Why do Indian children work, and is it bad for them?

Alessandro Cigno* and Furio C. Rosati**

*University of Florence

**University of Rome "Tor Vergata"*

July 11, 2001

Abstract

The causes and consequences of child labour are examined theoretically and empirically within a household decision framework, with endogenous fertility and mortality. The data come from a nationally representative survey of Indian rural households. The complex interactions uncovered by the analysis suggest that mere prohibition of child labour, or the imposition of school attendance, could make things worse, and would be difficult to enforce. Beneficially reducing child labour requires changing the economic environment to which the work of children constitutes, in the great majority of cases, the rational response. Suitable policies include reductions in the cost of attending school, and public health improvements. The effects of these policies go far beyond direct impacts. Health policies have favourable indirect repercussions on the school attendance, demand for educational material, and labour participation of children. Educational policies have favourable indirect repercussions on the nutritional status of children. Both types of policy discourage fertility. Income re-distribution may be helpful, but land re-distribution could be counterproductive.

JEL: J22 *Keywords*: child labour, education, fertility, mortality, anthropometry

*Furio Camillo Rosati, Via San Nemesio 1, 00145 Roma (Italy) Tel. +390651602500 Fax +39062020500, email: f.rosati@agora.stm.it

1 Introduction

Child labour is an emotive subject. Especially where very young children are concerned, it evokes images of maltreatment and exploitation. Such cases do exist and call for repressive measures, but there is not a great deal that the economist can say on the subject (beyond pointing to a possible trade-off between severity of the sanction and probability of detection). Quantitatively more important, and within the scope of economic analysis, are the cases where child labour is not the result of criminal intent, but a well-meaning response to material poverty. It may well be argued that, in these cases too, national governments and international agencies should do something to reduce the extent of the phenomenon, but the arguments for intervention have to be the standard ones: either some kind of coordination failure,[1] which justifies public intervention on efficiency grounds, or social preferences such that some form of re-distribution (from parents to children, from rich to poor families, or from rich to poor countries) is deemed desirable. Either way, one has to start with a representation of child labour behaviour, and of how this responds to policy.

Section 2 of the present paper provides an overview of child labour (or, more generally, of child engagement in activities other than study and play) in rural India through a household survey. Section 3 develops a theoretical framework for explaining the allocation of a child's time, and related decisions regarding fertility and the allocation of household budgets. Sections 4 and 5 contain an econometric analysis of the Indian data. Section 6 discusses the empirical findings in the light of the theory, and examines their policy implications.

2 Child work, schooling and welfare in rural India

Our data come from the Human Development of India Survey, carried out by the National Council of Applied Economic Research (NCAER) of New Delhi. This is a multi-purpose, nationally representative sample survey conducted during 1994 in the rural areas of India. A two-stage stratified and partially self-weighting design was used to sample a total of 34,398 households spread over 1,765 villages and 195 districts in 16 states. Two separate survey instruments were devised, one to elicit the economic and income parameters from an adult male member, and the other to collect data on outcomes such as literacy, education, health, morbidity, nutrition, and demographic parameters from the adult female

[1] For an application of the argument to the present context, see Grootaert and Kanbur (1995).

Table 1: Child labour participation (by sector) and school enrolment rates, by sex

Activity	MALE	FEMALE	ALL
Agricultural	5,19	4,49	4,86
Non agricultural	2,29	1,66	1,99
Household	5,27	10,45	7,7
Total participation	12,75	16,6	14,55
School enrolment	71,53	56,94	64,69

members of the household. The data are representative of rural population at the level of all India, according to states and population groups, and according to selected population groups for the selected states.[2]

As shown in the last row of Table 1, school enrolment in India is relatively high. About 65 percent of children in the age range considered attend school, but gender differences are far from negligible. The enrolment rate of males is 15 percentage points above that of females.

The questionnaire divides working children into three non-overlapping categories: working within the home, working in the agricultural sector, working in the non-agricultural sector. Of those working outside the home (nearly 7 percent of the 6-16 age group), about half are reported receiving wages (in money or in kind). We assume that those reported working within the home are either employed in the family (usually farm) business, or perform household chores (including, as a large majority of these children is female, assistance to younger siblings).

Table 1 shows that about 15 percent of children in the 6-16 age group is reported to be engaged in paid or unpaid work. The household is the most common place of child work. While gender differences are not particularly relevant where work performed outside the home is concerned, the participation rate of girls in household work is twice as large as that of boys. There are, therefore, more boys than girls reported as not working. The unbalance reflects partly the fact that more of the boys go to school, but partly also the fact that more of the boys are reported as neither attending school, nor working (more about this later). Since the place of work most frequently reported is the household, leaving this out

[2] Information on child work is obtained merging the "Children" file, relating to children aged 0-12, with information on individuals older than 12 years, contained in the "Individuals" file. Information about household level variables was added by merging the "Reproductive Information" file with the other two.

Table 2: Work/study status of children by sex

	MALE	FEMALE	ALL
Work only	7.9	13.28	10.42
Neither work nor study	20.57	29.78	24.90
Study only	66.7	53.7	60.50
Work and study	4.9	3.3	4.10

would seriously underestimate the work commitment of children, particularly of girls.

Work and study are not mutually exclusive categories, and do not exhaust the list of possibilities. Some children are reported attending school, while at the same time performing some form of paid or unpaid work. Others, as already mentioned, are reported doing apparently nothing (neither attending school, nor working). We created four mutually exclusive and exhaustive categories: work only, study only, work and study, neither work nor study. As Table 5 shows, the majority of children (over 60 percent) studies only. The second largest category (25 percent) is that of children reported as doing nothing. The rest works only (about 10 percent), or attends school and works at the same time (less than 5 percent).

Tables 3 and 4 show the allocation of children to the four work/study categories by household income and age of the child. The probability that a child will work full time falls as income rises (the same is true of the probability that the child will, reportedly, do nothing). Conversely, the probability that a child will study (full or part time) rises with income. The proportion of children working full time rises with age, while that of children working and studying at the same time shows a U-shaped profile. This indicates that children enter the labour force without leaving school, but as they become older the probability that they will only work does increase. The large number of children apparently doing nothing is a puzzle. Not surprisingly, their incidence is highest among 6-year olds, suggesting a mere delay in starting school, but it remains substantial at higher ages (over a quarter at age 15-16). This could mean, as local experts suggest, that a sizeable share of the child population has no opportunity to perform any kind of work, paid or unpaid, and that (perhaps because of that) their parents are too poor to send them to school. But, it could be that at least some or these children are actually working and, for some reason, their parents do not wish it to be known.

Tables 5-6 show how a biometric indicator of nutritional status, body mass (weight divided by height squared), varies with the work/study status of the child. In addition to showing nutritional status,

Table 3: Work/study status of children by income

INCOME GROUP	1	2	3	4	5
Work only	12.24	10.17	7.15	6.02	4.66
Neither work nor study	29.92	22.00	18.03	16.98	13.04
Study only	53.61	63.78	70.92	72.49	78.54
Work and study	4.23	4.05	3.91	4.51	3.77

Table 4: Work/study status of children by age

AGE	6	7	8	9	10	11	12	13	14	15	16
Work only	4.77	3.96	4.98	4.98	7.29	6.66	9.36	12.35	16.02	21.31	30.49
Neither working nor attending school	47.62	27.29	23.78	16.39	20.51	15.31	21.06	20.43	23.24	25.16	26.23
Study only	45.32	65.11	66.43	73.10	67.15	72.69	64.12	63.04	56.44	51.11	41.01
Work and study	2.30	3.64	4.81	5.53	5.05	5.34	5.46	4.19	4.30	2.42	2.28

Table 5: Body mass by age and work/study status (boys)

STATUS/AGE	6	7	8	9	10	11	12
Work only	15.74	15.30	15.02	14.41	15.64	15.39	16.13
Study only	14.87	14.88	15.19	14.99	15.26	15.41	15.54
Work and study	14.50	14.35	14.62	14.70	14.83	15.36	15.53
Neither work nor study	15.20	14.99	15.16	15.39	15.41	15.24	15.91

Table 6: Body mass by age and work/study status (girls)

STATUS/AGE	6	7	8	9	10	11	12
Work only	15.30	15.64	14.79	15.11	15.24	15.04	15.49
Study only	14.82	14.66	14.78	14.71	14.85	15.08	15.63
Work and study	14.77	14.43	15.05	13.95	14.64	15.02	15.43
Neither work nor study	14.80	15.75	14.91	15.09	15.05	15.41	15.40

body mass is a predictor of the child's probability of survival to (and, more generally, health status in) subsequent stages of life.[3] Since the probability of survival (or its complement, the probability of death) is arguably the best synthetic indicator of economic success or failure (Sen, 1995), this anthropometric measurement gives us very valuable information. Looking at the raw data, we cannot say that working children fare worth than children attending school. Working girls up to the age of 10, and working boys up to age 7, have higher body mass than their contemporaries attending school (children working and attending school at the same time fare worst of all). At higher ages, there is no clear pattern. Of course, a child engaged in energetic forms of work is likely to have a higher ratio of muscles to fat,[4] and thus to weigh more, than a non-working contemporary with the same body volume. On the other hand, other things being equal, a working child needs more food to reach any given body volume. It thus seems unlikely that, of two children with the same sex, age and body mass, the one who works will have received less nutrition than the one who does not.

To sum up, the data show that child work is an important phenomenon. How important depends on what we call work: little important if we only count children reported working for a wage or in the family business (7 percent), important (14 percent) if we add those performing household chores, very important (over 39 percent) if we also include those that are reported doing nothing, but which we suspect may be actually working. Working children appear to fare better, in terms of current nutrition and future health, than children who study; but will enter adulthood with a smaller stock of human capital than children who study. Children who study will have more human capital, but probably poorer health, than working children.[5]

[3] See, for example, de Onis and Habicht (1996), Klasen (1996), Waaler (1984). Fogel (1993) argues that weight and height enter separately into the determination of the survival probability, so that the same body-mass ratio could be associated with different survival rates. Indeed, Fogel and Waaler report evidence that the relationship between survival and body mass is U-shaped where adults in developed countries are concerned. Given the age-range we are considering, however, and the fact that practically all the children in our sample are undernourished by western standards, we may reasonably take the relashionship to be monotonic in our case.

