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## The Strategic Demand for Children: Theory and Implications for Fertility and Migration

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Discussion Paper Series

THE STRATEGIC DEMAND FOR CHILDREN:  
THEORY AND IMPLICATIONS FOR  
FERTILITY AND MIGRATION

by

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#### ABSTRACT

Intra-familial conflict which arises from individual consumption choices in an environment characterized by mutual altruism and direct consumption externalities results in parents receiving from their children less than the desired level of attention. Parents adopt a joint bequest-fertility strategy in order to extract from their children the desired level of attention, producing that number of children which, in conjunction with such a manipulative behavior, results in optimal extraction. Fertility implications are drawn, especially under alternative assumptions about the mortality regime. Predictions of the theory for investment in children's human capital and migration are delineated.

## I. Introduction

Whereas individuals are technically responsible for many basic demographic phenomena, they are often not decisionally accountable for them. A group such as the family or the household may, to various degrees, be the effective decision making unit. It also seems to be the case that a good many demographic phenomena are organized and realized within families rather than ceded to the marketplace. The main implication of these innocuous observations is that in order to understand demographic behaviour there is a need to study intra-group interactions and decisions. As is well known, this task is far from easy. Intra-group conflicts are likely to arise and mechanisms to resolve them may, but need not, evolve. Modelling the conflicts and their resolutions is usually difficult and requires significant adaptation and innovation. An all encompassing satisfactory theory does not exist and the specific nature of the problem, as in our case, often requires a distinct modelling effort. What appears to be particularly interesting is that despite the presence of altruism, conflict appears inevitable when the group at stake is the family. Here bargaining and altruism coexist; they are not mutually exclusive.

Our paper explores the nature of a specific type of intra-familial conflict: That which arises from individual consumption choices in an environment characterized by mutual altruism and

direct consumption externalities. We show that a remarkably simple, yet strong result obtains: Regardless of how much weight one person places on another's well-being, and how much weight the other places on his, if the first enjoys some activity of the second, he will always feel that the second undertakes too little of the activity. An interesting implication is that if parents desire attention from their children, they will always feel neglected! What can parents do to resolve this? We argue that a specific, joint bequest-fertility strategy is the effective device. Parents make and distribute bequests in such a way as to extract from their children the desired level of attention, and produce that number of children which, in conjunction with such manipulative behaviour, results in optimal extraction. Since with respect to provision of the desirable attention, one child is in a natural monopoly position, whereas two or more children need to collude, form a single bargaining unit, or stable coalition, in order to secure a similar position, distinct fertility implications can be drawn. As the presence of another child reduces the bargaining power of a given child with respect to the terms of delivery of such a service, parents have an incentive to bear more than one child. Since an extra child is required to fulfill this diluting role as an adult, high infant and child mortality regimes, when prevalent, call for having and raising a large number of children. In this context, children are thus needed to fulfill two distinct roles: To directly



furnish their parents with desired services and, by eroding the bargaining position of each other, to ensure that such services are supplied and at an "affordable" cost.

In exploring the economic determinants of fertility, we add to a large and still burgeoning literature. Our approach contrasts with that of Becker and Barro (1985), Nerlove, Razin, and Sadka (1984a), and Wildasin (1986), among others, who envision fertility as the consequence of altruism towards children, rather than of selfish interest. Rather, our work is in the tradition of those who have argued that there is a strong "old age security" motive for having children (see e.g. Fawcett et. al. (1974), Arnold et. al. (1975), and Mathew (1975)). We therefore join an active debate concerning the existence and significance of this motive (see, for example, Vlassoff and Vlassoff (1980), Lee and Bulatao (1983), Caldwell (1983), Lindert (1983), Datta and Nugent (1984), Vlassoff (1984), and Nugent (1985)). Unfortunately, previous investigators have spent very little time discussing the theoretical foundations of these motives. One notable exception is Willis (1980, 1982), who assumes that social norms require children to support their parents, and that capital markets, which might offer parents an alternative avenue for carrying resources into old age, are imperfect. Our analysis provides an alternative theoretical foundation, which requires neither the existence of social norms nor capital market imperfections. Furthermore, by fully fleshing

out a theory of the old age security motive, we are able to explore the implications of this motive more completely.

The stage is then set to delineate other predictions. We thus link our analysis with issues of the optimal level of investment in children's human capital vis-à-vis investment in physical assets (the two have different impacts upon children's bargaining power), and with issues of migration (depending on some market features, especially the degree of imperfection of capital markets, enhanced migratory opportunities could weaken or strengthen, in a manner specified below, a parental, bequest-based threat).

## II. Characterizing the Parent-Child Conflict and its Resolution

There are social contexts whereby the actions but not the well-being of one person directly impinge upon the well-being of another and there are other groupings whereby only the well-being of others counts whereas their actions (given levels of well-being) do not. People may not care at all about others yet suffer a great deal from their unpleasant conduct. And people may care about the well-being of others, e.g. so much so as to engage in income transfers to them, but not care directly at all about their actions. The family constitutes a social group where members ordinarily care about each other's well-being and are directly affected by each other's actions. We wish to model this type of interaction and explore its implications.



Consider a family consisting of one parent (labelled  $p$ ), and  $N$  children (labelled  $k=1, \dots, N$ ). The well-being of each agent depends upon consumption choices,  $c^p$  for the parent and  $c^k$  for the  $k^{\text{th}}$  child, as well as upon some specific action or consumption choice,  $a^k$ , taken by each child. For the time being, we will think of  $a^k$  as care or attention provided to the parent by child  $k$ . However, other interpretations are possible, since our formulation simply treats  $a^k$  as an action which produces a direct consumption externality. Throughout this discussion, we will use the following notational conventions:

$$a \equiv (a^1, \dots, a^N)$$

$$c \equiv (c^1, \dots, c^N)$$

We summarize the parent's preferences by a utility function  $u^p(\cdot)$ ; similarly,  $u^k(\cdot)$  reflects the preferences of child  $k$ . Since we assume that the parent and his children are altruistic towards each other, the well-being of each individual will depend upon all choices of consumption and attention. Thus, each of the functions described above takes as its arguments  $c^p$ ,  $c$ , and  $a$ ; any particular values of these variables yield utility levels

$$u^p(c^p, c, a)$$

$$u^k(c^p, c, a) \quad k=1, \dots, N$$

We wish to study the case in which there is both mutual altruism, as well as direct consumption externalities through  $a$  (the parent cares directly about how much attention he receives). This places additional structure on our problem. In particular, we assume that there exist functions  $\psi^P$  and  $\psi^k$ ,  $k=1, \dots, N$ , such that for all values of  $c^P$ ,  $c$ , and  $a$ ,

$$u^P(c^P, c, a) = \psi^P(c^P, a, u^1(c^P, c, a), \dots, u^N(c^P, c, a))$$

and

$$u^k(c^P, c, a) = \psi^k(c^k, a^k, u^P(c^P, c, a))$$

The parent cares directly about his own consumption, attention, and the well-being of each child. Child  $k$  cares directly about his own consumption, the level of attention which he himself provides, and his parent's well-being. Implicitly, we assume that children do not care about each other directly; relaxing this assumption would alter nothing of consequence.

