage (11) can indeed be solved for the (unconstrained) optimal education transfer, henceforth denoted e^0.

The lack of commitment may thus cause a downward distortion in the family provision of education. Intuitively an agent can only be asked to contribute to the education of the children by an amount which equals her valuation of obtaining the implicitly higher return on savings offered by intra-family transfer system, n, rather than the market return r; it is therefore natural to conjecture that the intra-family education transfer will be inefficient – the self-enforceability constraint will bite – unless n exceeds r by a sufficient amount. Indeed, since $\overline{e}$ decreases in r while e^0 is independent of r it follows that, for a fixed n, there exists a critical r such that e^0 is self-enforceable if and only if r falls short of the critical level.

For n, things are complicated by the fact that e^0 also depends on n. Applying the envelope theorem to (11) reveals that there are two opposing effects of an increase in n on the unconstrained optimal education transfer e^0. First, as n increases, the amount each adult must transfer to maintain the level of investment per child increases; this tends to increase e^0. On the other hand, as n increases, the effective cost of education increases which tends to reduce e^0. Which effect dominates depends on the properties of the net-income function $y(\cdot)$ defined in (8).[11] If $y(\cdot)$ is not too concave – either because $w(\cdot)$ is moderately concave or because $\phi(\cdot)$ is moderately convex (implying that labour supply is fairly responsive to the wage) – e^0 will be decreasing in n. In this case, for a fixed r, there will exist some critical n such that the self-enforceability constraint will be slack if and only if n exceeds the critical level. This would make the intuitive reasoning from which we started perfectly rigorous: as n falls and gets closer to r, we go from a region where the family behaves efficiently to one in which it behaves inefficiently.

V Education policy

When the families, due to lack of commitment, make inefficiently small investments in human capital there will be a case for policy intervention. Note that there are two sources of inefficiency, the incompleteness of the credit market and the impossibility for the agents to commit to transfers. The primary source is the lack of formal borrowing opportunities for the young: an obvious possibility is therefore that the government aims to relax the borrowing constraints, e.g. by offering subsidies to the young. We will deal informally with this option in Section VI below. Our analysis here will instead be devoted to another option available for the government, namely that of aiming policy at the secondary source of inefficiency – the lack of commitment within the families. This allows us to point out a novel explanation for education policy, i.e. the need to facilitate intrafamily transfers.

We will assume that the family's and the government's objective are perfectly aligned: both aim to maximize the (representative) agent's lifetime utility. This helps us to avoid overstating the case for policy intervention, and to sharpen our focus on the novel role of policy as a remedy to the lack of commitment. In particular, we will postulate that the government has only distortionary instruments at its disposal and we will illustrate how these instruments can be used to alleviate the self-enforceability constraint. Intuitively, it will be desirable to use the instruments so as to reduce selectively the utility for the agents who deviate from the family norm since this indirectly facilitates larger voluntary transfers to education.

It turns out to be useful to formulate the government's problem as if it was choosing – in addition to the policy instruments σ and τ – the intra-family transfers e and d; however, we then have to incorporate as incentive constraints that the transfers are privately optimal, i.e. that $(e,d) = (e^*,d^*)$ as defined in the previous section. Recall that when the self-enforceability constraint is binding the privately optimal transfers (e^*,d^*) are characterized by two conditions: (i) the utility of an agent who abides by the norm is the same as that of a deviating agent, and (ii) the transfer to the old is chosen so as to smooth consumption optimally over time. Thus the following two equations can be included as incentive constraints in the government's problem

$$u(e^*,d^*) = \tilde{u}(e^*); \tag{12}$$

$$d^* = d(e^*). \tag{13}$$

Also, a budget constraint must be satisfied:

$$\tau w \left(\frac{e}{1+n}\right) l + \sigma e = 0. \tag{14}$$

Formally, the government maximizes $u(e,d)$ by choice of e, d, σ and τ subject to (12) through (14). Note however that (13) will be satisfied automatically at the optimum – the government has no reason to distort the choice of d since this cannot help relax the self-enforceability constraint and since marginal changes in d do not affect tax revenue.

