Mortality Risks and Child Labor

F. Estevan and J.M. Baland

Discussion Paper 2005-40

Département des Sciences Économiques
de l'Université catholique de Louvain

UCL

Mortality risks and child labor*

Fernanda Estevan[†] Jean-Marie Baland[‡]

Abstract

In this paper, we investigate the role of young adult mortality on child labor and educational decisions. We show that, in the absence of appropriate insurance mechanisms, the level of child labor is inefficient. It may be too high if parents are not very altruistic and anticipate positive transfers from their children in the future, but it can also be too low, in particular when parents expect to make positive transfers to their children in the future. Imperfect capital markets unambiguously increase the equilibrium level of child labor. We also show that a cash transfer conditional on child's schooling can always restore efficiency regarding child labor.

*This paper is part of Fernanda's Phd thesis. For useful discussions and comments, we would like to thank Guido Friebel, Jean Hindriks and Pierre Pestieau, as well as participants to seminars given in Public Economics Meeting at CORE, CORE-IDEI Conference in Public Economics (Toulouse), CRED Workshop, and Journées de l'AFSE 2005. We would like to thank the MacArthur network on Inequality and Economic Performance and the CRED for financial support. This work is part of the Belgian Program on Inter-University Poles of Attraction initiated by the Belgian State, Prime Minister's office, Science Policy Programming and of the Action de Recherches Concertees (Namur).

[†]Corresponding author: Department of Economics, CORE, Catholic University of Louvain - 34, Voie du Roman Pays - 1348 - Louvain la Neuve, Belgium - Phone: +32.10.47.83.06 - Fax: +32.10.47.43.01 *E-mail address:* estevan@core.ucl.ac.be.

[‡]Department of Economics, CRED, University of Namur.

1 Introduction

Child labor is a pressing and important social issue. According to the ILO, about one fifth of all children between 5 and 14 were considered as working in the world in 2000. Child labor is highly concentrated in developing countries, with 60% of all working children living in the Asian-Pacific region. The highest proportion of working children is however found in Sub-Saharan Africa, with an average 29% of children working.

In a seminal paper, Basu and Van (1998) show that, if adult and child labor are substitutes and parents send their children to work only when the family is poor, multiple equilibria can exist. This gives scope for policy interventions such as a ban that moves the economy from a 'bad' equilibrium, where both children and adults are working for low wages, to a good one, where children do not work and wages are high.

Another approach attempts to understand how child labor can arise as the rational decision by parents who take into account the trade-off between child labor and schooling. In this perspective, there are two possible explanations for the incidence of child labor. The first possibility is that private returns from education are not high enough. This view is apparently contradicted by several empirical studies, such as Psacharopoulos (1997), which show that returns from education are relatively high in developing countries.[1]

The second possibility is that several constraints force parents to take inefficient decisions with respect to child labor. Baland and Robinson (2000) explicitly consider the trade-off between child labor and the accumulation of human capital. In a model in which parents are fully altruistic with respect to their children, they show that an inefficiently high level of child labor may arise when parents leave their children no bequests or when capital markets are imperfect.[2] With perfect capital markets and positive bequests, parents always choose the privately efficient level of child labor, as they perfectly internalize the negative impact of child labor on their children

[1]However, Couralet (2002) argues that estimations of the rate of return to education in developing countries are biased upwards. First, the great heterogeneity of education quality in developing countries induces a selection bias: the better the quality of education, the longer the duration of the studies. Also, several estimates of returns to education do not take into account other characteristics of the individual, such as the socioeconomic background, which also contributes to an over-valuation of these returns.

[2]This finding seems to be confirmed in the light of empirical studies. The impact of liquidity constraints on child labor was investigated in Edmonds (2004) using South African data, by analyzing the effect of anticipated pension income on child labor and schooling decisions. He shows that once households become eligible for the pension income, child labor declines and schooling increases, suggesting the presence of liquidity constraints.

future earning ability. Clearly, however, to obtain this result, parents must perfectly anticipate returns to education.

However, human capital is a risky investment (see e.g., Becker, 1964; Levhari and Weiss, 1974). First, parents do not observe perfectly their children's abilities nor the quality of schooling. Second, future labor market conditions are subject to unpredictable events. It can however be argued that these sources of risk affect equally developed economies, so that they do not constitute a likely explanation for the prevalence of child labor in poor countries.[3] Another source of uncertainty consists in the high mortality rates among young adults that prevail nowadays in poor countries, and directly affect returns to education. Table 1 presents some data on life expectancy and mortality rates for selected countries.