We make three additional assumptions concerning the structure of preferences. These are:

Assumption 1:  $\psi^P$  is increasing and differentiable in all of its arguments.

That is, the parent enjoys consumption and attention, and does not envy his children. Differentiability is a standard technical condition.

Assumption 2:  $\psi^k$  is differentiable, and increasing in  $c^k$  and  $u^p$ .

This is very similar to assumption 1, except that we do not necessarily assume  $\psi^k$  increasing in  $a^k$ . We wish to allow for the possibility that, taking the parent's well-being as fixed, children may dislike providing attention past a certain point.

Assumption 3:  $\sum_{k=1}^N \psi_{u^k}^p \psi_{u^p}^k < 1$ , (where subscripts denote partial derivatives).

This technical condition rules out certain pathologies. Specifically, when it is violated, an exogenous increase in the parent's consumption makes all agents worse off, despite the fact that consumption is a good, and despite the absence of envy. Alternatively, one may think of assumption 3 as a stability condition.<sup>1</sup> It is interesting to note that, for single child families ( $N=1$ ), our central result holds even when assumption 3 is violated.

We now discuss the determination of consumption and attention. The parent possesses an initial endowment of wealth,  $w^p$ . Since the provision of attention requires time and/or resources, we write the financial endowment of each child as a function of attention,  $w^k(a^k)$ . We make the following assumption on  $w^k(\cdot)$ :

Assumption 4:  $w^k(\cdot)$  is differentiable and non-increasing.

Attention involves some financial sacrifice. The parent may also choose to make a transfer,  $b^k$ , to each child  $k$ ; similarly, the  $k^{\text{th}}$  child may wish to make a gift,  $g^k$ , to his parent. Once transfers and attention levels have been determined, consumption is given by

$$c^P = w^P + \sum_{k=1}^N (g^k - b^k)$$

and

$$c^k = w^k(a) + (b^k - g^k)$$

For the moment, let us ignore the determination of transfers and take them as fixed. Given choices of attention and consumption for children other than  $k$ , what will the  $k^{\text{th}}$  child choose? To answer this question, we introduce some new notation. Let

$$c^{-k} = (c^1, \dots, c^{k-1}, c^{k+1}, \dots, c^N)$$

(similarly for  $a^{-k}$ ). For any  $c^k$  and  $c^{-k}$ , let

$$c^{-k}/c^k \equiv (c^1, \dots, c^N)$$

(similarly for  $a^{-k}/a^k$ ). Given  $c^{-k}$  and  $a^{-k}$ , the  $k^{\text{th}}$  child will solve the following problem:

$$\max_{c^k, a^k} u^k(c^P, c^{-k}/c^k, a^{-k}/a^k)$$

subject to  $c^k = w^k(a^k) + (b^k - g^k)$

We will denote the level of attention which solves this problem as  $\hat{a}^k(c^{-k}, a^{-k})$ .

In order to determine the extent of conflict within the family, we wish to compare this solution with the level of attention which the parent would choose for the child, were he able to make that decision himself. That is, the parent wishes that the child would select the solution to

$$\max_{c^k, a^k} u^P(c^P, c^{-k}/c^k, a^{-k}/a^k)$$

subject to  $c^k = w^k(a^k) + (b^k - g^k)$ .

We will use  $\bar{a}^k(c^{-k}, a^{-k})$  to denote the solution to this problem.

We are now prepared to state our central result.

Proposition 1:

For all  $k$ ,  $c^{-k}$ , and  $a^{-k}$   $\bar{a}^k(c^{-k}, a^{-k}) > \hat{a}^k(c^{-k}, a^{-k})$ .

This proposition establishes that the parent always receives less attention than he would like from each child. This is true regardless of how devoted the child is to his parent, or how much

he intrinsically likes to care for his parent. Indeed, the child may attach almost no importance to his own consumption, and may intrinsically enjoy caring for his parent more than the parent enjoys being cared for. We may even be in a regime where the child makes large monetary transfers to his parent.

Nevertheless, the parent will necessarily feel that his child is providing insufficient care and attention. We therefore refer to this result as the Neglected Parent Theorem.

We relegate the proof of Proposition 1 to an appendix. Nevertheless, it is important to gain an intuitive understanding of this result. It is not, as one might think, a consequence of any features of a public good which attention might have with respect to the children. Indeed, the result holds for the case of  $N=1$ . Rather, it is a direct consequence of altruism.

A graphical exposition illuminates the argument (the reader is referred to figure 1). Child  $k$ 's choice problem is standard: he selects the level of attention ( $\hat{a}^k$ ) which allows him to attain the highest indifference curve ( $I^k$ ) which passes through his opportunity set. The parent's tradeoff between  $c^k$  and  $a^k$  depends upon the child's trade-off through  $u^k$ ; however, since he also cares about  $a^k$  directly, his indifference curve through any point is steeper than the child's. Thus, the parent's indifference curve that passes through the child's optimal bundle ( $I^P$ ) lies above  $I^k$  to the left of  $a$ , and below it to the right. The parent's optimal bundle ( $\bar{a}$ ) must therefore lie to the right of



â. It is interesting to note that, while we have drawn everything with the usual convex shapes, convexity plays no role in the argument; indeed, we did not assume it above.

Throughout the preceding discussion we have taken intrafamily transfers as exogenous. In practice, these transfers may play a significant role in ironing out the conflicts described here. Indeed, Becker (1974) has shown that under certain conditions automatic adjustments in the parent's transfers will induce his children to behave in a way which maximizes the parent's well-being. This result is known as the "Rotten Kid Theorem." Unfortunately, it depends upon very restrictive conditions. As shown in Bernheim, Shleifer, and Summers (1985, henceforth BSS), automatic transfers do not ordinarily provide optimal incentives when one relaxes Becker's assumption that utility is linearly transferrable. BSS suggest that, in general, a parent will wish to commit himself to some scheme for dividing resources which, while not necessarily optimal post hoc, will induce his children to behave in a more desirable fashion. In order to explore the potential link between strategic manipulation of children and fertility, it is necessary to study such schemes within the context of the current model.

Henceforth, we will assume that children choose attention levels prior to the determination of transfers, so that it is possible to condition transfers on attention levels, thereby

influencing behavior. We will confine our attention to environments in which gifts flow only from parents to children. Thus, we can represent conditional transfers as a vector-valued function,

$$B(a) \equiv (B^1(a), \dots, B^N(a))$$

which determines  $b \equiv (b^1, \dots, b^N)$  as a function of  $a$ .