[4] Also, a child born with more muscle is more likely to be selected for energetic work activities (Dasgupta, 1997).

[5] While the trade-off between work and study is obviously one-to-one, the trade-off between the outputs of these activities (respectively, current consumption and future human capital or consumption) may be lower. The evidence (*e.g.*, Psacharopoulos, 1997; Patrinos and Psacharopoulos, 1997), however, is somewhat discordant.

3 An explanatory framework

Assuming that infants and children are under the control of parents, any analysis of why a child might work must start with a model of parental decisions. Since the decision of whether or not to send a child to work is closely interrelated with that of whether or not to send the child to school, of how much to spend for the child (and in which way) at various points of the life cycle, and ultimately of how many children to have, all of these must considered within a unified framework. We shall see that, not only the effects of policies directly aimed at improving children's welfare, such as free or subsidized provision of school facilities, but also those of more broadly aimed policies, such as sanitation or preventive medicine, depend on how parental decisions are modified in response to such policies.

The decision problem has the following structure. Children are born at date 1, and reach school age at date 2. At date 1, parents choose the number of births,[6] and decide how much to spend for each pre-school child, under conditions of uncertainty about how many of those children will still be alive at date 2. At date 2, when the number of survivors is known, parents decide how much to spend for each school-age child, and how to allocate the time of these children between work and study.[7]

We examine the issue in the context of two alternative models, one assuming altruism and the other self-interest on the part of parents towards their children. Throughout, we assume that parents control fertility, and condition the survival probability of their children at various points of the life-cycle through expenditure on certain items. Since the model must serve to explain household data on rural India, we allow for the possibility that parents own or rent land.

[6]Strictly speaking, we should be saying that parents-to-be condition the probability distribution of births by choosing frequency of intercourse, use of contraceptive devices, etc. But, the mechanics of fertility determination are not the focus of the present paper. For similar reasons, we do not go into the issue of preference aggregation (or balance of power) between father, mother and other adult family members, but we are aware that the weight of the mother in decision making may rise (and the quality of decisions regarding child welfare may improve) with her education and outside earnings. We shall allow for that in the interpretation of the empirical results.

[7]Given the nature of the data we shall want to explain, it seemed reasonable to assume that the real competition for the use of the child's time is between work and study. Leisure (or playtime) is treated as a residual, something that is done at times of the day, or of the year, when there is nothing else for children to do.

3.1 Altruistic model

Ex post, the utility of parents is given by $U_1 = u_1(a_1) + u_2(a_2) + v(c_2, h, n)$, where a_i and c_i denote, respectively, consumption by adults and consumption by each child at date i $(i = 1, 2)$, h is the human capital of each child, and n the number of children alive at date 2.[8] We are assuming, therefore, that children dying in infancy do not yield utility. The functions $u_i(.)$ and $v(.)$ are assumed to be strictly concave.

The list of goods entering c_i includes food and medical care, but excludes education (which appears as a separate variable). The amount consumed at date i is assumed to have a positive effect on the probability that the child will survive to date $(i+1)$ and, more generally, on his or her current and future health prospects. Since the amount that a person is able to earn, as an adult, is positively related to the person's health and ability (human capital), we may interpret $v(c_2, h, n)$ as the value given by parents to their children's lifetime welfare.

Human capital is determined by $h = h_0 + k(e, x)$, $k(0) \equiv 0$, where $k(.)$ is a constant-returns-to-scale production function, e time spent in education (which includes not only school attendance, but also study outside school hours), x other educational inputs (books, tuition and writing material, but also travel to school), and h_0 a positive constant ("natural talent"). Denoting by z the price of these inputs, and by $w*$ the opportunity-cost (equal to the child wage rate, or to the marginal product of child labour in the family farm, whichever is higher) of time spent in education, and normalizing to unity the total amount of time available to each child for work and study, the "price" (marginal cost) of human capital is

$$q(h, w*, z) \equiv \min(ew * + xz) \text{ s.t. } k(e, x) \geq h - h_0, \; e \leq 1. \quad (1)$$

The cost to parents of providing each of their n children with an extra unit of human capital is nq. The function q is obviously increasing and concave in $(w*, z)$. The relationship with h is shown in Fig.2. As h rises, q remains constant up to the point where the child's time if fully employed in education, because each unit of human capital is then produced with the same cost-minimizing combination of e and x. From that point onward, q increases with h, as more and more x has to be used in conjunction with a fixed e. This is illustrated in Fig.1, where the curves are isoquants, and the vertical line through points

[8] Since time spent in education reduces time spent working hour-for-hour, the marginal rate of substitution of h for c_2 may reflect not only willingness to trade present for future consumption, but also physical complementarity between work and food consumption.

E and F represents the constraint that the time spent in education cannot exceed the endowment. For any given $\frac{w*}{z}$, the production of human capital expands along a given isocline, *e.g.* the one through point F, until the time endowment is fully used ($e = 1$). Beyond that point, h can only be increased, at rising marginal cost, by moving on to steeper isoclines (*e.g.*, the one through point E).

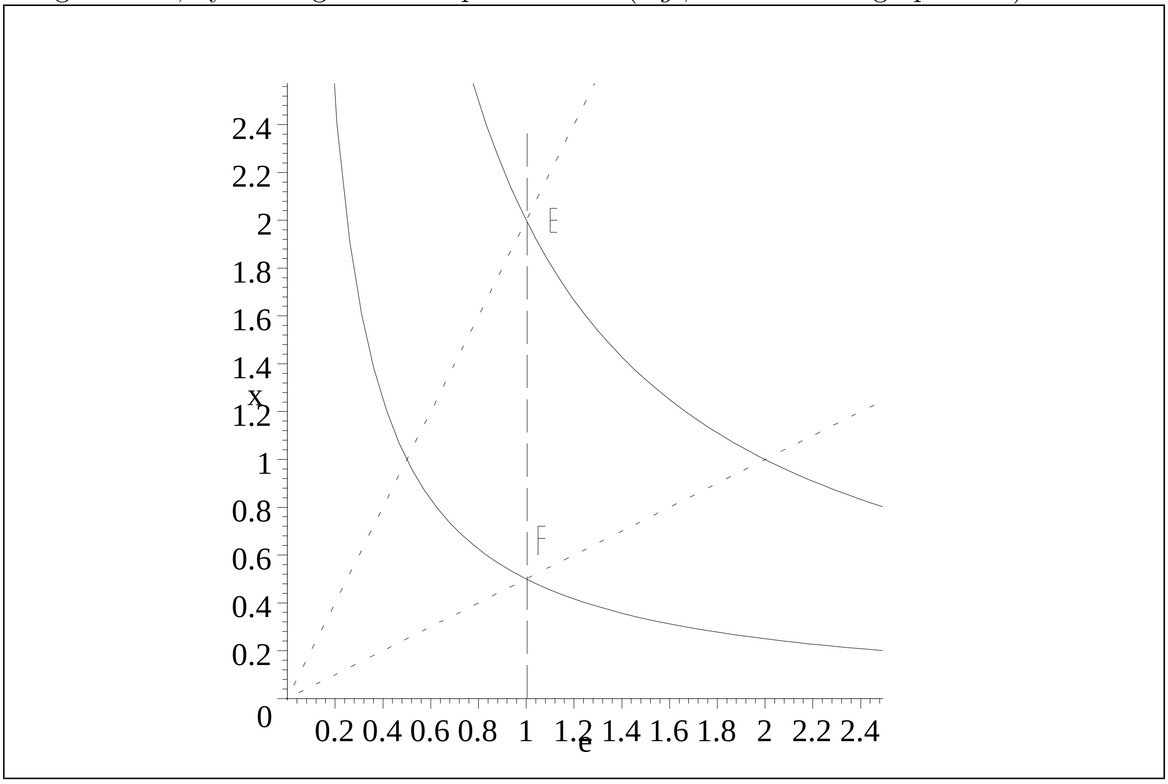

Fig. 1

The relationship between q and k (remember that $h = k + h_0$) may be interpreted as a supply curve. Fig. 2 shows how this curve is affected by changes in $w*$ or z. The broken line through point I represents the supply of h for a particular $(w*, z)$. The abscissa of I is the amount of human capital, h_1, that exhausts the child's time at those prices. If $w*$ rises, the supply curve becomes that through point H: the horizontal segment of the curve shifts upwards; h_1 moves to the right because parents economize on their children's time. Next, take the curve through point H as the initial situation, and consider the effect of a rise in z. The new supply curve is the one through point L: the horizontal segment shifts upwards again, but h_1 moves to the left because parents now economize on x.

The time worked by each child is equal to $(1 - e)$. We say that a child works full time if $e = 0$, studies full time if $e = 1$. Full household income at date i ($i = 1, 2$) is denoted by y_i. For $i = 1$, this is obtained by allocating the time endowments of adult household members so as to maximize the sum of total revenue from outside employment and value of domestic production. For $i = 2$, it is obtained by similarly allocating the time endowments of school-age children also. Thus, y_2 is the maximum income that the family would enjoy if not only adults, but also school-age children worked full time.

Assuming that parents do not have access to capital markets,[9] decisions are subject to a separate budget constraint for each decision date:

$$a_1 + bc_1p = y_1, \tag{2}$$

where b denotes the number of births, and p the price of goods consumed by pre-school children, for date 1;

$$a_2 + (c_2 + hq)\, n = y_2 \tag{3}$$

for date 2.

The optimization problem has a dynamic programming structure.