These figures illustrate the huge discrepancies in life expectancy between developing and developed countries, but also among developing countries. In Asia or Latin America, life expectancy is on average 10 years lower than in a developed economy, but 20 to 30 years higher than in most African countries. Infant and under-five mortality rates certainly explain part of these differences, but they are not directly relevant to our question. More interesting is the evidence on mortality rates between ages 5 and 40. In Africa, the probability of dying between 5 and 40 lies between 13% and 62.5% while it reaches barely 10% in other developing countries (and less than 5% in developed countries). Indeed according to the World Health Report (World Health Organization, 2004), the average mortality rate between 15 and 44 exceeded 25% in Africa in 2004.

Clearly, there is also a high correlation between the prevalence of child labor and mortality among young adults. Figure 1 represents this relation for 126 developing countries.

In this paper we investigate the relationship between young adult mortality and child labor. To do this, we present a modified version of Baland and Robinson (2000) to allow for children's uncertain lifetime and the possibility of premature death. We show that even when capital markets are perfect and intergenerational transfers are positive, the level of child labor is inefficient. It is inefficiently high when parents are not too altruistic and anticipate positive transfers from their children in the future, as in the old age security model. This is because, given the possible death of their child, they tend to favor a certain investment, such as saving, to an uncertain one, such as human capital. However, we shall also show that child labor is inefficiently low when parents anticipate to make positive future transfers to their children. Indeed, with the possible death of their child, parents prefer an investment

[3]Razin (1976) focuses on the advantage of physical capital compared to human capital, as the latter is not transferable, in the presence of premature mortality.

Table 1: Demographic figures

Country	Life expectancy at birth (years) 2000-05	Mortality rate between ages 5 and 40 (per 1,000 births)[a] 2002
Japan	81.6	14
Germany	78.3	16
China	71.0	32
United States	77.1	34
Mexico	73.4	47
India	63.9	60
Indonesia	66.8	63
Guatemala	65.8	92
Mali	48.6	131
Senegal	52.9	139
Ghana	57.9	158
Gambia	54.1	170
Sudan	55.6	182
Burkina Faso	45.7	227
Chad	44.7	229
Ethiopia	45.5	262
Uganda	46.2	270
Cameroon	46.2	276
Burundi	40.9	315
Cote d'Ivoire	41.0	341
Mozambique	38.1	363
Kenya	44.6	373
South Africa	47.7	384
Malawi	37.5	413
Namibia	44.3	456
Zambia	32.4	509
Swaziland	34.4	556
Zimbabwe	33.1	625

Source: Human Development Report (United Nations, 2004)

[a]Data refer to the probability at birth of not surviving to age 40 minus under-five mortality rates.

that is contingent on their child being alive, such as education, to one which is not, such as savings. In this respect, it is striking that Sub-Saharan Africa presents the highest young mortality rates, the largest proportion of working children as well as a generalized practice of large scale transfers from young working adults to their parents.

Closest to this paper is that of Eswaran (2000). There, he builds an old-age security model, where parents simultaneously decide how many children to have and whether to send them to school or to work, taking into account that some of them will die before adulthood. The combination of high mortality rates with lack of access to capital markets induces parents to have many children to ensure that enough will survive to provide them with old-age support. Child labor is then used to maintain income in large families. Our paper stresses another mechanism,

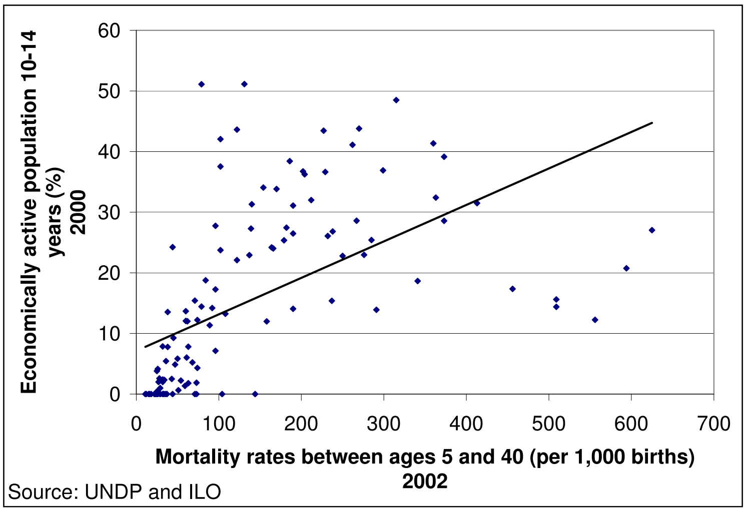

Figure 1: Mortality rates vs. Child labor

by positing exogenous fertility and perfect capital markets, and focussing on the imperfections of the insurance market (against child mortality).[4] Moreover, we also show that while child labor is too high in the old-age fertility model, it can also be too low when parental altruism is strong.[5]

More recently, Pouliot (2005) introduces uncertainty in returns to human capital into Baland and Robinson (2000). He shows that, if the return to education is a continuous random variable, the level of child labor is inefficiently high in the absence of insurance markets, even when bequests and savings are interior. Parents then always prefer to increase child labor at the expense of education, as the latter is now a risky investment. We show that this result depends crucially on the type of uncertainty that is being considered. When young adult mortality is introduced, the issue of contingent transfers becomes critical. Additionally, to explain the prevalence of child labor in developing countries, one would need to show that uncertainty in the returns to education is more widespread there. Unfortunately no evidence is presented towards this end[6].