Even parents who do not consciously attempt to structure incentives for their children will automatically condition transfers on prior behavior. The "passive" parent will, for each  $a$ , always subsequently choose  $b$  to solve

$$\max_b u^P(w^P - b \cdot e, w(a) + b, a)$$

where

$$w(a) \equiv (w^1(a^1), \dots, w^N(a^N)),$$

and  $e$  is a vector of 1's. The solution to this problem yields an automatic transfer function, which we shall write as  $\hat{B}(a)$ .

Becker's (1974) Rotten Kid Theorem essentially establishes that under very restrictive conditions,  $\hat{B}(a)$  provides children with incentives that are optimal from the parent's point of view. However, BSS argue that more generally, the parent ordinarily wishes to improve upon this incentive scheme by committing himself in advance to some alternative scheme. This may prove difficult. To the extent this other scheme differs from  $\hat{B}(\cdot)$ , the parent may well wish to renege on his announced scheme

following the selection of attention levels, deviating to  $\hat{B}(a)$ . He may credibly bind himself to an alternative scheme only if subsequent defection is costly. Costs of defection may arise from a variety of sources, including 1) the desire to maintain a good reputation with one's children by keeping one's promises, or 2) the fear of subsequent retaliation by one's children.

We model costs of defection as follows: Suppose that the parent announces that he will transfer  $b$  in the event that his children provide attention levels  $a$ ; subsequently, his children select  $a$ , and he makes transfers  $\tilde{b} \neq b$ . The parent then suffers a utility penalty, given by

$$L(b, \tilde{b})$$

We impose one innocuous assumption on this function:

Assumption 5: If

$$u^k(w^p - \tilde{b} \cdot e, w(a) + \tilde{b}, a) \geq u^k(w^p - b \cdot e, w(a) + b, a)$$

for  $k = 1, \dots, N$ , then

$$L(b, \tilde{b}) = 0$$

The parent is not penalized for breaking his promise as long as this breach benefits all of his children.

Given the costs of defection, the parent may credibly commit to transfer  $b$  in the event that children provide attention levels  $a$  as long as for all  $\tilde{b}$ ,

$$u^P(w^P - \tilde{b} \cdot e, w(a) + \tilde{b}, a) - u^P(w^P - b \cdot e, w(a) + b, a) \leq L(b, \tilde{b}) \quad (1)$$

(that is, as long as the costs associated with defection exceed the benefits).

Now suppose that the parent wishes to make transfers  $b_0$ , and to induce his children to provide attention levels  $a_0$ . Supposing that his children will not collude, how should he accomplish this? One way to support  $a$  is to punish deviators as harshly as possible. Clearly, it is possible to induce children to choose  $a$  if and only if these harshest punishments are sufficient to guarantee compliance. (This observation is analogous to Abreu's (1984) insight concerning repeated games). Thus, for each child  $k$ , we define a punishment scheme,

$$B_k(a) \equiv (B_k^1(a), \dots, B_k^N(a)),$$

which, for each  $a$ , is the solution to

$$\min_b u^k(w^P - b \cdot e, w(a) + b, a)$$

subject to (1). Let  $\underline{u}^k(a^{-k})$  denote the highest level of utility which child  $k$  can obtain given the incentive scheme  $B_k(\cdot)$ , when every other child chooses  $a^{-k}$ . This reflects the worst punishment which the parent can credibly threaten to inflict on child  $k$ .

When will the parent be able to obtain  $(a_0, b_0)$  as an outcome of parent-child interaction? Two conditions are clearly

necessary. First,  $b_0$  must be a credible distribution for the parent (i.e. it must satisfy (1) given that the children choose  $a_0$ ). Second, it must be enforceable (i.e. it must generate utility for each child at least equal to the worst punishment for that child,  $\underline{u}^k(a_0^{-k})$ ). These conditions turn out to be sufficient as well. In particular, when they are satisfied, the parent may credibly bind himself to the schedule

$$B_0(a) = \begin{cases} b_0 & \text{when } a = a_0 \\ \underline{B}_k(a) & \text{when } a^j = a_0^j \text{ for all } j < k, \text{ and } a^k \neq a_0^k. \end{cases} \quad (2)$$

This incentive scheme then induces  $a_0$  as a Nash equilibrium among the children.<sup>2</sup>

These observations allow us to represent the parent's problem as follows:

$$\max_{a, b} u^P(w^P - b \cdot e, w(a) + b, a)$$

subject to (1), and to

$$u^k(w^P - b \cdot e, w(a) + b, a) \geq \underline{u}_k(a_0^{-k}) \text{ for each } k. \quad (3)$$

Let  $(\bar{a}, \bar{b})$  denote the solution to this problem. The parent sustains this solution by constructing an incentive scheme as in equation (2).

In the following Section we discuss the manner in which the solution to this problem varies with the number of children, and we explore implications for fertility.

### III. The Derived Demand for Children

Assume that children furnish their parents with a service strongly desired by the latter. Assume further, but relax later on, that close substitutes to the service produced by children are not available. We have demonstrated in Section II that the parent perceives the quantity of this service to be suboptimal. Since through strategic behaviour the parent may extract further service from his children and since success in doing so may depend upon the number of children which he has, child-bearing affects parental well-being in part through the strategically stimulated provision of a desired service. As the possibility of enhancing attention through strategic behaviour raises the benefit of having children, fertility levels may rise.

In the context of our model, high levels of fertility benefit the parent through at least three distinct channels. First, the presence of additional children enhances the parent's ability to punish any particular child. The difference between having one child or two children may be particularly important. Clearly, the parent can extract the most surplus from his children by threatening to "disinherit" them either partially or completely. This is feasible only if he can credibly precommit to some alternative disposition of his resources. Unless this alternative entails redistributing the miscreant child's portion to other beneficiaries for whom the parent cares (and who he



would therefore be reluctant to offend by subsequently reneging), threats of disinheritance will not be credible. Since an only child has a virtual monopoly in supplying attention to his parent, he is therefore difficult to punish effectively. In fact, we prove the following result in the appendix:<sup>3</sup>

Proposition 2: For  $N=1$ ,  $\underline{B}_1 = \hat{B}_1$

Proposition 2 establishes that a parent with one child can only precommit himself to punishments which he would actually prefer to carry out, post hoc.

Of course, this does not mean that the parent cannot influence his child's behavior at all. Aside from the incentives that arise automatically from the passive scheme  $\hat{B}$ , the parent can also credibly offer certain rewards over and above those prescribed by  $\hat{B}$  for certain actions. We illustrate this in figure 2. The axes represent the amount of attention,  $a$ , provided by, and the amount of gifts,  $b$ , given to an only child. The parent's preferences are represented by indifference curves  $(I_1^P, I_2^P, I_3^P)$ . Since his global optimum is interior (he wishes both to make gifts and to receive attention), these curves are nested ellipses.  $\hat{B}(\cdot)$  is given by the locus of points at which these indifference curves are vertical (for a fixed level of  $a$ , the parent's optimal choice of  $b$  is given by the tangency of an indifference curve with the vertical line at  $a$ ). The child's

The second channel through which high levels of fertility benefit the parent concerns the feasibility of collusion among children. The incentive schemes described in Section II effectively induce the desired patterns of behavior only when the parent can count on his children to act competitively. Yet in many cases one might expect the children to collude among themselves. In general, such collusion becomes more difficult to enforce as the number of children rises. By definition, an only child presents the parent with a united front. In contrast, many children may have difficulty reaching an agreement, and the parent may offer large incentives for any one child to defect from that agreement. Thus, we should think of two as a lower bound on the number of children required for effective manipulation.