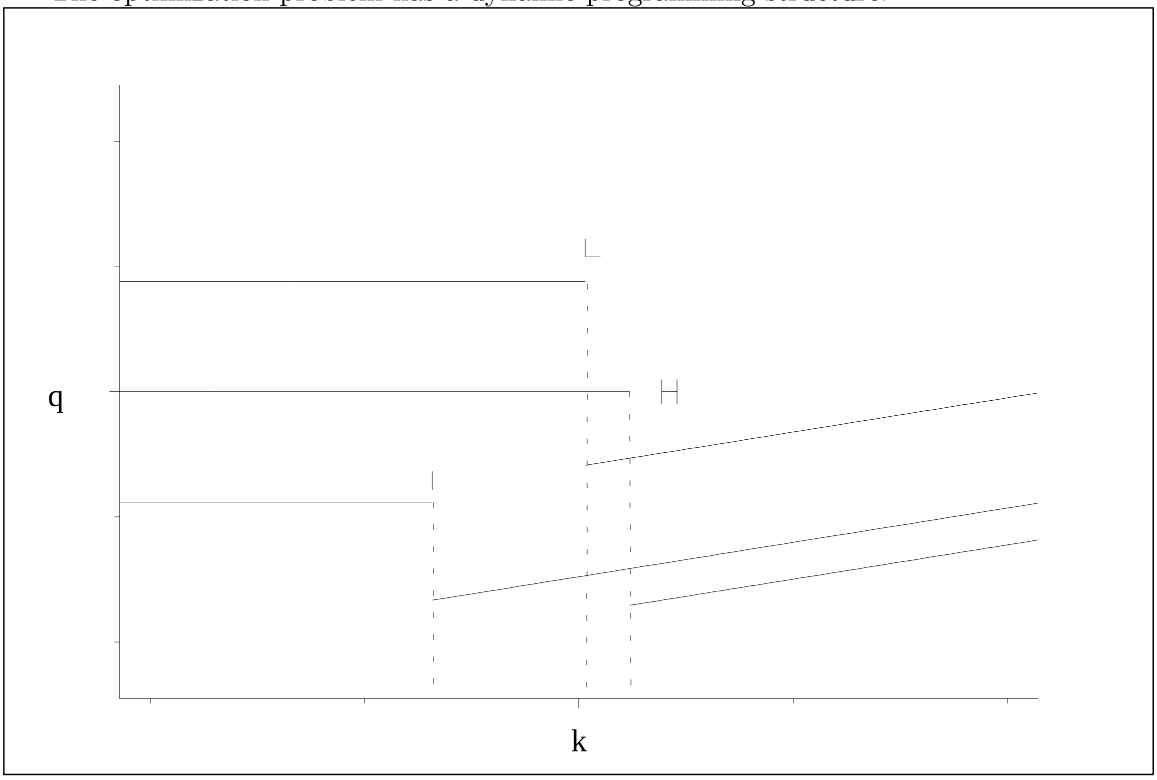

Fig. 2

[9]As we are going to apply the model to rural India, that seems a reasonable approximation to reality.

Date 2 At date 2, when the number of children who have survived to school age is known, parents choose (a_2, c_2, h) to maximize

$$U_2 = u_2(a_2) + v(c_2, h, n), \tag{4}$$

subject to (3). The possible types of solution are illustrated in Fig. 3.

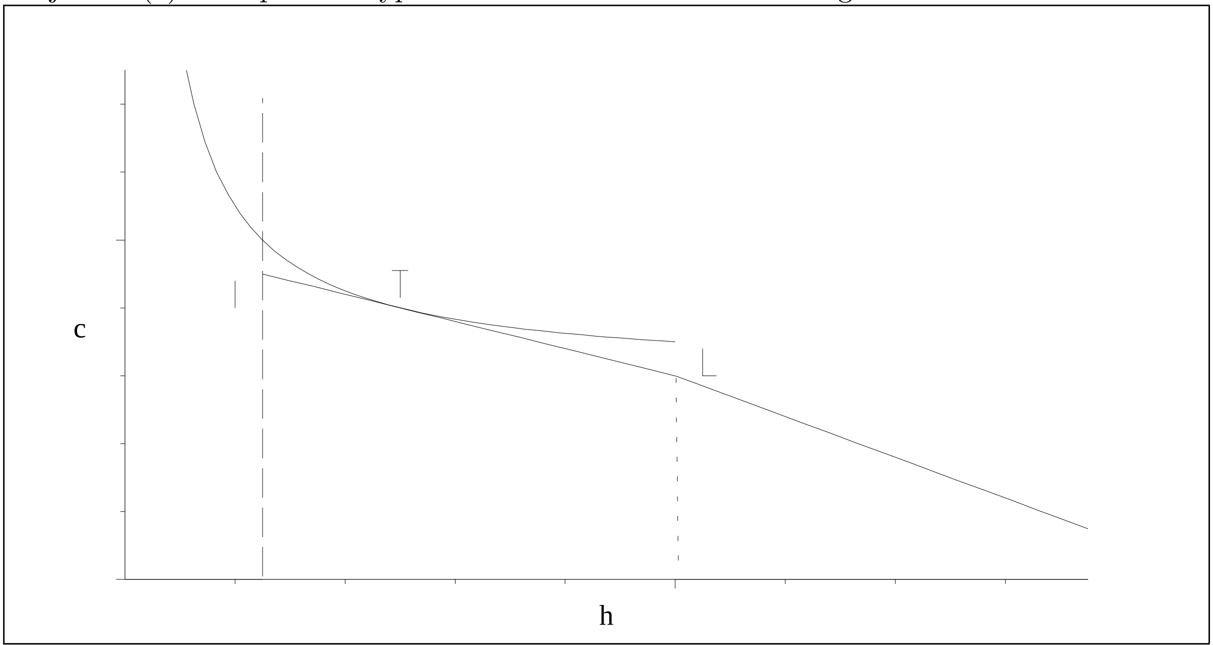

Fig. 3

The line through points I and L (with abscissas h_0 and h_1) is the production frontier. Its slope, equal to the price of human capital q, is constant to the left of point I, where the child's time is not fully occupied in education, and increasing to the right. The choice set is delimited by the vertical line through point I to the left, meaning that parents cannot sell off their children's natural talent, and by the production frontier upwards. Let q_0 denote the slope of the indifference curve at point I, and q_1 the slope of the indifference curve at point L. The former is the price of human capital above which parents are not willing to bear any cost for their children's education. The latter is the price of human capital below which parents want their children to study full time.

The first type of solution is at point I, where $q \geq (v_h/v_c) \equiv q_0$, and $h = h_0$. If that is the solution, parents make their children work full time ($e = 0$). The second type of solution is at any point between I and L (*e.g.*, at point T), where $\frac{v_h}{v_c} = q$, and $h_0 < h < h_1$. If that is the case, parents make their children work and study at the same time ($0 < e < 1$). The third type of solution is at, or to the right of, point L, where $q \leq (v_h/v_c) \equiv q_1$, and $h \geq h_1$. If that is the case, parents make their children study full time

($e = 1$). If parents send their children to school at all ($e > 0$), they also buy educational inputs ($x > 0$).

Assuming that c_2 and h are normal goods, a lump-sum increase in y_2 raises current consumption, c_2, and the future stock of human capital, h, for every child, but it also raises the limit prices q_0 and q_1(because the ratio of c_2 to h rises at both $h = h_0$, and $h = h_1$). Since q is not affected, the probability that a child will work full time falls, and the probability that the child will study full time rises. The probability that the child will work and study may go either way.

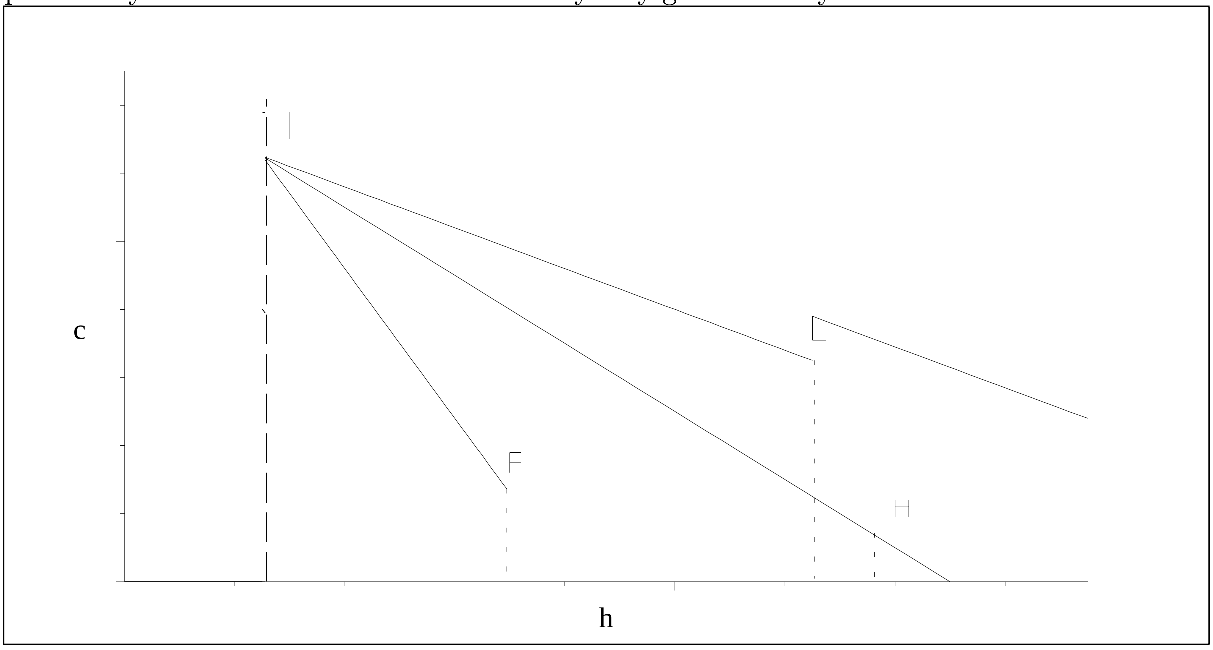

Fig. 4

Fig. 4 illustrates the effects of an increase in the price of the child's own time, $w*$, or of other educational inputs, z , holding full income, y_2, constant (*i.e.*, assuming a compensatory lump-sum transfer to the household if z rises, from the household if $w*$ rises)[10]. Take the line through points I and L as the frontier at the initial prices. By raising q, an increase in either $w*$ or z makes the frontier steeper everywhere. Unless the solution happens to be at point I (*i.e.*, the child already is a full-time worker), this compensated increase in the marginal cost of h will lead to a rise in c_2. The other effects are different according to which of the two prices has risen. If it is $w*$, the new frontier will be like the one through points I and H. Then, h_1 rises, q_1 falls, h_0 and q_o stay the same. The effect of a rise in the child wage rate (or, if the child works for his parents, in the domestic productivity of child labour) is thus to raise the probability of full-time work, and to lower the probability of full-time study; the effect on the probability

[10]The reason for holding income, rather than utility, constant is that, as we have seen, the data contain income information, and we shall want to exploit it.

of part-time work is ambiguous. The effect on the demand for educational inputs (other than the child's own time) is also ambiguous because, on the one hand, the demand for h falls, but on the other, each unit of human capital is produced with more x and less e. If the price that has risen is in z, by contrast, the new frontier will be the one through points I and F. Then, h_1 falls, q_1 may rise or fall, h_0 and q_o are again unaffected. Therefore, if the price of, say, books or travel to school goes up, the probability of full-time work increases, but we cannot say whether the child is more likely to study full or part time. The effect on the demand for the input is clearly negative.