This paper is organized as follows. In Section 2, we present the model, the results of which are presented in Section 3. In Section 4, we discuss possible policy

[4]Our results easily generalize to a situation where fertility is endogenous.

[5]Strulik (2004) builds a growth model combining fertility, child mortality, child labor and education to analyze the impact of child mortality on economic growth. However, human capital does not enter explicitly into the utility function of parents, and there is no inter-generational transfers, while they play a crucial role in our results.

[6]Note that the existence of social security in most developed countries is probably not enough to justify the fact that child labor is lower in such countries. Indeed, most benefits do not take directly into account the level of education of the recipients and so do not really constitute insurance against such risks.

interventions, and the last Section concludes.

2 The model

We consider two periods, $t = 1, 2$. In each period, the production technology is such that one unit of labor produces one unit of the numeraire good. The wage rate is equal to 1. There are L_p parents who supply A efficiency units of labor in each period. Each parent has one child. In the first period, the parent decides the amount of time his child spends working, $l_c \in [0, 1]$, where $(1 - l_c)$ represents the time she spends at school. The parent also decides the amount he consumes, c_1, and the amount he chooses to save, s. The child takes no decision in period 1. We consider that capital markets are perfect, so that s can be positive or negative, and we assume that the discount rate and the interest rate are both equal to zero. In the end of this Section we discuss the implications of imperfect capital markets, that is, the situation in which the parents can save but cannot borrow.

While all parents live in the second period[7], some children may die at the end of period 1 with probability $(1-p)$. We assume that p, the probability that a child lives in period 2, is exogenous [8]. In period 2, if she survived, the child is now an adult and supplies $h(1 - l_c)$ efficiency units of labor. $h(.)$ represents the human capital she possesses in period 2 if she worked l_c units of time in period 1. We assume that an increase in schooling increases the amount of human capital, but at a decreasing rate, that is, $h'(1-l_c) > 0$, and $h''(1-l_c) < 0$. We also assume $h(0) = 1$, $h'(0) = \infty$ and $h'(1) = 0$ (which will imply that the optimal value of l_c is interior). In period 2, the child, when alive, chooses the amount she consumes, c_c, and the amount τ she transfers to her parent. Each parent chooses the amount b he gives to his child. If the child dies at the end of period 1, no transfers can be made, so that $b = \tau = 0$. Transfers are positive or nil: $b \geq 0$, $\tau \geq 0$[9].

We first consider the situation under which there is a perfect insurance market. The only risk faced by a parent is the possibility that his child dies at the end of period 1, in which case he cannot, in period 2, give or receive transfers. The insurance contract is such that if P is the premium a parent decides to pay in period 1, he receives an amount $I = P/(1 - p)$ in period 2 if his child dies, and 0 if not.

[7] Note that the possibility that parents die after the first period complicates substantially the analysis, but yields more ambiguous results.

[8] Empirical evidence seems to give support to this assumption of exogenous probability. According to the World Health Report (World Health Organization, 2004), in the age range of 15-29 years, 42.5% of deaths in AFRO E (African countries with high child and adult mortality rates) can be attributed to AIDS epidemics, while 18% are caused by war and violence.

[9] Our results do not change significantly if we assume instead that the parents alone control all the transfers, that is, that they leave bequests that can be positive or negative.

In period 1, the parent faces the following budget constraint

$$c_1 = A + l_c - s - (1-p)I \tag{1}$$

where c_1, his consumption in period 1, is equal to the household labor earnings, $A + l_c$, minus the amount he saves, s, and the insurance premium, $(1-p)I$ (for simplicity, we assume that children do not consume in period 1). In period 2, the parent's budget constraint differs depending on whether his child died at the end of period 1 or not. We let c_2^a and c_2^d denote parental consumption in period 2 if his child is alive and not alive, respectively. If the child is alive, the parent's budget constraint is

$$c_2^a = A + s - b + \tau \tag{2}$$

and if the child died at the end of period 1, the parent's budget constraint in period 2 is

$$c_2^d = A + s + I \tag{3}$$

Given his budget constraints, a parent chooses l_c, s and $(1-p)I$ in period 1 and, in period 2, b if his child is alive, to maximize the following utility function:

$$W_p = U(c_1) + \left[pU(c_2^a) + (1-p)U(c_2^d)\right] + p\delta W_c \tag{4}$$

where W_c represents the child's utility in period 2, if she is alive, and δ measures parental altruism.