The third and final channel through which high levels of fertility benefit the parent concerns the costs of obtaining attention. In many circumstances (e.g. children are needed as workers on the family farm), the parent is concerned primarily with the total level of attention extracted from his children. Under standard assumptions (quasiconcavity of  $u^k$ ), the parent must offer each child a larger sum to compensate him for each incremental unit of attention. By spreading his attention requirements over several children, the parent succeeds in purchasing the same total level of attention at lower cost.

Of course, additional children will affect the parent's

well-being in our model even if he chooses to act passively.<sup>4</sup> While the use of strategic incentives raises the parents' total welfare for any fixed number of children, it has an ambiguous effect on the marginal benefit of having additional children, and therefore on fertility. Suppose, for example, that the parent wishes only to achieve a certain target level of total attention. In general, he can accomplish this objective with fewer children when he acts strategically than when he acts passively.

Yet in practice, the effect of strategic behavior on fertility may be clear cut. It is certainly obvious that the marginal benefit of having one child is greater when the parent actively structures incentives than it is when he behaves passively (the marginal benefit of having one child is equal to the total benefit of having one child). Furthermore, in light of proposition 2 it seems likely that the marginal benefit of the second child is also higher when the parent behaves strategically. Indeed, BSS find significant evidence to support the hypothesis that parents use financial incentives to facilitate intrafamily exchange only in families with two or more children. Thus when the desired number of children is low, strategic behavior should unambiguously raise fertility.

At first this conclusion might seem rather unexciting. Certainly, it is important to understand the determinants of fertility when birth rates are high. However, a moment's reflection suggests that high levels of fertility are consistent

with a low derived demand for children. To the extent  $a^k$  represents activities undertaken during the parent's old age (such as running the family farm, or nursing an elderly parent), this derived demand refers to surviving adult children. In societies where child survival probabilities are not too high, there is a great difference between children born and children surviving to adulthood. Although there is nothing new in this observation as such, meshing it with our theory subjects it to a powerful twist.

Suppose then that parents have children primarily to obtain some service from them later in life. We wish to contrast the implications of two distinct views concerning the provision of this service. One view implicitly maintained in most studies examining the old age security motive for bearing and rearing children is that surviving children will automatically confer anticipated benefits.<sup>5</sup> Under this view, it is certainly plausible that one surviving child would be sufficient to provide for the parent's basic needs. The alternative view espoused here is that parents must behave strategically, providing proper incentives in order to procure desired levels of service. Under this alternative view, there is an important additional benefit to having a second child. To the extent that strategic behavior shifts the derived demand for surviving adult children from one to two, it may have profound effects on fertility.

When child mortality is a significant factor, we must think

of child bearing as representing a decision to purchase a certain probability that the desired number of children will survive. Clearly, the effective "price" associated with the purchase of any probability of "success" rises the larger is the number of desired survivors or the lower are the survival probabilities. It will be erroneous to claim that these effects are bound to increase fertility since the income effects could be so powerful as to constrict the demand for children.

We can obtain some insight into likely magnitudes by considering two extreme cases. In the first, survival probabilities are independent of the number of children; we justify this by assuming that the cost of an incremental child is constant. In the second, we assume that total expenditures on children are fixed, but that, accordingly, survival probabilities decline with the total number of children. We will see that these two formulations have very different implications.

Suppose first that both the marginal cost of children and survival probabilities are fixed. If the probability that a single child survives is  $p$ , then the probability that  $n$  or more out of  $N$  survive is given by

$$\pi_n(N) \equiv 1 - B(p, N, n-1)$$

where  $B(p, N, n-1)$  is the CDF for a Bernoulli distribution with  $N$  trials and probability  $p$  of success. Suppose that under "success" (at least  $n$  children survive), the parent's payoff is



$U^S$ , and that under "failure" (less than  $n$  survive), the parent's payoff is  $U^f$ . Also assume that the cost of childbearing,  $C$ , enters linearly. Then the parents utility is given by

$$U^P = \pi_n(N)U^S + (1 - \pi_n(N))U^f - N C.$$

The parent's utility is maximized when

$$\pi'_n(N) = \frac{C}{U^S - U^f} \equiv \gamma.$$

Perhaps surprisingly, it is not always true that for  $n = 2$ , the solution,  $N_2^*$ , will be larger than  $N_1^*$ , the solution for  $n = 1$ . What matters is the relative magnitudes of the marginal probabilities  $\pi'_2(N)$  and  $\pi'_1(N)$ ; however, their difference cannot in general be signed.<sup>6</sup> We turn instead to some illustrative numbers.

Tables 1 and 2 present values of  $\pi_1(N)$  and  $\pi_2(N)$  for values of  $N$  between 1 and 10. Incremental gains in probability of success from additional childbearing are calculated by taking the difference between consecutive numbers in the same row.

To use Tables 1 and 2 we must have some information about  $\gamma$ . Unfortunately, none is available. In Table 3 we calculate the optimal number of children,  $N_1^*$  and  $N_2^*$ , for a variety of values for  $\gamma$ , ranging from .01 (a 1% increase in the probability of success is required to justify an additional child) to .10 (a 10% increase is required).

The striking feature of Table 1 is that in almost all cells



(except for some rather high survival probabilities)  $N_2^*$  exceeds  $N_1^*$  by 2 or more (typically by 2). Thus, even when survival probabilities are well over 50%, the desire for one additional surviving child may add two or more children per family.

The figures become still more striking when we account for sexual differences. In many underdeveloped and developed countries there is a strong preference for male children. Since it is often the case that women live with their husbands' families, this is consistent with our theory of children as providers of services.

If we take into account preferences for males, then Table 3 should be interpreted as optimal stopping rules (the parent continues to have children until he has reached  $N_1^*$  or  $N_2^*$  sons). As a result, family size is stochastic. It is relatively straightforward, however, to calculate average family size when a particular stopping rule is employed. Calculated values are presented in Table 4. We have assumed here that the maximum feasible number of children is 10; varying this limit by one or two in either direction does not substantially change the qualitative results.

Combining Tables 3 and 4 produces rather striking results. Suppose that the single child survival probability is .75, and that  $\gamma = .05$  or  $.10$ .<sup>7</sup> Stopping rules are  $N_1^* = 2$  and  $N_2^* = 4$ , and the average number of children is 3.977 and 7.523 for the cases of 1 and 2 desired surviving males, respectively. Thus, the

desire for a single additional surviving male may raise average number of children by as much as 3.5 children! Other parameters values yield similar conclusions.