These predictions have a number of interesting policy implications.

(*i*) A ban on child work (reducing $w*$), or compulsory school attendance, accompanied by a lump-sum subsidy sufficient to hold full household income constant, would raise the utility of parents. Since h would rise or stay the same, but c_2 would fall, the utility of children could rise or fall. Without the subsidy, the utility of both children and parents would fall, and the policy would be difficult to implement.

(*ii*) An educational subsidy (reducing z), compensated by a lump-sum tax, would also raise the utility of parents, and have ambiguous effect on the utility of children. In this case, however, the effect on child labour would be ambiguous too: full-time work would become less likely, but we cannot say the same of part-time work. Without the tax, parents and children would be better-off, child labour (full or part-time) would become less likely, but school-age consumption could still fall.

(*iii*) Universal income subsidies (lump-sum transfers to all households) are an expensive way of discouraging child labour, because some of the subsidy will end up as adult consumption, and a countereffective one in households where children would otherwise study full time (the probability of part-time work may rise). Income subsidies targeted at poorer families, where full-time study in the absence of policy is less likely, are more cost-effective. Therefore, income redistribution could help reduce child labour.

(*iv*) Land redistribution could increase the incidence of child labour, because it raises the productivity of labour in the households that receive additional land, and reduce it in those from which land is taken away. Therefore, it raises the probability of work for children of lower-income households, and lowers it for children of higher-income households, where parents are less likely to make their children work anyway.

The number of siblings, n, raises full income, but also the cost of providing each child with one more unit of human capital. Therefore, it tightens or relaxes the budget constraint according to whether the net cost of a child $(c_2 + hq - w*)$ is positive or negative. If we hold y_2 constant by an appropriate lump-sum compensation, a rise in n will then make the frontier steeper everywhere, leaving h_0 and h_1 constant. As q_1 will consequently fall, while q_0 will stay the same, having more brothers and sisters of school age then makes it less probable that a child will study full time, more probable that will study part time. The probability of full-time work stays the same.

Date 1 Substituting the demands for h and c_2 into the maximand yields the date-2 indirect utility function,

$$U_2 = V(n, y_2, w, z). \tag{5}$$

We shall assume that v is sufficiently large, relative to u_2, for V to be increasing in n even if the net cost of a child is positive, and that there is sufficient concavity in the direct utility function for V to be concave in n even if that cost is negative.

Let $f(n, b, c_1, s)$ denote the probability density of n children surviving to date 2 out of b born alive at date 1. The p.d.f. is positively conditioned by a vector, s, of survival-enhancing policy variables (sanitation, public health, etc.) and other variables exogenous to the family, but also by c_1 (with f equal to zero for c_1 below some subsistence minimum) .We are thus saying that a child's chances of reaching school age depend not only on external conditions, but also on actions taken by the child's own parents.[11]

At date 1, parents choose (b, c_1) to maximize

$$E(U_1) = u_1(y_1 - bc_1p) + \int_0^b V(n) f(n, b, c_1, s)\, dn \equiv u_1(y_1 - bc_1p) + g(b, c_1, s), \tag{6}$$

subject to the restriction that the number of births cannot exceed some physiological maximum m,

$$b \leq m. \tag{7}$$

If the physiological limit (7) is not binding, the first-order conditions tell us that parents equate the ex-ante marginal rate of substitution of births for child consumption to the opportunity-cost of the latter in terms of the former,

$$\frac{g_c}{g_b} = \frac{b}{c_1}. \tag{8}$$

[11]This contrasts with much of the economic literature on child fertility/mortality, where mortality is generally assumed to be exogenous. Cigno (1998) examines the implications of endogenizing mortality in a household decision model, and shows that this assumption is necessary in order to explain the observed positive correlation between fertility and infant/child mortality. The endogenous mortality model in Cigno (1998) differs from our date-1 decision problem only in that it *assumes* the function $V(n)$, instead of deriving it by backward induction as we do here.

The trade-off between b and $c_1$is positive, but falls as births are substituted for child consumption. Assuming that this trade-off falls more slowly than the marginal rate of substitution,[12] the optimization gives us demand functions $b(p, w, y_1, y_2, s, z)$ and $c_1((p, w, y_1, y_2, s, z)$. The derivatives of these functions with respect to the date-2 parameters (w, y_2, z) cannot be signed without special assumptions.[13] Those with respect to the date-1 parameters may be written (treating s as a scalar) as

$$\begin{aligned} b_y &= -(\frac{G}{H})bp^2(u_1')^2 r \\ b_p &= (\frac{g_c}{H})\{[(bc_1pr - \frac{c_1}{g_c}g_{cc}) + u_1' rK]bc_1p + u_1'G\} \\ b_s &= (\frac{1}{Hc_1})[(bc_1pr - \frac{c_1}{g_c}g_{cc})g_cg_{bs} - g_bg_{cs}K] \end{aligned} \tag{9}$$

and

$$\begin{aligned} c_y &= (\frac{c_1p(u_1')^2 r}{H})[(p^2 - c_1^2)\, bc_1r + pJ] \\ c_p &= \left(\frac{g_b}{pH}\right)[(bc_1^3p - u_1')pK + (br - \frac{b}{g_b}g_{bb})\,(1 + bc_1pr)\, u_1'] \\ c_s &= \left(\frac{u_1'}{bH}\right)[\left(\frac{b}{g_b}g_{bb} - bc_1^4 r\right) c_1g_{cs} + bpg_{bs}K] \end{aligned} \tag{10}$$

where H is the Hessian determinant, positive for second-order conditions, $r \equiv -(u_1'/u_1'')$ is positive for concavity of $u_1(.)$, $G \equiv 1 - \frac{b}{g_c}g_{cb} + \frac{c_1}{g_c}g_{cc}$, $J \equiv 1 - \frac{c_1}{g_b}g_{bc} + \frac{b}{g_b}g_{bb}$ and $K \equiv 1 - \frac{c_1}{g_b}g_{bc} + bc_1pr$. Clearly, g_{bb} and g_{cc} are negative, and g_{bc} positive. Since g_{bs} is the effect of an increase in public health provision (and thus, other things being equal, in the probability that children born at date 1 will still be alive at date 2) on the expected utility of an extra birth, the sign of this cross-second derivative cannot plausibly be negative.[14] The sign of g_{cs} will be positive if c_1 and s are substitutes, negative if they are complements. G and J will be negative or positive depending on whether the elasticities of the expected marginal utilities of, respectively, c_1 and b add up to more or less than unity (if the indifference curves of g are homothetic, $G = J = 1$). K is likely to be positive (for this to be true, it is sufficient that the elasticity of g_b to c_1 is less than unity, or that total household expenditure on children is "large").

[12]Otherwise, we get a corner solution, with the number of births equal to either zero or m.

[13]Indeed, they may not exist, because V is not a continuous function of (q, w, y_2) everywhere.

[14]Cigno (1998) tabulates g_{bs} for the case in which $f(n)$ is gamma-shaped, and $V(n)$ displays constant relative risk aversion. For realistic values of the parameters, g_{bs} is positive and decreasing in s, approaching zero as public health provision becomes so high, as to ensure a survival rate of 90 percent or more even for children whose parents spend for them nothing more than the subsistence minimum.

The effects of y_1, p and s are ambiguous in general. If G and J are positive, an income rise will lead to a fall in fertility. If G and K are positive, a rise in the price of child-specific goods will cause a rise in fertility.[15] If K is positive, and public expenditure on health, sanitation, etc. is a complement for private expenditure on children ($g_{cs} < 0$), an increase in s will reduce b and raise c_1. If that is the case, fertility and infant mortality move in the same direction.[16]

For policy purposes, the ambiguity of these predictions makes it important to establish empirically the signs of the various effects:

(*vi*) If p has a positive effect on b,[17] and thus a negative effect on c_1, subsidizing child-specific goods would reduce fertility, and raise the amount consumed by (hence the probability of surviving to school age for) current pre-school children. The opposite would be true if p had a negative effect on b.

(*vi*) If s turns out to have a negative effect on b, and a positive one on c_1, public expenditure on health, sanitation, etc. discourages fertility, and encourages private expenditure on children. If that is the case, the health-enhancing effects of public intervention are reinforced by induced private action. If the opposite is true, however, public expenditure finances more births (and more consumption by adult family members).