In period 2, if she is alive, the child's budget constraint is:

$$c_c = h(1-l_c) + b - \tau \tag{5}$$

and the child chooses τ to maximize

$$W_c = V(c_c) + \lambda\left[U(c_2^a) + \delta W_c\right] = \frac{V(c_c) + \lambda U(c_2^a)}{1-\delta\lambda} \tag{6}$$

where λ measures filial altruism.

Replacing (6) into (4), the parent's utility function can be rewritten as:

$$W_p = U(c_1) + p\frac{U(c_2^a)}{1-\delta\lambda} + (1-p)U(c_2^d) + p\frac{\delta V(c_c)}{1-\delta\lambda} \tag{7}$$

We assume that U and V are both strictly increasing, strictly concave, and twice continuously differentiable. We also assume that $\delta\lambda < 1$, to restrict the effect of the mutual altruism multiplier.

The first-order conditions with respect to child labor, savings, insurance and parental transfers are respectively

$$U'(c_1) + p\frac{U'(c_2^a)}{1-\delta\lambda}\frac{d\tau}{dl_c} = p\frac{\delta V'(c_c)}{1-\delta\lambda}\left[h'(1-l_c) + \frac{d\tau}{dl_c}\right] \quad \text{and} \quad \tau > 0 \tag{8}$$

$$U'(c_1) = p\frac{\delta V'(c_c)}{1-\delta\lambda}h'(1-l_c) \quad \text{and} \quad \tau = 0 \tag{9}$$

$$U'(c_1) + p\frac{\delta V'(c_c)}{1-\delta\lambda}\frac{d\tau}{ds} = p\frac{U'(c_2^a)}{1-\delta\lambda}\left[1 + \frac{d\tau}{ds}\right] + (1-p)U'(c_2^d) \quad \text{and} \quad \tau > 0 \tag{10}$$

$$U'(c_1) = p\frac{U'(c_2^a)}{1-\delta\lambda} + (1-p)U'(c_2^d) \quad \text{and} \quad \tau = 0 \tag{11}$$

$$U'(c_1) = U'(c_2^d) \tag{12}$$

$$U'(c_2^a) = \delta V'(c_c) \quad \text{and} \quad b > 0 \tag{13}$$

$$U'(c_2^a) > \delta V'(c_c) \quad \text{and} \quad b = 0 \tag{14}$$

Note that, in the first period, parents take into account the impact of their decisions in the first period on the amount of filial transfers, when positive.[10] Equation (12) states that a parent chooses $(1-p)I$ so as to equalize his first period marginal utility to his second period marginal utility if his child dies.

Similarly, the first-order condition with respect to filial transfers, τ, are given by:

$$V'(c_c) = \lambda U'(c_2^a) \quad \text{and} \quad \tau > 0 \tag{15}$$

$$V'(c_c) > \lambda U'(c_2^a) \quad \text{and} \quad \tau = 0 \tag{16}$$

Equations (13) and (15) cannot hold simultaneously. The non-negativity constraints on transfers allow us to distinguish between three different situations: (1) *Parental transfers*, with $b > 0$ and $\tau = 0$; (2) *Filial transfers*, with $b = 0$ and $\tau > 0$; and (3) *No transfers*, with $b = \tau = 0$, in which both the parent and the child choose to make no transfers. Lemma 1 establishes the existence of these three cases.

Lemma 1. *If $\delta\lambda < 1$, there always exists $[\delta, \lambda]$ such that filial transfers are positive, $[\delta', \lambda']$ such that parental transfers are positive, and $[\delta'', \lambda'']$ such that intergenerational transfers are nil.*

[10] Note however that there is no impact of the insurance premium, as this gives rise to benefits for the parent only if his child dies, and transfers are therefore nil. Parental transfers have no impact either as they are contemporaneous to filial transfers.

Proof. Consider the case in which $\tau > 0$. For all feasible values of c_2^a and c_c, there is a λ high enough and a δ low enough such that filial transfers are positive, that is,

$$\lambda > \frac{V'(h(0))}{U'(2A+1)}$$
$$\delta < \frac{U'(2A+1)}{V'(h(0))} \tag{17}$$

Note that $2A + 1$ corresponds to the highest possible parental income in period 2, as in this case, the child did not go to school and the parent saved all his income in period 1. Similarly, $h(0)$ corresponds to the level of human capital that the child will have if she did not receive any education. This condition implies that even if parents transfer all their income in period 2, children with zero education will still be willing to transfer strictly positive amounts of income to their parents.