If valid, these conclusions underscore the well recognized importance of raising survival probabilities as a step toward lowering fertility. For example, if  $\gamma = .10$  and  $p$  rises from .75 to .95, the average number of children falls from 3.977 to 1.998 (approximately 2 children) if one surviving male is desired, and from 7.523 to 3.977 (approximately 3.5 children) if two surviving males are desired. Thus, the returns to health care and improved nutrition programs appear even greater in light of our theory.

Consider now a second model of childbearing, representing the opposite extreme. We assume that the total amount spent on children is fixed. Consequently, survival probabilities will decline with family size. Families will continue to have more children until the marginal probability of success falls to 0.

In this case, we model the single child survival probabilities as  $p(N)$ , with  $p'(N) < 0$ , and define as before

$$\pi_n(N) = 1 - B(p(N), N, n-1)$$

We will treat  $N$  as continuous, and assume that  $\pi_n''(N) < 0$  (the success function is concave). Let

$$\bar{N}_i = \arg \max_N \pi_i(N)$$

for  $i = 1, 2$ . That is  $\bar{N}_1$  and  $\bar{N}_2$  represent the optimal number of children where 1 or 2 surviving males is desired, respectively.

In this case, the theory yields an unambiguous prediction. As shown in the appendix, we have:

Proposition 3:  $\bar{N}_1 < \bar{N}_2$ .

Despite the fact that the theory yields an unambiguous prediction for this case, plausible magnitudes of the effect are not large. Suppose, for example, that

$$p(N) = 1.0 - \beta N$$

(so that a single child will survive with probability  $1 - \beta$ ). By consulting Tables 1 and 2, we calculate that for  $\beta = .05$ , we have  $\bar{N}_1 = 7$  and  $\bar{N}_2 = 8$ . For  $\beta = .10$ , we have  $\bar{N}_1 = 4$  and  $\bar{N}_2 = 4$ . Thus, much smaller effects on family size are predicted by in this case.

Let us now remove the assumption that close substitutes to the services produced by children are not available. There are two close yet distinct contexts where such a relaxation is appropriate. First, that at least some such services are provided in the market place. Second, that although markets are deficient in catering to specific services, they become less so over time. Economic and social development may facilitate market provision of more services and of services which are more specific and special. Take the first context first. Even if markets are efficient, parents will ordinarily be able to "purchase" some attention from a child at a lower price than from

the market. This is because children will automatically provide attention up to the point at which they are indifferent towards marginal changes in their levels of provision. In contrast, unrelated third parties are not indifferent towards provision of services to the parent. Thus, the parent minimizes his procurement costs by first purchasing services from his children, up to the point where the marginal cost of influencing children to provide another unit of service equals its market price. Additional units should be purchased on the market. Hence, the child-service provision motive for bearing and rearing children need not disappear even if markets in services are perfectly efficient.

If markets are deficient yet become less so over time, the child-service provision motive is bound to undergo erosion. The broad implication is similar to that offered by other theories which account for and link negatively fertility and economic development, but the reasoning is different. The need to rely upon children to supply all the necessary care is weakened and the benefits from manipulation, measured by the terms of such a supply, are diminished. The demand for children will thus diminish.<sup>8</sup> However, this diminution should not be expected to go all the way through, or to cease randomly at various fertility levels, since the marginal manipulative gain associated with having the second child is large. Could this constitute a reason why in many and diverse developed societies the modal number of

children is two? We pose this question speculatively; clearly, further tests of the theory must be made before such strong conclusions are warranted.

#### IV. Other Implications

Allowing for strategic considerations invites additional implications. Parents will behave strategically not only when deciding on how many children to have and how to condition bequests to them upon their behaviour, but also when deciding how to invest in them so as to manipulate their future conduct. As mentioned earlier, most studies of the old age security motive for bearing and rearing children surprisingly assume that children will automatically confer the anticipated benefits. Yet once this assumption is eliminated, quite divergent prescriptions and predictions follow. With automatic transfers, parents find it advantageous to engage in all sorts of transactions which are expected to enhance the capacity of their children to so behave. With discretionary transfers, parents will find it advantageous to engage in acts expected to enhance the will of their children to confer benefits, that is, in acts enhancing their bargaining power vis-à-vis that of their children. And if the will to deliver parental support is negatively correlated with the capacity to do so, parental investment in furthering such a capacity will be constrained. Thus, for example, transfers prior



to death under the first scenario can be expected to be high, under the latter scenario, low.<sup>9</sup> Furthermore, the composition of parental investment will also be affected. With automatic transfers, investment in children's human capital will be higher and in physical capital lower than with discretionary transfers. Although in both cases parental human capital expenditures on children enhance the capacity of children to make transfers, in the latter case such investment, by strengthening children's bargaining power, could further weaken their willingness to furnish the parents with old age support or increase the parental cost in terms of concessions, etc. associated with ensuring or extracting a given support. (When transfers are discretionary, the net marginal yield to investment in children's education, etc., is lower than when transfers are automatic; hence less of it will be undertaken.) Unless children are the sole means of transferring consumption from the present to the future, that is, if some alternative means for a transfer such as a well-functioning capital market exists, parents will tend to rely more on returns from other investments and less on transfers from their own children. Clearly, this would also affect the asset demand for children and the very decision to have them.

Finally, we turn our attention to the intersection of the manipulative demand for children with migration possibilities for children. We illustrate several of the interesting implications which arise here by considering migration within and from LDCs.



On the whole, parents may favor migration by their children when migration opportunities prevail. As migrants, children may raise the mean per capita family income and reduce the uncertainty of per capita family income. To a considerable extent, the labour market success of children as migrants may depend upon the flow of resources from their parents to them, e.g. remittances (actual, promise of remittances as a form of insurance in adverse circumstances), provision of information (contacts) etc. Often, parents at home control the access of their children to the urban kinship network and finance training and additional education of their children in the urban area. In view of our argument above, it need not be the case that the parental interests would be served best by a child's enjoying the maximal degree of success since this could render him immune to manipulation. Put somewhat differently, the parents need to support success but also to preserve an appropriate incentive structure. This might entail a desire to see to it that the migrant's job pays only reasonably well and that it is only moderately secure. If the job pays too well, the migrant may save considerably and reduce his dependence upon parental wealth too much. Of course, if the job pays very badly or is very insecure, the parents may be required to continue supporting the migrant for too long, an outcome which the parents will also regard as unfavourable. That parental strategic considerations back in the sending areas impinge on the degree of labour market success of migrant children is a novel

hypothesis which might be worth exploring further.