3.2 Non-altruistic model

As an alternative, suppose that people derive utility from their own lifetime consumption only. Let $U_1 = u_1(a_1) + u_2(a_2) + u_3(a_3)$, where a_3 may be interpreted as old-age consumption. Since children are costly but, under present assumptions, do not yield direct utility, adults will be parents only if they get an adequate return on the investment. We shall assume that members of the same family abide by some set of rules prescribing the amount of income, T, that a grown-up child must transfer to his or her aged parents at date 3, and that this amount is positively related to what the child received from the parents

[15] The apparent paradox, that a rise in parental income or a cut in the price of goods consumed by children could result in a fall in fertility, is due to the fact that number of children and amount spent for each child enter the budget constraint as a product, so that any increase in the one raises the marginal cost of the other. In this respect, b and c_1 behave like the quantity and quality of children in Becker's original model of fertility choice (*cf.* Becker and Lewis, 1973).

[16] Widespread empirical evidence that fertility and infant mortality are positively correlated does suggest that this may indeed be the case. See Cigno (1998) for further discussion.

[17] Cigno and Pinal (1999) find evidence to this effect for the Andine area of Argentina.

at date 2, [18] so that $T = T(c_2, h)$.

Under such assumptions, parental choice is still restricted by (2)-(3), where y_2 must now be intended as net of transfers to grandparents. Additionally (assuming, for simplicity, that old-age income is zero),

$$a_3 = TN, \tag{11}$$

where N is the number of children reaching adulthood. Denoting by $F(N, n, s)$ the p.d.f. of N children surviving to date 3 out of n alive at date 2, conditional on c_1 and s,[19] we can then write

$$v(c_2, h, n, s) \equiv \int_0^n u_3(T(c_2, h)N) F(N, n, c_1, s)\, dN.$$

At date 2, parents choose (c_2, h) to maximize

$$E(U_2) = u_2\left[y_2 - (c_2 + hq - w)n\right] + v(c_2, h, n, s), \tag{12}$$

Since $c_1$is given, this problem is formally the same as that of altruistic parents, and the solution qualitatively the same, except for the fact that the choice of (c_2, h) is now conditioned by s. The effect of s on (c_2, h) is ambiguous because, on the one hand, an exogenous increase in the probability that a child will live to be an adult (a reduction in the risk of default) raises the expected utility of T, but on the other reduces the amount of c_2 required to achieve any given probability of survival. This has the policy implication that,

(*vii*) if the underlying model is non-altruistic, public expenditure on health, sanitation, etc. *may* encourage parents to send their children to school, and to spend more for their consumption and education.

The possible presence of an effect of s on (c_2, h) may also allow us to discriminate empirically between altruistic and non-altruistic motivations. In the altruistic model, we did in fact represent the utility that parents derive from their school-age children by $v(c_2, h, n)$, thereby making date-2 decisions independent of s. That may be thought to be a restrictive assumption, because altruistic parents might be happier if

[18] Cigno (1993) derives conditions, under wich some such rules are self-enforcing, in the sense that it is in everyone's interest to comply with them. These conditions are weaker if, as we are assuming, individuals do not have access to capital markets, and have thus no means of shifting consumption to old age other than by investing in children. Indeed, under present assumptions, parents with no land and no public pension would have no alternative but to rely on their children for old-age support.

[19] As already mentioned, there is biometric evidence that the morbidity and mortality throughout the life-cycle is crucially affected by nutrition and health care during infancy).

their children live to be adults, than if they do not. Removing this assumption, would change the date-2 maximand of altruistic parents to $E(U_2) = u_2(a_2) + \int_0^n v(c_2, h, n)F(N, n, c_1, s)\, dN$. That, however, would not make their choice of (c_2, h) dependent on s, because the marginal rate of substitution of human capital for school-age consumption is still independent of s.[20] Therefore, self-interested parents, who regard their children's consumption and education as a means of increasing their own future consumption, will buy more c_2 or h if the probability of these children surviving into adulthood rises for exogenous reasons. By contrast, the choices of altruistic parents, interested in their children's happiness *per se,* are not affected by exogenous changes in their children's probability of survival. If the data were to show an effect of health policies, and other exogenous factors affecting the probability of survival, on the consumption or education of school-age children, that would then make it likely that the underlying model is non-altruistic, rather than altruistic.

The structure of the date-1 decision problem is clearly the same as for the altruistic model.[21] The effects of the exogenous variables on (b, c_1) are thus qualitatively the same as in the case of altruism.

4 Estimates and tests

The theoretical model decomposes the decision problem faced by parents into two stages. Parents make fertility decisions, and allocate resources to each child that is born under conditions of uncertainty about how long the child will survive. For each child that reaches school age, parents decide how his or her time should be allocated between work and study, and how much to spend for his or her consumption and education. Since it so happens that most of the mortality occurs up to age 5, and school begins at age 6, it seems natural, in moving from the theory to the data, to identify the length of the first stage with the first five years of life of the child.

Where school-age children are concerned, the theory predicts how much a child consumes, the probability that the child will work or study (part or full time), and how much will be spent for his or her

[20] However, without the (standard) assumption of additive separability of the utility function of parents into a term reflecting the benefit from their own consumption, and another reflecting their altruistic concern for their children's wellbeing, a change in s could have income effects on the choice of (c_2, h).

[21] That would not be true if capital markets or a comprehensive system of social security provided a viable alternative to filial support in old age.That case is examined in Cigno (1993) under the assumption of certainty about child survival, and by Rosati (1996) under the assumption that survival is uncertain, and the probability of survival exogenous.

Table 7: Descriptive statistics for the variables employed in the regressions

	Mean	Std. Dev.	Min	Max
Sex	0.44	0.49	0	1
Child's age	10.80	3.03	6	16
Child's age^2	12.60	67.00	36	256
Poverty	2.60	0.98	1	4
Tenure	0.29	0.45	0	1
Land size	2,23	1,44	1	5
Income	25139	19259	677	99000
Household size	7.16	3.01	2	19
Siblings	3.82	1.57	0	12
Siblings (6-16)	3.01	1.50	1	10
Siblings (0-5)	0.92	1,15	0	10
Type of school available	1.60	0,95	0	3
Hindu	0.83	0.38	0	1
Muslim	0.11	0,31	0	1
Christian	0.02	0,15	0	1
Other	0.04	0,19	0	1
Father's education 1	0.53	0.49	0	1
Father's education 2	0.28	0.45	0	1
Father's education 3	0.13	0.34	0	1
Father's education 4	0.06	0.38	0	1
Mother's age	34.80	5.83	18	49
Mother's education 1	0.75	0.42	0	1
Mother's education 2	0.18	0.39	0	1
Mother's education 3	0.03	0.21	0	1
Village survival rate	0.90	0.06	0.62	0.99

education if he or she goes to school, taking household composition as given. Where pre-school children are concerned, the theory predicts how much a child will consume, again taking household composition as given. It also predicts the number of births (the demand for additional pre-school children). As the number of births changes the composition of the household, there is thus a problem of endogeneity. However, since the average number of births is small in relation to the stock of pre-school children (and smaller still in relation to the total number of children), we chose to overlook the problem.

We estimated equations predicting the probability that a school-age child will work full time or part time, educational expenditure for each child attending school, consumption by pre-school and school-age children, and the probability of an extra birth. Time use by school-age children is represented by a variable taking value 0 if the child is reported working and not attending school, 1 if the child goes to school and works, 2 if the child attends school and does not work (we shall come to the no-work, no-school category in a moment). Demand for educational inputs (other than time) is represented by educational expenditure per child attending school. Having no direct information on consumption by children of either age group, we proxyed consumption by the bodymass index, which, as mentioned in Section 2, is at once a measure of nutritional status, and a predictor of the probability of survival to the next stage of life. Fertility is represented by a dichotomous variable taking value 1 if a birth occurred in the two years[22] preceding the interview, 0 if it did not.

The explanatory variables (descriptive statistics in Table 7) reflect, as closely as data permit, those figuring in the theoretical analysis. Income is measured as the sum of the value of own-farm production and outside earnings by all household members, including school-age children. It is thus half way between y_1, which excludes income produced by children, and y_2, which includes the full (not just actual) income of children. Subsidiary income information is provided by Tenure and Poverty. The former is a dichotomous variable, taking value 1 if the household owns the land it works, 0 if it does not. The latter is an expert-group classification of households according to relative poverty (as it takes values from 1 for poorest, to 4 for least poor, it should be interpreted as "absence of poverty"). With so few children overtly working in the market, information on child wage rates is too sparse to be of much use. Given the number of household members, land size may be taken as a proxy for the marginal productivity of child labour employed in the family farm. As the marginal product of children (mainly girls) employed in domestic

[22] Two rather than one because there is a certain margin of error in the recording of the exact date of birth of each child (and also because it gives us more observations).

Table 8: Time use of school-age children. Multinomial estimates, Reference group: study only Observations = 33124 $Chi2(66) = 5580$ Pseudo $R2 = 0,15$

	Work only		Work and study			Work only		Work and study	
	Coef.	z	Coef.	z		Cof.	z	Coef	z
Sex	0.94	24.72	-0.17	-3.40	Andhra				
Age	-0.64	-12.93	0.22	3.13	Pradesh	0.78	5.37	0.83	3.97
Age^2	0.04	18.44	-0.01	-3.17	Bihar	0.37	2.55	-0.18	-0.80
Poverty	-0.11	-4.07	-0.13	-4.14	Gujarat	0.38	2.54	0.57	2.62
Tenure	-0.02	-0.40	-0.23	-3.51	Haryana	-0.06	-0.37	0.63	3.00
Land size	0.15	10.86	0.05	2.87	Himachal				
Income	0.00	-6.21	0.00	-0.80	Pradesh	-1.12	-5.79	0.31	1.36
Siblings (0-5)	0.20	7.69	-0.02	-0.72	Karnataka	0.53	3.78	0.77	3.85
Siblings (6-16)	0.13	7.04	0.28	12.60	Kerala	-2.13	-7.16	-0.17	-0.63
Household size	-0.11	-9.28	-0.07	-5.10	Maharshtra	0.24	1.67	0.65	3.22
Type of school					Madhya				
available	-0.14	-6.77	-0.04	-.45	Pradesh	0.23	1.63	0.24	1.17
Village surv. rate	-2.13	-6.55	-2.03	-4.60	Orissa	0.50	3.40	0.54	2.52
Mother ed. 1	2,04	2,81	0,10	0,25	Punjab	-0.16	-0.87	0.63	2.53
Mother ed. 2	-0,35	0,48	-0,66	-1,66	Rajasthan	-0.07	-0.46	0.19	0.87
Mother ed. 3	-0,63	-0,80	-1,60	-3,44	Tamil Nadu	0.19	1.13	0.80	3.53
Muslim	-0.29	-2,39	-0,12	-0.72	Uttar Pradesh	0.05	0.39	0.16	0.81
Christian	0.31	2.38	0.17	0.91	West Bengal	0.35	2.32	0.45	2.05
Other	-0.94	-3.89	-0.78	-2.39	cons	-0.84	-0.98	-1.76	-2.42

chores, and the wage rate of children (mainly boys) working in the labour market must be at least as high as the marginal product of own-farm work, land size is also a proxy for the opportunity-cost of time spent in education ($w*$ in the theoretical model).