Denote then the Lagrange multipliers associated with the two constraints (12) and (14) by λ and μ. By manipulating the first-order conditions for the optimal policy, one obtains a simple rule for the income tax rate

$$-wlU'\left[\tilde{u}^{1}\right] = -\frac{\tau}{1-\tau}\frac{\varepsilon_{l\omega}}{\lambda^*}, \tag{15}$$

where $\varepsilon_{l\omega}$ is the elasticity of labour supply w.r.t. the net wage $\omega = (1-\tau)w$, and where $\lambda^* = \lambda/(\mu w l)$. Noting that the l.h.s. is the direct effect of a marginal increase in τ on the utility of a deviator, we see that this marginal benefit of taxation (i.e. the relaxing of the self-enforceability constraint) should stand in proportion to its cost in terms of distortion of the labour supply. From (15) it is immediately clear that $\tau > 0$ at the optimum whenever the self-enforceability constraint binds ($\lambda^* > 0$). Given that τ is strictly positive at the constrained optimum, it follows from the budget constraint that $\sigma < 0$, i.e. education is optimally subsidized. This makes clear that the value of policy lies in its ability to discourage deviations by hurting selectively the deviating agent, who bears the burden of the labour income tax but does not benefit from the education subsidy (since she is not spending anything on her children's education). So, while the form taken by the policy is quite standard, its motivation is unconventional.

Finally, as regards the impact of policy on the level of education, it is possible to derive the following simple rule:

$$lw' = 1 + n. \tag{16}$$

This rule coincides with the definition of the first-best level (obtained from (11) by setting $\tau = \sigma = 0$). However, since the tax on labour reduces the net wage and thus the labour supply, which in turn reduces the return on investments in education it follows immediately that both the second-best labour supply and education level are below the first-best levels. Summing up for the case where the set of policy tools available to the government includes proportional taxes on labour and education we have:

Proposition 2 *When the self-enforceability constraint is binding, the optimal policy mix consists of a labour income tax, $\tau > 0$, and an education subsidy, $\sigma < 0$; at the optimum, labour supply and education will be below their first-best levels.*

Proof. See the Appendix.

VI Extensions

In this section, we briefly and informally review a number of extensions of the model. First, we discuss the possibility of making fertility endogenous, as in Cigno (1993, 2000). Non-altruistic agents regard children as assets; hence, if other forms of investments are more profitable, parents will want to spend as little as possible on children. If fertility is exogenous, then, the children will receive only the subsistence consumption transfer – assuming, as we do, that it is enforceable by the law – whereas if fertility is endogenous deviating agents would simply decide not to have children. This suggests that, as the extent to which fertility can be controlled increases, the cost of deviating from the family norm becomes lower, i.e. the self-enforceability constraint is tightened; the effect is larger, the larger is the legally enforced subsistence transfer. One can also consider the effect of policy on fertility; note that the policy considered above worked by strengthening the relative attractiveness of using the intra-family transfer system, effectively lowering the cost of making investments in the children. The effect of such a policy on fertility can be expected to be quite different from a policy, e.g. public pensions, which effectively replaces intra-family transactions (see Cigno, 1993).

Second, we could introduce the possibility that the family network collapses for exogenous reasons: e.g. an old agent may become separated from her dynasty, or an adult may die before reaching old-age (as in Rosati, 1996). The main implication of introducing uncertainty is that it may generate financial savings for precautionary reasons. Adding this possibility would leave the main results unchanged; however, in such environments other policy instruments, such as a capital income tax or pay-as-you-go public pensions, could meaningfully be introduced. One can e.g. show that, with precautionary savings, it would be optimal to introduce a positive capital income tax – based on a rule with the same flavour as (15). Intuitively, a capital income tax will hurt a deviating agent more than an agent who stays within the family system since the deviating agent will, as before, naturally choose to save more financially. When uncertainty is added to the economy it can also be shown that it will in general be optimal to introduce a pay-as-you-go pension system when the fertility rate exceeds the (after-tax) rate of return to saving (Aaron's condition – see Aaron,1966). Of course, this is exactly what motivates the existence of the family transfer system; public pensions then yield the same return as the private transfers but have the additional advantage of offering some degree of insurance. On the cost side, public pensions will slow down the accumulation of human capital by crowding out intra-family old-age transfers and thereby making it less costly to deviate from the family norm.