The choice of migration destination might be affected in a similar fashion. Parents may find it optimal to have their children migrate to distinct labour markets. Although such a scattering might counter efficiency considerations associated with scale economies, utilization of established information networks etc., it may be preferred to children's concentrating in a single labour market as it reduces children's capacity to collude against parental manipulation. Hence, the diversification of income earning sources benefit may not be the sole reason for the placement of migrant children in different markets. Remittance and manipulation considerations may explain why in the case of Mexican villages in the Patzcuaro region of the state of Michoacán (Stark, Taylor and Yitzhaki (1986)), several households have both internal migrants and Mexico-to-US migrants.

Another implication relates to the choice of a migrant among children. Institutional and cultural factors along with endogenous familial ones might condition differential susceptibilities to manipulation by different children, e.g., of sons versus daughters. Since the parents will attach a value not only to the earning power of their children as migrants but also to their manipulability, the child chosen as migrant need not be the one whose earning power is maximal. Perhaps this is a reason why in some countries migration is male (sons) selective whereas

in others, e.g. the Philippines, Latin America, it is female (daughters) selective. A similar consideration impinges on the targeting of the human capital investment. Parents who realize that having their children experience a reasonable degree of success in the urban economy requires equipping them with human capital may nonetheless need to make a choice between investing a relatively large amount of human capital in, say, one child or a smaller amount per child across several children. The latter option might remove the threat that too much earning power will be placed in the hands of one child, exposing him to too little manipulation. If efficiency considerations call for concentrating human capital investment in the hands of one migrant child, i.e. if the returns to the human capital investment are convex, manipulation considerations support an alternative allocation; if the returns are concave, the manipulation consideration reinforces an efficiency derived consideration advocating a spread.

## FOOTNOTES

1. Suppose there is an exogenous rise in  $c^P$ . Envision the following iterative process for the adjustment of utility levels. Additional consumption directly raises the parent's utility, which creates a "first round" increase in the utility of his children. This produces a "second round" benefit to the parent, which in turn produces a second round benefit to the children, etc. This process is locally stable if and only if assumption 3 is satisfied.
2. Indeed, under relatively weak conditions,  $a_0$  is the only Nash equilibrium for the children, given this incentive scheme.
3. Bernheim, Shleifer, and Summers (1985) assume that the parent of an only child cannot precommit to incentive schemes, and justify their assumption on the basis of the kind of intuition given here. Proposition 2 formally establishes that this assumption is valid in an explicit model of precommitment.
4. If support from one child does not significantly affect support from another, increased fertility will tend to benefit the parent. On the other hand, if children tend to view support of their common parent as a public good, children in large families may tend to shirk this responsibility. Increased fertility might then benefit the

parent very little, if at all.

5. Even sophisticated models such as those of Neher (1971) and Nerlove, Razin, and Sadka (1984b) adopt such a perspective.
6.  $\pi_1(N) - \pi_2(N) = \text{Prob (one success in } N \text{ trials)}$ . This need not be monotone in  $N$ .
7. Note that we must adjust our interpretation of  $\gamma$  to reflect the fact that only male children confer a benefit in this model.
8. Indeed, many studies, including Hohm (1975), Entwisle and Bollen (1984), Entwisle and Winegarden (1984), and Nugent and Gillaspy (1983) provide evidence suggesting that social security programs tend to depress fertility.
9. Societies differ in the degree of parental control, norms, etc., which govern the support children furnish their parents and also in the extent to which commitments to provide such support are reinforced by social sanctions. This could account for the variance characterizing the pattern and timing of bequests of physical capital.

## APPENDIX

Proof of Proposition 1: Without loss of generality, take  $k = 1$ . We will use  $\bar{a}^1$  and  $\hat{a}^1$  as shorthand for  $\bar{a}^1 (c^{-1}, a^{-1})$  and  $\hat{a}^1 (c^{-1}, a^{-1})$ , respectively. Let  $\bar{u}^p, \bar{u}^j$  be the utility levels associated with  $\bar{a}^1$ , and let  $\hat{u}^p, \hat{u}^j$  be the utility levels associated with  $\hat{a}^1$ . We know that

$$\bar{u}^1 \leq \hat{u}^1, \text{ and} \quad (\text{A.1})$$

$$\bar{u}^p \geq \hat{u}^p \quad (\text{A.2})$$

Now assume that

$$\bar{a}^1 < a^1 \quad (\text{A.3})$$

Then

$$\begin{aligned} \bar{u}^p &= \psi^p (c^p, \bar{a}^1, a^{-1}, \bar{u}^1, \psi^2 (c^2, a^2, \bar{u}^p), \dots, \psi^N (c^N, a^N, \bar{u}^p)) \\ &< \psi^p (c^p, \hat{a}^1, a^{-1}, \hat{u}^1, \psi^2 (c^2, a^2, \bar{u}^p), \dots, \psi^N (c^N, a^N, \bar{u}^p)) \\ &< \psi^p (c^p, a^1, \hat{a}^{-1}, \hat{u}^1, \psi^2 (c^2, a^2, \hat{u}^p), \dots, \psi^N (c^N, a^N, \hat{u}^N)) \\ &+ (\bar{u}^p - \hat{u}^p) \\ &= \hat{u}^p + (\bar{u}^p - \hat{u}^p) = \bar{u}^p, \end{aligned}$$

which is a contradiction (the first line is definitional; the second follows from assumption 1, (A.1), and (A.3); the third follows assumption 3, combined with (A.2) and the fact that the relevant functions are increasing; the fourth is definitional).



Now we rule out the case of equality. Differentiation reveals that

$$\frac{du^p}{da^1} = \psi_{a^1}^p + \psi_{u^1}^p \cdot \frac{du^1}{da^1} + \sum_{k=2}^N \psi_{u^k}^p \psi_{u^p}^k \frac{du^p}{da^1}$$

Solving,

$$\frac{du^p}{da^1} = \frac{\psi_2^p + \psi_{u^1}^p \cdot \frac{du^1}{da^1}}{1 - \sum_{k=2}^N \psi_{u^k}^p \psi_{u^p}^k}$$

By assumption 3, the denominator is strictly positive. Thus, when  $du^1/da^1 = 0$  (which must be satisfied at  $\hat{a}^1$ ), we have  $du^p/da^1 > 0$ , so  $\bar{a}^1 \neq \hat{a}^1$ .

Q.E.D.

Proof of Proposition 2: Suppose  $B_1(a) \neq \hat{B}_1(a)$  for some  $a$ . Then

$$\begin{aligned} & u^p(w^p - \hat{B}_1(a), w(a) + \hat{B}_1(a), a) \\ & > u^p(w^p - B_1(a), w(a) + B_1(a), a). \end{aligned} \tag{A.4}$$

Further, by definition of  $B_1(a)$ ,

$$\begin{aligned} & u^1(w^p - \hat{B}_1(a), w(a) + \hat{B}_1(a), a) \\ & > u^1(w^p - B_1(a), w(a) + B_1(a), a) \end{aligned}$$

But then, by assumption 5,

$$L(B_1(a), \hat{B}_1(a)) = 0 \tag{A.5}$$

Combining (A.4) and (A.5) gives us

$$u^P(w^P - \hat{B}_1(a), w(a) + \hat{B}_1(a), a) - u^P(w^P - \underline{B}_1(a), w(a) + \underline{B}_1(a), a) \\ > L(\underline{B}_1(a), \hat{B}_1(a)),$$

which violates constraint (1). Thus, we have a contradiction.