Individual and household characteristics are represented by the age (Age and Age^2) and sex (taking value 1 for a girl, 0 for a boy) of the child, the mother's age, dummies describing the level of education of the child's father and mother (respectively, Father's education i and Mother's education i, where i takes value 4 for completed high school or higher, 3 for middle school, 2 for primary, 1 for less than primary), total number of household members (Household size), number of pre-school children (Siblings $0-5$), and number of school-age children (Siblings $6-16$). In the theoretical analysis, the number of school-age children is indicated by n, but the number of pre-school children does not appear. At date 1, parents decide how many children to have. At date 2, children have reached school age. In reality, however, pre-school children may be present at both decision dates, and influence the decision. Where the age structure is not significant, we use the total number of children (Siblings). We also use dummies for the religion (Hindu, Muslim, etc.) of the household head.[23]

Health policies and local environmental conditions (s in the theoretical model) are proxyed by the village-level survival rate to age 6 (Village survival rate). We assume that individual household decisions have negligible effect on the village-level aggregate, so that the latter can be taken as exogenous with respect to the former.[24] The village-level survival rate may then be used as a proxy for what parents expect that their own children's probability of surviving to age 6 would be, if they provided them the average amount of nutrition, health care, etc. Using the village survival rate as a regressor, we are thus in effect saying that parental actions (and household characteristics) cause a dispersion of individual probabilities of survival around the village mean. [25] As the overall sample mean is only 90 percent (but

[23] Caste was tried, but proved insignificant.

[24] Since, in some villages, the number of households with children aged less than 6 is rather small, putting in question the validity of the exogeneity assumption, we tried replacing the village-level with the district-level survival rate. The results do not change in any relevant way. Estimates using the district-level survival rate are available on request from the second author.

[25] Ideally, we would want to get at the information, up to the date of conception of each child, that helped form parental expectations of these village means. That would require a large panel data set. As that is not available, we decided to exploit cross-sectional variations in survival data at village level. We computed village-level mean survival rates from individual data. If cross-village differences have not changed widely over time, our estimates should be a reasonably good measure of inter-village differences in parental expectations.

village-level means range from as little as 62 percent, to as much as 100 percent), there is clearly plenty of scope for improving the survival chances of one's own children. In view of the high degree of correlation among survival rates to all ages, the survival rate to age 6 is also a predictor of survival rates to higher ages.[26] The effect on fertility is particularly important because its sign gives information on whether the health policies proxied by the aggregate survival rate are a substitute or a complement for parental expenditure on pre-school children. In the absence of statistical information on the price of child-specific goods (p in our theoretical model), which also would convey information on this matter, that is all we have.

Educational policies are represented by the variable School available, which takes value 0 if there is no school in the village where the child lives, 1 if there is only a primary school, 2 if there is a primary and a middle school, 3 if there is also a high school. The presence of a school ready at hand constitutes a reduction in the price of educational inputs (z in the theoretical model). State dummies (Andhra Pradesh, Bihar, etc.) allow for other differences[27] of policy, climate, ethnic mix, etc.

Since, as mentioned in Section 2, we are not sure about the real status of children reported as neither attending school nor working, we exclude these children from the estimates presented in this section. The characteristics of the "missing children" are examined in the subsequent section.

4.1 Time use

To model the study-work choice, we estimated a multinomial logit model for the probability that a school-age child will "work only" or "work and study", as against "study only" (the reference state). Estimates are reported in Table 8.

Girls are more likely to specialize fully in either work or education than to do both, and more likely to specialize in work than boys.[28] The probability of working full time is decreasing in age for children up to 8 years old, increasing for older children. The probability of studying and working at the same

[26] That is because, as the biometric literature shows, life expectancy at any age depends crucially on nutrition and health care during infancy,

[27] These can be very pronounced (see Drèze and Sen, 1995).

[28] A "bootstraps" explanation is provided in Cigno (1991, Ch.5). Parents perceive the return to educating girls as lower than the return to educating boys, because they observe that women are less likely to work, and thus to profit from their education, than men. Women work less than men, however, because they are less educated and, therefore, in the marital division of labour, have a comparative advantage in specializing in housework.

Table 9: Educational expenditure. Heckman selection model. Observations = 44129 $Chi2(52) = 1300$

			Probit					Probit	
	Coef.	z	Coef.	z		Coef.	z	Coef.	z
Sex	-0.04	-2.89	-0.17	-13.62	Karnataka	-0.15	-3.75	-0.07	-1.80
Age			0.27	17.39	Kerala	0.23	4.95	0.17	3.44
Age2			-0.01	-18.61	Maharshtra	-0.07	-1.75	-0.03	-0.79
Income	0.02	1.28	0.03	1.80	Madhya Pradesh	-0.19	-4.97	-0.22	-5.73
Siblings (0-5)	-0.02	-2.99	-0.06	-6.76	Orissa	-0.07	-1.68	-0.04	-0.91
Siblings (6-16)	-0.04	-6.38	-0.01	-2.28	Punjab	0.17	3.69	0.02	0.46
Household size	0.01	2.37	2.37	6.66	Rajasthan	0.14	3.46	-0.11	-2.57
Poverty	0.05	3.69	0.06	4.17	Tamil Nadu	-0.01	-0.25	0.07	1.33
Land size	0.00	0.58	-0.02	-3.97	Uttar Pradesh	-0.02	-0.53	-0.13	-3.34
Type of school	0.02	2.23	0,05	6,64	West Bengal	0,03	0,62	-0,01	-0,26
Class attended	0.19	15.33							
Village surv. rate	0.40	3.48	0,51	4,56	_cons	4,54	25,47	-1,58	-8,39
Andhra Pradesh	-0.13	-3.07	-0,10	-2,32					
Bihar	-0.06	-1.58	-0,15	-3,59	_Rho	0,31			
Gujarat	-0.11	-2.51	-0,07	-1,57	_Sigma	1,06			
Haryana	0.25	6.06	-0,03	-0,61	_Lambda	0,34	8,2		
Himachal Pradesh	0.33	7.25	0,22	4,43					

time increases with age up to age 12, then decreases.

Consistently with the theory, the estimated coefficients of the various income measures indicate that belonging to a richer household reduces the probability of working. Land size raises the probability that a child will work (relative to not working at all), and the probability that work will be full time rather than part time. Since land size proxies the opportunity cost of time in education, this too is consistent with the theory, and provides valuable indirect information on the return to child labour. The effects of household size and composition are more complex.

An increase in total household size reduces the probability that a school-age child will work at all, and makes it more likely that work will be part time. With the number of children (up to age 16) controlled for, this is the same as saying that the number of adults in the household reduces the probability of a child working. This is another labour productivity effect: the greater the number the adults working on a given piece of land, the lower the return to getting another child to work on it.

The number of pre-school children raises the probability that a school-age child will "work only", relative to the probability that the child will "study only", but has no significant effect on the probability of "work and study".[29] Given that pre-school children are too young to work, and that an increase in their number is thus equivalent to a lump-sum reduction in full income (an income-dilution effect), this finding is consistent with the theoretical prediction that a lump-sum increase in full income raises the probability of full-time work, lowers that of full-time study, and has ambiguous effect on that of part-time work.

The number of school-age children raises the probability that a child in that same age range will "work only" or "work and study", but the effect on the probability of "work only" is not as large as that of the number of pre-school children. That is consistent with the theory, according to which an increase in the number of school-age children, holding full income constant, raises the probability of part-time work, and lowers that of full-time study, but has no effect on that of full-time work (while the number of pre-school children reduces it).

The probability that a child will study full time increases, relative to the probability that the child will work full time, or work and study, with the presence of a school in the village, and with the grade of education this school offers.[30] These are price effects. Having a school of any grade ready at hand

[29] Patrinos and Psacharopoulos (1997) find the same in Peru.

[30] This contrasts with the finding by Ravallion and Wodon (2000) that, in Bangladesh, reducing the marginal cost of education raises the probability of part-time, rather than full-time study.

reduces the marginal cost of, and thus raises the demand for that grade of education. The fact that having a higher-grade school in the village raises the probability of attending not only that grade of school, but also the lower grades, requires some explanation. Drawing on evidence from Ghana, Lavy (1996) maintains that returns to completing primary education and stopping there are low relative to completing secondary and higher education. A lower cost of access to secondary education thus increases the returns to investing in primary education. To check the validity of this inference, we re-estimated the model for children aged 6 to10 using two separate dummies, one for the presence of a primary school, the other for the presence of a higher level school. Since the coefficients of both these dummies have positive sign, the interpretation seems legitimate. These findings are consistent with the theoretical predictions of both the altruistic or the non-altruistic model, that a reduction in the price of education raises the probability of going to school, and lowers the probability of working.

Consistently with the theoretical prediction of the non-altruistic model, the village-level aggregate survival rate has a positive effect on the probability of studying full time (relative to working full or part time). Therefore, public policies (sanitation, mass immunization, etc.) aimed at improving the health and survival rates of children have the desirable side-effect of inducing more parents to send their children to school.[31] Since this effect is not present in the altruistic model, this finding may be an indication that the non-altruistic model (see sub-section 3.2) provides the more appropriate explanatory framework for the phenomenon under consideration.