The proof for the case of parental transfers and no transfers can be obtained with a similar argument. □

Typically, transfers are nil when δ and λ are small enough, parental transfers will be positive if δ is high and λ is low, and filial transfers will be positive if λ is high and δ is low.

3 Main results

When transfers are not nil, the parent fully internalizes the impact of his decision regarding child labor on the earning ability of his child in period 2. As a result, he equalizes the expected marginal benefit of schooling, $ph'(1 - l_c^e)$, to 1, its cost in terms of lost labor income in period 1. This corresponds to the Pareto efficient level of child labor, which is decreasing in the probability of survival. This result is stated in Proposition 1:

Proposition 1. *With perfect insurance markets, child labor is efficient iff transfers are not nil. The efficient level of child labor is such that*

$$ph'(1 - l_c^e) = 1 \tag{18}$$

Proof. We propose here a brief sketch of the proof. Equation (18) obtains by combining equations (9), (11), (12) and (13) when parental transfers are positive. When filial transfers are positive, differentiating (15) with respect to l_c and s we obtain:

$$\frac{d\tau}{dl_c} = \frac{-h'(1-l_c)V''(c_c)}{\lambda U''(c_2^a) + V''(c_c)} \tag{19}$$

$$\frac{d\tau}{ds} = \frac{-\lambda U''(c_2^a)}{\lambda U''(c_2^a) + V''(c_c)} \tag{20}$$

Then by combining equations (8), (10), (12), (15), (19), and (20) we obtain the result. To show that this is efficient, one has to show that no profitable contract can be made between the parent and the child such that the latter would be ready to pay for a marginal increase in her education more than its opportunity cost to her parent, which is exactly equal to 1. The inefficiency of parental decisions when transfers are nil can be proven following Baland and Robinson (2000). Thus, with $b = \tau = 0$, one obtains easily that $ph'(1-l_c^e) = \frac{(1-\delta\lambda)U'(c_1)}{\delta V(c_c)} = \frac{U'(c_2^a)}{\delta V(c_c)} > 1$. □

We now turn to the consequences of the absence of an insurance market. In this case, equation (12) does not hold as parents have no more access to an insurance contract. We now determine the equilibrium level of child labor that prevails in the three different situations of parental transfers, filial transfers and no transfers. When parental transfers are positive, combining equations (9), (11) and (13), the equilibrium level of child labor is determined by:

$$ph'(1-l_c^*) = p + (1-p)\frac{U'(c_2^d)}{\frac{U'(c_2^a)}{1-\delta\lambda}} \tag{21}$$

When filial transfers are positive, using equations (8), (10), (15), (19), and (20), one obtains:

$$ph'(1-l_c^*) = p + (1-p)\frac{\lambda U''(c_2^a) + V''(c_c)}{\delta\lambda^2 U''(c_2^a) + V''(c_c)}\frac{U'(c_2^d)}{\frac{U'(c_2^a)}{1-\delta\lambda}} \tag{22}$$

The additional term in the expression corresponds to the anticipation by the parent of the impact of his decisions on filial transfers. Finally, in the absence of transfers, combining equations (9) and (11) yields:

$$ph'(1-l_c^*) = p\frac{U'(c_2^a)}{\delta V'(c_c)} + (1-p)\frac{U'(c_2^d)}{\frac{\delta V'(c_c)}{1-\delta\lambda}} \tag{23}$$

In all these situations, the equilibrium level of child labor is monotonically increasing with mortality rates. This is expressed in the following proposition:

Proposition 2. *With or without perfect insurance markets, an increase in child mortality increases the equilibrium level of child labor.*

Proof. With perfect insurance, this result is straightforward by (18). Without perfect insurance, a proof in the case of parental transfers is presented in the Appendix. □

The intuition for this result is straightforward. An increase in mortality rates lowers the expected return to education, which induces parents to reduce their investment in education and increase the level of child labor. We now show that the impact of mortality on child labor goes well beyond its direct impact on the expected returns to education. Indeed, in the absence of insurance, the uncertainty about child survival leads parents to choose inefficient levels of child labor. This holds even if capital markets are perfect, and transfers are not nil.[11] The impact of uncertainty on child labor, however, critically depends on the direction of intergenerational transfers.