Third, we could assume that the family norm specifies how much an adult should transfer to the children, and that the latter then decide how to spend the transfer on education and consumption – that is, we could make the children active agents in the model. Again, this would not change the analysis apart from minor details (an agent would e.g. not "wait until adulthood" to deviate). A formulation with active children would, however, allow additional policy tools to be considered in a meaningful way. For example, one could consider the possibility for the government to alleviate the credit constraints using lump-sum subsidies targeted directly at the young.[12] It should be noted however, that the immediate effect of any form of public transfer to the children would be to crowd out the transfer from the adults (the family norm is conditional on policy). Therefore, direct subsidisation of children is effective only if the public transfers is larger than the private transfer that would be fixed by the family norm in the absence of policy. By contrast, an educational policy of the form we explored above, being based on the subsidisation of the expenditure borne by the adults, acts by altering the latter's marginal incentives. At a general level, it is difficult to establish whether one of the two policy strategies is more effective than the other.

Fourth, we have assumed a complete absence of altruistic links. We would argue that this is a reasonable working assumption: an extended version of the current model which includes uncertainties would fit observed fact quite well. Empirical evidence e.g. suggests that bequests account for a larger share of total intergenerational transfers than inter-vivos gifts (see e.g. McGarry, 1999), a fact that is hard to reconcile with an assumption of strong altruism: why should benevolent parents postpone transfers as long as they can? In the present model, inter-vivos transfers are considered as "exchanges" rather than "gifts"; furthermore, by introducing realistic uncertainties (about family breakups and about lifetimes) accidental bequests could be generated in the model. The fact that inter-vivos transfers between selfish agents are constrained by the self-enforceability requirement may then explain why they tend to be small relative to bequests. However, if altruism was introduced in the model this would have the immediate effect of alleviating the incentive problem, thus making it less likely that the intrafamily financing of human capital would be inefficient. Indeed, a standard result in the Beckerian tradition of education-as-consumption models is that investments in education are efficient unless the parents are liquidity constrained. In our model, in contrast, educational expenditures may be inefficient quite independently of whether parents are liquidity constrained or not. Relatedly there is no presumption that the policy recommendation which emanates from the education-as-consumption model, i.e. targeting assistance to those likely to face liquidity constraint, will be effective in the current education-as-exchange model.

VII Discussion

We have considered how human capital investments can be financed through transfers between generations within a family when credit markets fail and when there are no formal contracts to enforce intrafamily transactions. The model we considered was in many ways extreme; for one we assumed that the individuals are not at all altruistic – hence parents would be willing to provide the funds their children need only if they expect to get something in return. Similarly, we assumed that there are no other forms of "emotional" links between the family members; in particular, we assumed that the only punishment that could be delivered onto a deviating family member was to deny her any future transfers. However, more generally an individual who misbehaves towards the rest of the family may be subjected to a wider range of "punishments" (exclusion, withheld affections, feelings of guilt etc.). If the "family social capital" is a system of obligations, expectations and sanctions, we have thus adopted a minimalistic approach in which norms and utilities are characterized entirely in terms of income transfers and consumption, ignoring less tangible forms of sanctions.

The main reason for not including family social capital of a less tangible nature is that the size and structure of family social capital can, as pointed out by Coleman (1988), in general not be taken to be exogenous. Indeed, as we have seen, even with our minimalistic approach, there may exists a conflict of interest among current family members as to what constitutes the most desirable family norm. It would be a trivial exercise to include other forms of sanctions and show that this improves the scope for intrafamily financing of human capital investments. However, the more difficult task would be to endogenize such sanctions.

The fact that undertaking this task is difficult does not make it less urgent; indeed, doing so may bring the problem close to a fundamental questions about the effects of welfare state arrangements, namely the question of whether the welfare state weakens family ties. A stylized fact is that large extended families seem to be more frequent in countries where the welfare state is less developed (in Europe think of e.g. Italy, Greece); in contrast, large and generous welfare states are typically associated with small families (thing of e.g. the Nordic countries). The main point is that a large welfare state (broadly defined) reduces the role of the extended family as an economic unit by reducing the importance of informal family systems. In terms of the current problem it is conceivable that certain forms of policy will decrease the return to building and maintaining family social capital which facilitates intrafamily financing of human capital. Conversely, in countries with weak public institutions (say due to inefficient tax collection and/or corruption) there might be a large return to developing such family social capital. Analyzing these important issues however requires a more general approach than the one we have been able to develop in the current paper and hence will be a task for future research.