The mother's own level of education appears to have an influence on the decision to make a child work or study. Children whose mothers have less than primary education are more likely to work full time than to study full time. Children whose mothers have more than primary education are less likely to work and study than to study full time. By contrast, the father's education does not exert a significant influence. With total household income controlled for, the explanation for the effect of the mother's education has to be found outside the formal model of Section 3. A possible explanation is that education confers on the mother greater weight (moral authority or, if education translates into income, bargaining power) in family decisions. If, as some assume, mothers care for their children more than their fathers do, the mother's education then tends to increase the welfare of children (Folbre, 1986). Given the trade-off between education and current consumption, however, this does not necessarily mean that children of

[31] We shall see in Section 5 that, as is to be expected, this effect is not present when children attending school are excluded from the sample.

more educated mothers are more likely to go to school. Indeed, caring mothers might insist that their children work, and that the additional income is used to better feed the children. Another consideration is that education increases the probability that the mother will find outside employment, and thus that her children will be called upon to substitute for her on the family farm or within the home (Basu, 1993). That is particularly true of girls who, if they do work, tend to do so within the home (looking after younger siblings, or in some other way substituting for their mothers in the performance of domestic chores). Yet another possibility is that the mother's time is an input into the education (production of human capital) of their children, and that the mother's own level of education raises the productivity of that input. According to this explanation (Behrman *et al.*, 1999), the mother's level of education raises the demand for her services as a home tutor, rather than as a market labourer, and thus the return to the time that her children will spend in education. The possible coexistence of some or all of these mechanisms may explain the finding of an effect of the mother's education on the probability that her children will go to school, but also the finding that this effect is not as pervasive (the probability of full-time work is not affected by educational levels above, and that of part-time work by educational levels below, completed primary education) as sometimes assumed.

4.2 Educational expenditure

Given that educational expenditure is only incurred by parents who choose to send their children to school, and there is thus a problem of self-selection, we used the Heckman two-stage estimation procedure (see Table 9). The appropriateness of this approach is confirmed by the significance of the selectivity parameter *lambda*.

The first-stage (probit) results are coherent with the time-allocation predictions of the multinomial logit we have just examined, and confirm the explanatory power of the non altruistic model. Girls are less likely to go to school than boys. The probability of attending school increases with age up to the 10th year of life, then decreases. Household size raises the probability of attending school, the number of younger (0-5 years old) brothers and sisters reduces it, the number of 6-16 years old has no significant effect. Land size (labour productivity) reduces the probability of going to school, household income increases it. School availability (and grade), and the village-level aggregate survival rate, also have a positive effect.

The second-stage estimates show that the level of educational expenditure, conditional on the child going to school, is lower if the child is female, and rising with the grade of school attended.[32] Coherently with the theory, the estimates show also positive effects of household income, village-level survival rate, and local school availability. The finding that land size has no significant effect on educational expenditure is compatible with the theoretical prediction that $w*$ has ambiguous effect on the demand for educational inputs other than the child's own time.

4.3 Nutrition and anthropometry

With age and sex controlled for, body mass is an indicator of nutritional status,[33] but also, as pointed out in Section 2, a predictor of individual survival probability. Following advice from the anthropometric literature,[34] we estimated separate equations for pre-school and school-age children.

Table 10 shows the results for school-age children.[35] Their nutritional status appears to be higher in richer households (Income and Tenure are not significant, but Poverty, *i.e.* being less poor, has a significantly positive effect). For any given household income and size, children with more brothers and sisters have lower body mass (an income dilution effect). Land size has a positive effect on nutrition. Since the quantity of land (labour productivity) raises the probability that a child will work full time, this explains the observation that working children tend to be better nourished (Tables 9-10). School availability also raises nutrition, suggesting that the income effect of this cost-reducing variable dominates the cross-substitution effect. All these findings are consistent with the theoretical predictions of Section 3,[36] and further substantiate the proposition that the effects of the different policies extend well beyond immediate impacts. We see, for example, that educational policies affect not only school attendance, but

[32] In the second (level) stage of the estimation procedure, it seemed more appropriate to substitute age with school grade, which reflects not only age, but also other factors (e.g., talent, past morbidity, etc.) affecting school achievement.

[33] In this respect, the bodymass index could be an overestimate or an underestimate. On the one hand, children performing physical work are likely to have more muscle, and thus to appear better fed, than their brethern engaged in sedentary activities like studying. On the other, working children expend more calories, and thus require more food to achieve the same body weight. Similar ambiguities occur in the interpretation of sex differences. The negative coefficient of Sex in tables 16 and 17 indicates that girls have lower bodymass than boys of the same age. But, constitutionally, girls tend to have less muscle than boys. It is thus not clear whether the observed difference in body mass can be taken as evidence of sex discrimination in the intra-household allocation of nutrients (see Behrman, 1988).

[34] For example, de Onis and Habicht (1996), Klasen (1996), Waaler (1984).

[35] Since height and weight information is only available for children aged up to 12, school age is re-defined, for present purposes, as 6-12.

[36] But school availability may be acting, here, also as a proxy for the relative development level of the village.

Table 10: Body mass of school-age children. Number of obs = 21568 $F(29, 21538) = 55$ $R2 = 0.07$

	Coef.	t		Coef.	t
Sex	-0.18	-3.21	Bihar	-3.13	-18.41
Age	-0.61	-4.25	Gujarat	-3.97	-21.71
Age^2	0.04	4.97	Haryana	-3.48	-20.08
Mother's age	0.13	2.63	Himachal Pradesh	-3.61	-18.86
Mother's age^2	0.00	-2.43	Karnataka	-3.04	-18.67
Poverty	0.11	3.16	Kerala	-4.51	-22.81
Tenure	0.10	1.52	Maharshtra	-5.15	-31.50
Land size	0.11	5.23	Madhya Pradesh	-3.37	-20.87
Income	0.00	0.60	Orissa	-4.07	-23.20
Siblings	-0.06	-2.88	Punjab	-4.12	-21.17
Household size	0,02	2,22	Rajasthan	-4,22	-24,03
Type of school available	0,08	2,54	Tamil Nadu	-4,78	-23,08
Village survival rate	1,00	2,02	Uttar Pradesh	-4,10	-25,73
Andhra Pradesh	-4,31	-24,12	West Bengal	-4,21	-22,88
			_cons	17,61	15,61

also nutrition.

The village-level survival rate has a positive effect on the nutritional status of school-age children. The very presence of this effect on the body mass of this age group reinforces the point, already made in connection with the finding of a similar effect on time use and educational expenditure, that the non-altruistic model (see Sub-Section 3.2) might be the more appropriate analytical framework for examining our set of data. Interpreting this survival rate as the result of health-enhancing policies (as well as of climatic or environmental factors), the finding of a positive effect tells us that private expenditure is a net complement for public expenditure. As pointed out in the theoretical discussion, this has the important policy implication that public action stimulates and is reinforced by private (parental) action.

Biometric measures of pre-school children (not reported) are much less reliable than for the older age-group. All explanatory variables, other than age, sex and state, have very low levels of significance.

For both age groups, the state dummies have highly significant effects on nutritional status. No doubt, these effects pick up climatic and ethnic differences (other things being equal, children are likely to be more strongly built in Punjab, than in Maharashtra). The sign pattern (children fare better in Andhra Pradesh than in Kerala) does, however, suggest that they may also reflect differences in state policies, other than those accounted for by the survival rate and the availability of schools at village level.

4.4 Fertility

For the probability of an extra birth, we estimated a probit model. The explanatory variables include, in addition to those used for the other estimates, also the order of birth, and the proportion of school-age children in the household that work. The latter is intended to serve as a proxy for the probability that the structure of incentives facing the household when the new-born child reaches school age will be such, that he or she will be made to work.[37] The results are shown in Table 11.

As usual in this type of estimates, mother's age and birth order have negative effects on the probability of a birth. Income has a positive effect on fertility, but being less poor has a negative one. This apparent contradiction between the effect of the level of income, a continuous variable, and that of the poverty category may be an indication of non-linearity in the income-fertility relationship.[38]

The mother's education is not significant. That is not unusual, because the birth order picks up the effects of the variables, including the mother's education, that affect the demand for completed (lifetime) fertility. If completed fertility (approximated, for any given age of the mother, by the total number of births at the date of the interview), rather than the probability of an extra birth, is taken as the dependent variable, and birth parity is consequently dropped from the list of regressors, we find that the mother's education comes out significantly negative as expected.

Interestingly, the higher the probability that a child will work when older, the higher the probability of an additional birth. This positive (and highly significant) connection between fertility and probability of work brings further support to the hypothesis that the data are generated by a non-altruistic model, because it suggests that parents may be looking for an extra source of income, or for an extra pair of arms.

[37] We are saying, in other words, that current conditions (full income, prices, relevant policies, etc.), proxyed by current decisions concerning time-use of currently school-age children, influence parental expectations of what these conditions will be, if and when a child born today reaches shool age.

[38] See Atella and Rosati (1999).