3.1 Case 1: Filial transfers

We focus on the situation where filial transfers are positive, which corresponds to the old-age security model. We obtain:

Proposition 3. *If $\tau > 0$, the equilibrium level of child labor is inefficiently high or low. It is too high if $\delta\lambda < \frac{1}{2}$, and it is too low for $\delta\lambda \to 1$.*

Proof. First note that with positive filial transfers, $c_2^a > c_2^d$. If $\delta\lambda < \frac{1}{2}$, equation (22) equals

$$ph'(1 - l_c^*) = p + (1 - p)\frac{\lambda U''(c_2^a) + V''(c_c)}{\delta\lambda^2 U''(c_2^a) + V''(c_c)} \frac{U'(c_2^d)}{\frac{U'(c_2^a)}{1-\delta\lambda}} > 1 \tag{24}$$

We see that if $\delta\lambda \to 1$,this result may no longer hold and the equilibrium level of child labor is inefficiently low. □

This result is surprising at first sight, since one would believe that, in the absence of insurance, parents would rather choose the "certain" income (i.e., child labor) at the expense of the uncertain one (i.e., child education). The above proposition shows that this intuition does not always hold. From equation (24) in the proof, we can distinguish two opposite effects determining the equilibrium level of child labor. The *strategic* effect, represented by the term $\frac{\lambda U''(c_2^a)+V''(c_c)}{\delta\lambda^2 U''(c_2^a)+V''(c_c)} \frac{U'(c_2^d)}{U'(c_2^a)}$, is directly related to the idea that parents prefer a certain income than the risky investment in education. (Note that, when doing so, they internalise the impact of their child labor and saving choices on filial transfers in period 2.) The term $1 - \delta\lambda$ represents the *mirror* effect

[11] When transfers are nil, the level of child labor is inefficient even in the presence of perfect insurance market, as discussed in Proposition 1. To properly identify the impact of the absence of an insurance market, we thus need to focus on situations where transfers are not nil.

which operates in the opposite direction. Indeed, under two-sided altruism, a parent gives more weight to his own utility when his child is alive what induces him to invest more in education. If $\delta\lambda$ is low enough, the strategic effect dominates the mirror effect, and the level of child labor is inefficiently high.

3.2 Case 2: Parental transfers

Suppose that parental transfers are strictly positive: $b > 0$. We obtain:

Proposition 4. *If $b > 0$, the equilibrium level of child labor is inefficiently low in the absence of insurance markets.*

Proof. With positive parental transfers, $c_2^a < c_2^d$. In equation (21), one obtains:

$$ph'(1 - l_c^*) = p + (1 - p)\frac{U'(c_2^d)}{\frac{U'(c_2^a)}{1-\delta\lambda}} < 1$$

□

Once again, the result is counter-intuitive. When parental transfers are positive, child labor is too low. The reason for this is that a parent have two ways to make transfers to his child: reducing child labor to increase the child's human capital and therefore raise her future income, or making his child work, saving and then transferring in period 2. The latter strategy however implies that, if the child dies, the parent will be left with too much income in period 2. As a result, parents choose to invest more in the contingent transfer, education.

So far, we assumed capital markets to be perfect. Consider now that they are imperfect so that parents can save but cannot borrow. We denote the equilibrium level of child labor by l_c^i.

If savings are at the corner, the first-order conditions with respect to s (see equations (10) and (11)), become:

$$U'(c_1) > p\frac{U'(c_2^a)}{1 - \delta\lambda} + (1 - p)U'(c_2^d) \quad \text{and} \quad \tau \geq 0 \tag{25}$$

since with $s = 0$, $\frac{d\tau}{ds} = 0$. One obtains by combining equations (9), (13), and (25) (in the case of parental transfers) or equations (8), (15), (25), (19), and (20) (in the case of filial transfers):

$$ph'(1 - l_c^i) > ph'(1 - l_c^*) \tag{26}$$

that is, under imperfect capital markets, the equilibrium level of child labor is always higher under the assumption of imperfect capital markets.

Proof. omitted □

As in Baland and Robinson (2000), imperfect capital markets always increase child labor. Since parents cannot borrow to transfer income to the present, they inefficiently increase child labor to this end. We showed above that in the case of parental transfers or in the case of filial transfers with $\delta\lambda \rightarrow 1$, child labor is inefficiently low. Imperfect capital markets may thus help to reduce this inefficiency (even though the resulting equilibrium level of child labor can now be too low or too high). In the case of filial transfers when $\delta\lambda < \frac{1}{2}$, capital market imperfections increase further the level of child labor, making it even more inefficient.

4 Efficiency-restoring policy interventions in the old-age security model

In Section 3, we have shown that, in the absence of insurance markets, parents may choose an inefficiently high or low level of child labor depending on the levels of parental and filial altruism. In this section, we shall focus on the situation where filial transfers are positive, and $\delta\lambda < \frac{1}{2}$. As shown in Cain (1982) or Nugent (1985), in many developing countries, filial transfers and the old-age security motive play indeed a major role for fertility or education decisions. Moreover, African countries in which early mortality is really an issue are also characterized by impressively high levels of filial transfers (see e.g., Caldwell and Caldwell, 1987). In this section, we discuss some policy interventions that can potentially restore efficiency in such a setting.