Q.E.D.

Proof of Proposition 3: Since  $B(p(N), N, 0) = (1 - p(N))^N$ , then

$$\partial (1 - p(N))^N / \partial N \Big|_{\bar{N}_1} = (1 - p(\bar{N}_1))^{\bar{N}_1} [\log(1 - p(\bar{N}_1)) \\ - \bar{N}_1 p'(\bar{N}_1) / (1 - p(\bar{N}_1))] = 0$$

Now

$$\pi_1(N) - \pi_2(N) = Np(N)(1 - p(N))^{N-1}$$

so

$$\pi_2'(\bar{N}_1) = - \frac{\partial (Np(N)(1 - p(N))^{N-1})}{\partial N} \Big|_{\bar{N}_1} \\ = - \frac{\partial}{\partial N} \left( \frac{Np(N)}{1 - p(N)} (1 - p(N))^N \right) \Big|_{\bar{N}_1} \\ = - (1 - p(\bar{N}_1))^{\bar{N}_1 - 1} p(\bar{N}_1) \left[ 1 + \frac{\bar{N}_1 p'(\bar{N}_1)}{p(\bar{N}_1)} + \frac{\bar{N}_1 p'(\bar{N}_1)}{1 - p(\bar{N}_1)} \right].$$

Using the first order condition  $\pi'_1(\bar{N}_1) = 0$ , we have

$$= - (1-p(\bar{N}_1))^{\bar{N}_1} \frac{1}{p(\bar{N}_1)} [1 + \log (1-p(\bar{N}_1))/p(\bar{N}_1)]$$

But since  $\log (1 - \eta) < -\eta$  for all  $\eta > 0$ , we have that this expression is positive, i.e.,  $\bar{N}_2$  satisfying  $\pi'_2(\bar{N}_2) = 0$  is strictly greater than  $\bar{N}_1$ .

Q.E.D.

Table 1

Probabilities of Success When A Single Child is Desired

N

P	1	2	3	4	5	6	7	8	9	10
0.500	0.500	0.75000	0.87500	0.93750	0.96875	0.98437	0.99219	0.99609	0.99805	0.99902
0.550	0.550	0.79750	0.90887	0.95899	0.98155	0.99170	0.99626	0.99832	0.99924	0.99966
0.600	0.600	0.84000	0.93600	0.97440	0.98976	0.99500	0.99836	0.99934	0.99974	0.99989
0.650	0.650	0.87750	0.95712	0.98499	0.99475	0.99816	0.99936	0.99977	0.99992	0.99997
0.700	0.700	0.91000	0.97300	0.99190	0.99757	0.99927	0.99978	0.99993	0.99998	0.99999
0.750	0.750	0.93750	0.98437	0.99609	0.99902	0.99975	0.99994	0.99998	0.99999	1.00000
0.800	0.800	0.96000	0.99200	0.99840	0.99968	0.99994	0.99999	1.00000	1.00000	1.00000
0.850	0.850	0.97750	0.99662	0.99949	0.99992	0.99999	1.00000	1.00000	1.00000	1.00000
0.900	0.900	0.99000	0.99900	0.99990	0.99999	1.00000	1.00000	1.00000	1.00000	1.00000
0.950	0.950	0.99750	0.99987	0.99999	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000
1.000	1.000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000

Table 2

Probabilities of Success When Two Children are Desired

N

P	1	2	3	4	5	6	7	8	9	10
0.500	0.0	0.25000	0.50000	0.68750	0.81250	0.89062	0.93750	0.96484	0.98047	0.98926
0.550	0.0	0.30250	0.57175	0.75852	0.86878	0.93080	0.96429	0.98188	0.99092	0.99550
0.600	0.0	0.36000	0.64800	0.82080	0.91296	0.95904	0.98116	0.99148	0.99620	0.99832
0.650	0.0	0.42250	0.71825	0.87352	0.94598	0.97768	0.99099	0.99643	0.99860	0.99946
0.700	0.0	0.49000	0.78400	0.91630	0.96922	0.98906	0.99621	0.99871	0.99957	0.99985
0.750	0.0	0.56250	0.84375	0.94922	0.98437	0.99536	0.99866	0.99962	0.99989	0.99997
0.800	0.0	0.64000	0.89600	0.97280	0.99328	0.99840	0.99963	0.99991	0.99998	0.99999
0.850	0.0	0.72250	0.93925	0.98802	0.99777	0.99960	0.99993	0.99999	1.00000	1.00000
0.900	0.0	0.81000	0.97200	0.99630	0.99954	0.99994	0.99999	1.00000	1.00000	1.00000
0.950	0.0	0.90250	0.99275	0.99952	0.99997	1.00000	1.00000	1.00000	1.00000	1.00000
1.000	0.0	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000

Table 3  
Optimum Number of Children

p	$\gamma$							
	<u>.01</u>		<u>.02</u>		<u>.03</u>		<u>.04</u>	
	$N_1^*$	$N_2^*$	$N_1^*$	$N_2^*$	$N_1^*$	$N_2^*$	$N_1^*$	$N_2^*$
0.95	2	3	2	3	1	3	1	2
0.9	2	4	2	4	2	3	1	3
0.85	3	4	2	4	2	3	2	3
0.8	3	5	3	5	2	4	2	3
0.75	4	6	3	5	2	4	2	4
0.7	4	6	3	5	3	5	2	4
0.65	4	7	4	6	3	5	2	4
0.6	5	8	4	7	3	5	2	4
0.55	6	8	5	7	4	6	3	5
0.5	6	9	5	8	4	6	3	5



Table 4Average Family Sizes with Various Stopping Rules

Required Number of Males	Average Family Size
1	1.998
2	3.977
3	5.867
4	7.523
5	8.770
6	9.523
7	9.867
8	9.977
9	9.998
10	10.000