Appendix

Proof of Proposition 1. Let h^t denote a history a time t. The set of all possible histories at t is denoted H^t. A strategy for agent i is a mapping $\alpha_i : H^{t(i)} \rightarrow R_+^2$ where $t(i)$ is the period in which i is adult. A strategy profile (or norm) is a collection of individual strategies $\alpha = \{\alpha_i\}$.

The fact that all agents adopting $GRIM(e,d)$ constitutes a SPE if $(e,d) \in SE$ immediately implies the existence of an SPE with the required path whenever $(e,d) \in SE$. To see the converse suppose there exists some SPE α with the specific path. We can then show that "all agents adopting $GRIM(e,d)$" will also constitute an SPE (with the same path). Note first that α must prescribe $\alpha_i\left(h^{t(i)}\right) = (e_i, d_i)$ whenever $h^{t(i)}$ contains only the actions (e,d). "All agents adopting $GRIM(e,d)$" therefore agrees with α as long as everyone has chosen (e,d). Let us then verify that all agents adopting $GRIM(e,d)$ is indeed an SPE. Consider first subgames where $(e_j, d_j) \neq (e,d)$ for some j; "all adopting $GRIM(e,d)$" then prescribes that all agents i, $t(i) > t(j)$, should transfer nothing which is trivially a subgame perfect continuation equilibrium (no matter the exact history). Consider then a subgame where $h^{t(i)}$ only contains transfers (e, d). α and "all adopting $GRIM\,(e, d)$" then both prescribe that agent i should choose $(e_i, d_i) = (e, d)$ leading to the same utility, $u\,(e, d)$. Suppose then that agent i can do better than choosing (e, d) when all other players adopt $GRIM\,(e, d)$. Since this will cancel any future transfer to agent i the value of deviating cannot be larger than the value of deviating given α which contradicts that α is a SPE. To complete the proof we need now only recall that if $GRIM\,(e, d)$ constitutes a SPE then $(e, d) \in SE$. ■

Proof of Proposition 2. The proof derives (15) and (16). The government's problem is to choose e, d, τ and σ so as to maximize $u(e, d)$ subject to (12) and (14). The first order conditions are (using the definitions of $u\,(\cdot)$ and $\tilde{x}\,(\cdot)$)

$$\frac{\partial \mathcal{L}}{\partial e} = (1+\lambda)\,U'\left(x^1\right)\left[\frac{(1-\tau)\,w'l}{(1+n)} - (1+\sigma)\right] - \lambda U'\left(\tilde{x}^1\right)\frac{(1-\tau)\,w'l}{(1+n)} +$$

$$+\mu\left[\tau\left(\frac{w'l}{1+n} + w\frac{\partial l}{\partial e}\right) + \sigma\right] = 0; \tag{A1}$$

$$\frac{\partial \mathcal{L}}{\partial d} = (1+\lambda)\left(-U'\left(x^1\right) + (1+n)\,U'\left(x^2\right)\right) = 0; \tag{A2}$$

$$\frac{\partial \mathcal{L}}{\partial \tau} = -wl\left\{(1+\lambda)\,U'\left(x^1\right) - \lambda U'\left(\tilde{x}^1\right)\right\} + \mu wl\left(1 + \frac{\partial l}{\partial \tau}\frac{\tau}{l}\right) = 0; \tag{A3}$$

$$\frac{\partial \mathcal{L}}{\partial \sigma} = -e\,(1+\lambda)\,U'\left(x^1\right) + \mu e = 0, \tag{A4}$$

where we used that $wl = \tilde{w}l$. (Note from (A2) that the constraint (13) is automatically satisfied at the optimum.) Using (A4) to replace $-(1+\lambda)\,U'\left(x^1\right)$ in (A3) yields

$$\lambda U'\left(\tilde{x}^1\right) = -\mu\left(\frac{\partial l}{\partial \tau}\frac{\tau}{l}\right); \tag{A5}$$

then using that $\varepsilon_{l\tau} = -\varepsilon_{l\omega}\tau/(1-\tau)$, (15) follows. Finally, using (A4) and (A5) to simplify (A1) gives

$$\frac{w'l}{(1+n)}\left(1 + (1-\tau)\frac{\tau}{l}\frac{\partial l}{\partial \tau}\right) + \tau w\frac{\partial l}{\partial e} = 1. \tag{A6}$$