A tax schedule that replicates the insurance scheme would obviously be efficiency-enhancing. But, as much as an insurance contract, such a direct scheme might not be implementable. Public pensions is potentially an attractive alternative policy, since we have shown that inefficient levels of child labor were related to the old-age security motive. The introduction of a fully-funded public pension has no impact, given that we have already assumed perfect capital markets. However, a pay-as-you-go pension system provides insurance to parents since it constitutes a transfer from surviving children to all parents, and so may restore efficiency in this setting.

Another alternative is to introduce cash transfers conditional on child's education. Such conditional cash transfers are increasingly popular in developing countries, as attested by the *Bolsa Escola* program in Brazil or *PROGRESA* in Mexico (see e.g., Ravallion and Wodon, 2000). The conditional cash transfer distorts incentives in favor of the child's education, while simultaneously compensating poor families for foregone child labor earnings. Consider that a parent receives in period

1 a cash transfer proportional to the amount of education he provides to his child, $1 - l_c$. We let this transfer be financed by a tax on surviving children in period 2. The tax is uniform, and depends on the average level of education in the economy (we assume that the economy is populated by a large number of individuals)[12]. We can then show:

Proposition 5. *There always exists a conditional cash transfers program, financed by a uniform tax, such that the equilibrium level of child labor is efficient.*

Proof. The parent's first period budget constraint becomes

$$c_1 = A + l_c - s + \theta(1 - l_c)$$

where θ represents the transfer per unit of education provided. In period 2, the parents' budget constraints are as before given by equations (2) and (3). Let $\overline{1 - l_c}$ represent the average level of education in the economy. Under a balanced budget constraint, the tax we need to impose on surviving children in period 2 is equal to $(\theta(\overline{1 - l_c})/p)$, so that the child's budget constraint in period 2 is now given by

$$c_c = h(1 - l_c) - \tau - \theta(\overline{1 - l_c})/p$$

The first-order condition with respect to l_c is now given by:

$$U'(c_1)(1 - \theta) + p\frac{U'(c_2^a)}{1 - \delta\lambda}\frac{d\tau}{dl_c} = p\frac{\delta V'(c_c)}{1 - \delta\lambda}\left[h'(1 - l_c) + \frac{d\tau}{dl_c}\right]$$

Combining this with equation (10), (15), (19), (20), one gets:

$$ph'(1 - l_c) = (1 - \theta)\left[p + (1 - p)\frac{\lambda U''(c_2^a) + V''(c_c)}{V''(c_c)}\frac{U'(c_2^d)}{\frac{U'(c_2^a)}{1 - \delta\lambda}}\right] \quad (27)$$

If $\theta = 0$, we find the initial equilibrium given by equation (22). If $\theta = 1$, the cash transfer is such that parents choose $l_c = 0$. Given our assumptions on U and V, the level of child labor defined by equation (27) is a continuous function of θ. As a result, there always exists a level of θ that implements the efficient level of child labor. □

As a result, an appropriate system of conditional cash transfers can always bring back the efficient level of child labor. It should however be noted that global efficiency is not achieved, as decisions over savings and transfers are typically inefficient.

[12]Note that our results do not change if we consider alternative financing mechanisms, such as a tax levied on the parents' first or second period income or a budget deficit. These schemes have no impact on the parental decision but only on the net income levels of the agents.

5 Conclusion

In this paper we have investigated the impact of young adult mortality on child labor and educational decisions. We have shown that, in the absence of appropriate insurance mechanisms, the level of child labor is inefficient. It is too high if parents are not too altruistic and anticipate positive transfers from their children in the future, but it can also be too low, for instance if parents expect to make future positive transfers to their children in the future. We also show that a cash transfer program conditional on child's schooling can always restore efficiency regarding child labor.

References

Baland, J. M. and Robinson, J. A. (2000). Is child labor inefficient. *Journal of Political Economy*, 108(4):663–679.

Basu, K. and Van, P. H. (1998). The economics of child labor. *The American Economic Review*, 88(3):412–427.

Becker, G. S. (1964). *Human Capital: A Theoretical and Empirical Analysis, with Special Reference to Education.* Columbia university press. National Bureau of Economic Research, New York, 1nd edition.

Cain, M. (1982). Perspectives on family and fertility in developing countries. *Population Studies*, 36(2):159–175.

Caldwell, J. C. and Caldwell, P. (1987). The cultural context of high fertility in sub-saharan africa. *Population and Development Review*, 13(3):409–437.

Couralet, P.-E. (2002). *Une analyse économique du travail des enfants.* Phd thesis, Ecole des hautes études en sciences sociales.