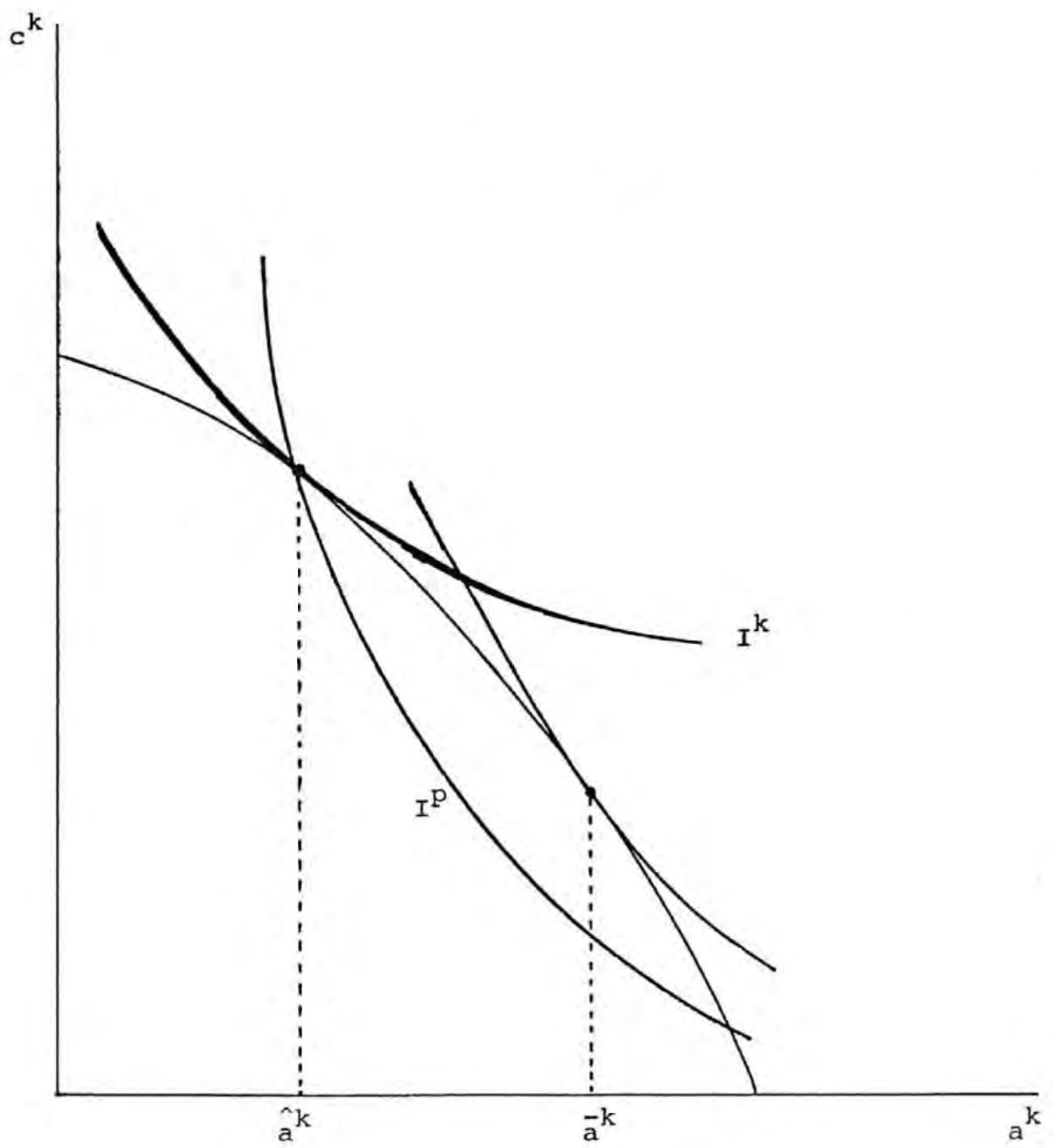


Figure 1

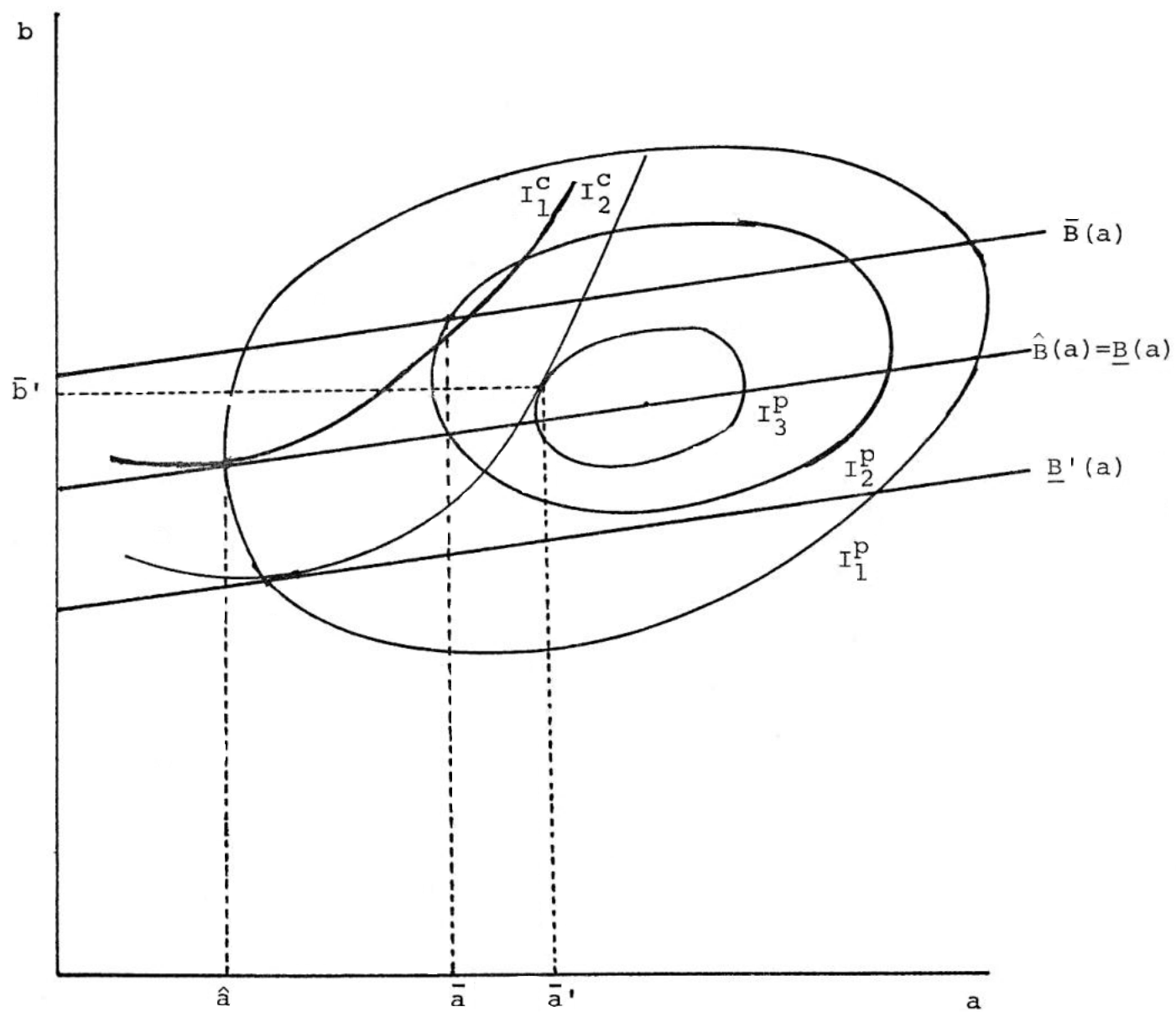


Figure 2

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