But straightforward comparative statics on the labour supply, l, shows that

$$\frac{\partial l}{\partial \tau} = -\frac{w}{(1-\tau)}\frac{(1+n)}{w'}\frac{\partial l}{\partial e}. \tag{A7}$$

Using (A7), (A6) immediately reduces to (16). ■

Notes

[1] Cox (1987), Cox and Rank (1992), Altonji et al. (1992), Cigno and Rosati (1996), Altonji et al. (1997), and Cigno et al. (1998) all give convincing evidence which does not confirm the hypothesis of altruism. We will return briefly to this issue in Section VI.

[2]Nothing of substance would change if one assumed (as some authors do) that educational contributions are given by the parents in exchange for care or attention, rather than in exchange for a money transfer – see e.g. Cigno et al. (1998).

[3]Lillard and Willis (1997), using data from the Malaysia, found evidence consistent with the hypothesis that transfers from parents to children for educational purposes are paid back in parents' old age.

[4]In an influential article, Coleman (1988) provides an interesting sociological perspective on the role of social capital for the intra-family financing of human capital, anticipating many of the issues later discussed in the economic literature.

[5]Kandori (1992) and Smith (1992) took the matter further and demonstrated that "folk theorems" may hold also in repeated games with overlapping generations of players provided that each player is present for sufficiently many periods. By contrast, we will focus on the case where the equivalent of the folk-theorem does not apply, so that the transfers that can be sustained are effectively restricted by the lack of commitment through formal contracts.

[6]To save notation we focus on the case where the agents do not discount the future; adding a discount factor would not qualitatively affect the results.

[7]$GRIM\,(e,d)$ is simple and powerful, but not without problems. If one agent i deviates, then all individuals in i's generation get "punished", and cooperation between future generations is cancelled. An attractive strategy should make sure that a player who is called upon to punish someone else gets rewarded for doing so, else the credibility of the threat may be in question. Furthermore, if cooperation is possible, a reasonable strategy should lead play back to the principal equilibrium path with cooperation after any finite number of deviations. Fortunately, it is possible to devise a SPE strategy with the last two properties without diminishing the set of feasible outcomes – cf. vanDamme (1989); actually, such a strategy is used by Cigno (1993).

[8]The income effect is negligible when the difference $V_y\left(\overline{y}-(1+\sigma)\,\overline{e},n\right)-V_y\left(\overline{y},r\right)$ is small. In this case each price effect is roughly proportional to savings, e.g. $\partial\overline{e}/\partial n \approx d\left(\overline{e}\right)/\left[(1+n)\,(1+\sigma)\right]$.

[9]Cigno (2000) argues that a SPE strategy with the properties outlined in fn. 7 is renegotiation-proof. This is true (in his model as in ours) if we take the so-called weak notion of renegotiation proof, or internal consistency, which requires that the equilibrium strategy does not prescribe a certain continuation when a different continuation, preferred by the current family members, is prescribed at another identical subgame. If one however requires strong renegotiation-proofness, or external consistency, which involves checking for improvements across weakly renegotiation-proof equilibria, the result does no longer hold.

[10]If non-stationary norms can be devised, it is not even clear that the transfers (e^*,d^*) can survive renegotiation. To see this, suppose e.g. that the stationary transfers (e^*,d^*) have prevailed up until time t. At time t all current family members can then agree to permanently reduce the education transfer by some small amount and to permanently increase the transfer to the old to by a certain amount starting from time $t+2$. This gradual move to a new stationary and inefficient set of transfers can improve the utility of the current children (by promising them a future windfall gain) and adults without affecting the utility of the current old. The problem here is that future generations have no bargaining power.

[11]The role played by $y(\cdot)$ is seen by noting that an alternative characterisation of e^0 is $y'\left(e^0/1+n\right) = (1+n)\,(1+\sigma)$ with the associated second-order condition $y''<0$.

[12]Public educational loans could be expected to face the same problem as private loans, that is re-payment's default – see e.g. Monteverde (2000).