Table 11: Probability of a birth in the last two years. Probit estimates. Observations = 13249 $Chi2(31) = 2662 PseudoR2 = 0,15$

	Coef.	z		Coef.	z
Work only	0.41	9.33	Andhra Pradesh	-0.40	-5.01
Mother's age	-0.05	-4.06	Bihar	-0.24	-3.09
Mother's age^2	0.00	2.28	Gujarat	-0.27	-3.35
Social	-0.06	-2.92	Haryana	-0.04	-0.51
Income	0.00	8.95	Himachal Pradesh	-0.31	-3.68
Tenure	-0.09	-2.90	Karnataka	-0.50	-6.68
Land size	-0.02	-1.72	Kerala	-0.43	-5.01
Poverty	-0.22	-14.79	Maharshtra	-0.21	-2.88
Father's education1	-0.04	-0.64	Madhya Pradesh	-0.22	-2.96
Father's education2	-0.06	-1.07	Orissa	-0.10	-1.23
Father's education3	-0.08	-1,42	Punjab	0.09	0.84
Muslim	0.16	1,81	Rajasthan	-0.02	-0.20
Christian	0.49	5,04	Tamil Nadu	-0.27	-0.09
Other	-0.09	-0,80	Uttar Pradesh	-0.13	-0.81
Birth order	-0.24	-23,63	West Bengal	-0.41	-4.94
			_cons	1.95	6.05

Availability of schools and survival rate are not significant and are excluded from the estimates. In view of the fact that we are using as a regressor the probability of full-time work if the child reaches school age, that is hardly surprising, because we know from the time-use estimates (Table 8) that this probability is significantly affected by the availability of schools and the rate of survival at the village level.. The finding of a positive effect of the probability that the new-born child will work full time when is of school age on the probability of an extra birth, combined with the finding of negative effects of school availability and survival rate at the village level on the probability of full-time work by school-age children seem to indicate that pro-education policies and public health improvements discourage fertility.[39]

5 The missing children

It is difficult to dismiss the case of school-age children reported as neither working nor attending school as a mere oversight. Local experts argue that, in certain circumstances, children have such low productivity that it is not worth employing them in any work activity, and that (partly as a consequence) their parents are too poor to send them to school. That may well be the case, but we do not find it plausible that so many children, one in four, are left totally idle by choice. It is thus worth investigating whether their characteristics bear any similarities with those of children reported doing something.

As a first step in this direction, we re-estimated the multinomial logit for the time use of children (Table 8) with the addition of a new category, "neither work nor study". The results, reported in Table 13, show that the probability of falling in this category is affected by the explanatory variables in pretty much the same way as the probability of "work only". We find, in particular, that where the effects of the child's sex and age, of household composition, and of the mother's education have different signs for "work only" and "work and study" ("study only" is again the reference group), the signs for "neither work nor study" are the same as for "work only".[40]

The next step was to estimate separate body-mass equations for these, reportedly idle, children, and

[39]As pointed out in the theoretical discussion, a *negative* effect of directly survival-enhancing policies on fertility implies that public health expenditure is a complement, rather than a substitute, for parental expenditure on pre-school children. The theory predicts that, if this is the case, fertility should be *positively* affected by the price of child-specific goods (p). We cannot verify this with our data, but Cigno and Pinal (1999) find, in another part of the world, a significantly negative effect of the aggregate survival rate, and a significantly positive effect of the price of child-specific goods, on fertility decisions.

[40]Similar results (not shown) are obtained, not surprisingly, estimating a separate probit for each category.

for the "work only" category. The estimates, not reported, are extremely poor (all explanatory variables, other than the geographical dummies, have very low significance). There could be a problem of sample size (the two groups account for, respectively, a quarter and a tenth of the total child population), or something specifically to do with these categories of children. Although it is extremely unsafe to draw inferences from such estimates, it is nonetheless worth reporting that, as in the time-use estimates just examined, the sign pattern is the same for both categories of children. Most importantly, where there is a sign difference between the "work only" equation and the equation estimated putting together all children except those reportedly doing nothing, the sign in "neither work nor study" is the same as in "work only". This strengthens the impression that the two groups may be one and the same thing or, at least, that the "neither work nor study" category contains a substantial proportion of children who are actually working full time.

6 Discussion

The empirical analysis of sections 4 and 5 shows a high degree of consonance among the estimates, and between these and the theoretical framework (particularly in its non-altruistic version) developed in Section 3. Taken together, the two levels of analysis prompt a number of considerations. A very general one is that child labour cannot be viewed in isolation from educational, health and fertility issues.[41] Another is that, barring extreme forms of exploitation (difficult to detect in the data), child labour should not be regarded as an aberration, but rather as the rational household response to an adverse economic environment – and, notice, this is true irrespective of whether parents are moved by altruistic or selfish motivations. Prohibiting child labour, or obliging children to attend school, without changing the economic environment is consequently difficult to enforce, and may be counterproductive.[42] As we have seen, children working full time tend to have a better nutritional status than children who study.

[41] Our findings are broadly consistent with those of Rosenzweig and Wolpin (1982), who also adopt a household economics framework, but are not directly concerned with child labour.

[42] Basu (1999) argues that prohibition to employ children would be beneficial (and self-enforcing, once the new equilibrium is in place) if the labour market had two possible equilibria, one with low wage rate and employment of children, the other with high wage rate and adults only employed. That is indeed true, but the very fact that prohibition has not worked where it has been tried suggests that the hypothesis does not hold universally. Furthermore, it seems scarcely relevant in a context like ours, where the overwhelming majority of the children that work is reported working in the home, or in the family farm.

Children who attend school and work at the same time fare worst of all.

We have identified a number of policies that would change the environment in the desired direction. One such policy is the provision of schools at village level. By reducing the cost of education, the presence of a school nearby induces parents to procure fewer births, and to better feed and care for each child that is born. As a consequence, a higher proportion will survive to school age. Of those who survive, more will be sent to school and fewer to work. Furthermore, each of these children will be better nourished, and attract higher educational expenditure if attending school. The higher the grade of school available, the stronger the effects. School provision influences, therefore, much more than education: it improves school attendance and reduces the incidence of child work (the two, remember, are not mutually exclusive), but is also likely to reduce morbidity and mortality through the life-cycle.

The effects of public expenditure on items such as sanitation or mass immunization also extend beyond the health sphere. This policy raises the probability that a child will be sent to school, and induces parents to spend more for the nutrition and education of each child attending school. Thus, it reduces morbidity and mortality, not only directly, but also indirectly, because its direct effects are reinforced by those of induced parental action. By discouraging child labour, the policy also reduces fertility. The finding of an effect of survival-enhancing measures on the school attendance, educational expenditure and nutritional status of school-age children makes it likely that the household decision model generating our data is non-altruistic.

Income redistribution could help reduce child labour, but land redistribution is likely to have the opposite effect (because it raises labour productivity, and thus the opportunity-cost of time in education, in those very households where children are more likely to work on the family farm).

A word, finally, about the so-called missing children, those reported neither working, nor attending school. The nutritional status of these children is better, on average, than that of children going to school, and no worse than that of children reported working full time. Despite local expert advice that many children indeed do nothing, or hardly anything, we have found signs that a sizeable proportion of reportedly idle children may be actually working full time. More information, and a more thorough statistical analysis is required before one can reach any firm conclusion about this category.

7 References

Atella, V. and F.C. Rosati (1999) "Uncertainty about children's survival and fertility: a test using Indian microdata", *Journal of Population Economics* (forth.)

Basu, A.M. (1993) "Family size and child welfare in an urban slum" in C.B. Lloyd (ed.) *Fertility, Family Size and Structure*, Population Council, New York

Basu, K. (1999) "Child labor: cause, consequence and cure, with remarks on international labor standards", *Journal of Economic Literature* 37, 1083-1119

Becker, G.S. and H.G. Lewis (1973) "On the interaction between the quantity and quality of children", *Journal of Political Economy* 81, 279-288

Behrman, J. (1988) "Intra-household allocation of nutrients in rural India: are boys favoured?", *Oxford Economic Papers* 40, 32-54

Behrman, J., Foster, A.D., Rosenzweig, M.R. and P. Vashishtha (1999) "Women's schooling, home teaching, and economic growth", *Journal of Political Economy* 107, 683-714

Cigno, A. (1991) *Economics of the Family*, Clarendon Press and Oxford University Press, Oxford and New York

Cigno, A. (1993) "Intergenerational transfers without altruism: family, market and state", *European Journal of Political Economy* 7, 505-518

Cigno, A. (1998) "Fertility decisions when infant survival is endogenous", *Journal of Population Economics* 11, 21-28

Cigno, A. and G. Pinal (1999) "Endogenous child mortality, price of child-specific goods, and fertility decisions: evidence from the Argentinian Andes", *IEA World Congress*, Buenos Aires

Dasgupta, P. (1997) "Nutritional status, the capacity for work, and poverty traps", *Journal of Econometrics* 77, 5-37

de Onis, M. and J.-P. Habicht (1996) "Anthropometric reference data for international use: recommendations from a World Health Organization expert committee", *American Journal of Clinical Nutrition* 64, 650-658

Drèze, I. and A. Sen (1995) *India: Economic Development and Social Opportunity,* Clarendon Press, Oxford

Fogel, R.W. (1993) "New sources and new techniques for the study of secular trends in nutritional status, health, mortality, and the process of aging", *Historical Methods* 26, 5-43

Folbre, N. (1986) "Hearts and spades: paradigms of household economics", *World Development* 14, 245-255

Grootaert, C. and R. Kanbur (1995) , "Child labour: an economic perspective", *International Labour Review* 134, 187-203

Klasen, S. (1996) "Nutrition, health and mortality in sub-Saharan Africa: is there a gender bias?", *Journal of Development Studies* 32, 913-32

Lavy, V. (1996) "School supply constraints and children's educational outcomes in rural Ghana", *Journal of Development Economics* 51, 291-314

Murthi, M., Guio, A.-C. and J. Drèze (1995) "Mortality, fertility and gender bias in India", *IEA World Congress*, Tunis

Patrinos, H.A. and G. Psacharopoulos (1997) "Family size, schooling and child labor in Peru", *Journal of Population Economics* 10, 387 -405

Psacharopoulos, G. (1997) "Child labor versus educational attainment: some evidence from Latin America", *Journal of Population Economics* 10, 377-386

Ravallion, M. and Q. Wodon (2000) "Does child labor displace schooling? Evidence on behavioral responses to an enrollment subsidy", *Economic Journal* 110, 158-176

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

Rosenzweig, M.R. and K.J. Wolpin (1982) "Governmental interventions and household behavior in a developing country", *Journal of Development Economics* 10, 209-225

Sen, A. (1995) "Mortality as an indicator of economic success or failure", *Innocenti Lectures*, UNICEF International Child Development Centre, Florence

Waaler, H.Th. (1984) "Height, weight and mortality: the Norwegian experience", *Acta Medica Scandinavica*, suppl.679