References

Aaron, H. (1966), 'The social insurance paradox', Canadian Journal of Economics and Political Science **32**, 371–374.

Abreu, D. (1988), 'On the theory of infinitely repeated games with discounting', Econometrica **56**, 383–396.

Altonji, J. G., Hayashi, F. & Kotlikoff, L. (1992), 'Is the extended family altruistically linked? Direct tests using micro data', American Economic Review **82**, 1177–1198.

Altonji, J. G., Hayashi, F. & Kotlikoff, L. (1997), 'Parental altruism and inter vivos transfers: Theory and evidence', Journal of Political Economy **105**, 1121–1166.

Bahram, V., Boadway, R., Marchand, M. & Pestieau, P. (1995), 'Education and the poverty trap', European Economic Review **39**, 1257–1276.

Balestrino, A. (1997), 'Education policy in a non-altruistic model of intergenerational transfers with endogenous fertility', European Journal of Political Economy **13**, 157–169.

Becker, G. S., Murphy, K. M. & Tamura, R. (1990), 'Human capital, fertility, and economic growth', Journal of Political Economy **98**, S12–S37.

Bernheim, B. D. & Ray, D. (1989), 'Collective dynamic consistency in repeated games', Games and Economic Behavior **1**, 295–326.

Browning, E. K. (1975), 'Why the social security budget is too large in a democratic society', Economic Inquiry **13**, 373–388.

Cigno, A. (1993), 'Intergenerational transfers without altruism: Family, market and state', European Journal of Political Economy **9**, 505–518.

Cigno, A. (2000), Self-enforcing family constitutions: Implications for savings, fertility and social security, in A. Mason & G. Tapinos, eds, 'Sharing the Wealth: Demographic Change and Economic Transfers Between Generations', Oxford University Press, New York.

Cigno, A., Giannelli, G. & Rosati, F. (1998), 'Voluntary transfers among Italian households: altruistic and non-altruistic explanations', Structural Change and Economic Dynamics **4**, 435–453.

Cigno, A. & Rosati, F. (1996), 'Jointly determined saving and fertility behaviour: Theory, and estimates for Germany, Italy, UK and USA', European Economic Review **40**, 1561–1578.

Coleman, J. (1988), 'Social capital in the creation of human capital', American Journal of Sociology **94**, S95–S120.

Cox, D. (1987), 'Motives for private income transfers', Journal of Political Economy **95**, 508–546.

Cox, D. & Rank, M. R. (1992), 'Inter-vivos transfers and intergenerational exchange', Review of Economics and Statistics **74**, 305–314.

Cremer, H., Kessler, D. & Pestieau, P. (1992), 'Intergenerational transfers within the family', European Economic Review **36**, 1–16.

Cremer, J. (1986), 'Cooperation in on-going organizations', Quarterly Journal of Economics **101**, 33–49.

Hammond, P. (1975), Charity: Altruism or cooperative egoism, in E. Phelps, ed., 'Altruism and Economic Theory', Russel Sage Foundation, New York.

Kandori, M. (1992), 'Repeated games played by overlapping generations of players', Review of Economic Studies **59**, 81–92.

Lillard, L. A. & Willis, R. J. (1997), 'Motives for intergenerational transfers: Evidence from Malaysia', Demography **34**, 115–134.

Maskin, E. & Farrell, J. (1989), 'Renegotiation in repeated games', Games and Economic Behavior **1**, 327–360.

McGarry, K. (1999), 'Inter vivos transfers and intended bequests', Journal of Public Economics **73**, 321–351.

Monteverde, K. (2000), 'Managing student loan defauls risk: Evidence from a privately guaranteed portfolio', Research in Higher Education **41**, 331–352.

Rosati, F. C. (1996), 'Social security in a non-altruistic model with uncertainty and endogenous fertility', Journal of Public Economics **60**, 283–294.

Smith, L. (1992), 'Folk theorems in overlapping generations games', Games and Economic Behavior **4**, 426–449.

Stiglitz, J. E. & Weiss, A. (1981), 'Credit rationing in markets with imperfect information', American Economic Review **71**, 393–410.

VanDamme, E. (1989), 'Renegotiation-proof equilibria in repated prisoners' dilemma', Journal of Economic Theory **47**, 206–217.