Edmonds, E. V. (2004). Does illiquidity alter child labor and schooling decisions? evidence from household responses to anticipated cash transfers in south africa. *NBER Working Paper*, w10265.

Eswaran, M. (2000). *Institutions, Incentives and Economic Reforms in India*, chapter 9, pages 267–296. Sage India.

Levhari, D. and Weiss, Y. (1974). The effect of risk on the investment in human capital. *The American Economic Review*, 64(6):950–963.

Nugent, J. B. (1985). The old-age security motive for fertility. *Population and Development Review*, 11(1):75–97.

Pouliot, W. (2005). Introducing uncertainty into baland and robinson's model of child labour. *Journal of Development Economics*, forthcoming.

Psacharopoulos, G. (1997). Child labor versus educational attainement. some evidence from latin america. *Journal of Population Economics*, 10:377–386.

Ravallion, M. and Wodon, Q. (2000). Does child labour displace schooling? evidence on behavioural responses to an enrollment subsidy. *The Economic Journal*, 110:C158–C175.

Razin, A. (1976). Lifetime uncertainty, human capital and physical capital. *Economic Inquiry*, 14:439–448.

Strulik, H. (2004). Child mortality, child labour and economic development. *The Economic Journal*, 114:547–568.

A Proof of Proposition 2

A.1 Parental transfers

We concentrate in the case in which parental transfers are positive and so filial transfers are nil.

Proof. The first-order conditions are given by equations (13), (9), and (11). These equations then define three implicit equations, namely

$$F_1(l_c, s, b; p, \lambda, \delta) = \delta V'(h(1-l_c)+b) - U'(A+s-b) = 0 \quad (28)$$

$$F_2(l_c, s, b; p, \lambda, \delta) = U'(A+l_c-s) - p\frac{\delta V'(h(1-l_c)+b)}{1-\delta\lambda}h'(1-l_c) = 0 \quad (29)$$

$$F_3(l_c, s, b; p, \lambda, \delta) = -U'(A+l_c-s) + p\frac{U'(A+s-b)}{1-\delta\lambda} + (1-p)U'(A+s) = 0 \quad (30)$$

From the implicit function theorem, we know that

$$\begin{pmatrix} \frac{db}{dp} \\ \frac{dl_c}{dp} \\ \frac{ds}{dp} \end{pmatrix} = - \begin{pmatrix} \frac{\partial F_1}{\partial b} & \frac{\partial F_1}{\partial l_c} & \frac{\partial F_1}{\partial s} \\ \frac{\partial F_2}{\partial b} & \frac{\partial F_2}{\partial l_c} & \frac{\partial F_2}{\partial s} \\ \frac{\partial F_3}{\partial b} & \frac{\partial F_3}{\partial l_c} & \frac{\partial F_3}{\partial s} \end{pmatrix}^{-1} \begin{pmatrix} \frac{\partial F_1}{\partial p} \\ \frac{\partial F_2}{\partial p} \\ \frac{\partial F_3}{\partial p} \end{pmatrix}$$

Applying it to the implicit equations (28), (29), and (30), we obtain

$$\begin{pmatrix} \frac{db}{dp} \\ \frac{dl_c}{dp} \\ \frac{ds}{dp} \end{pmatrix} = - \begin{pmatrix} \delta V''(c_c) + U''(c_2^a) & -\delta V''(c_c)h' & -U''(c_2^a) \\ -p\frac{\delta V''(c_c)}{1-\delta\lambda}h' & U''(c_1) + p\frac{\delta V''(c_c)}{1-\delta\lambda}[h']^2 + p\frac{\delta V'(c_c)}{1-\delta\lambda}h'' & -U''(c_1) \\ -p\frac{U''(c_2^a)}{1-\delta\lambda} & -U''(c_1) & U''(c_1) + p\frac{U''(c_2^a)}{1-\delta\lambda} + (1-p)U''(c_2^d) \end{pmatrix}^{-1} \cdot \begin{pmatrix} 0 \\ -\delta V'(c_c)h' \\ \frac{U'(c_2^a)}{1-\delta\lambda} - U'(c_2^d) \end{pmatrix} \quad (31)$$

The determinant of this matrix is negative due to the concavity of this problem. Thus we can express $\frac{dl_c}{dp}$ as

$$\begin{aligned} \frac{dl_c}{dp} &= \left\{ \left[\delta V''(c_c) + U''(c_2^a)\right] \left[U''(c_1) + p\frac{U''(c_2^a)}{1-\delta\lambda} + (1-p)U''(c_2^d)\right] - p\frac{[U''(c_2^a)]^2}{1-\delta\lambda} \right\} \left[-\frac{\delta V'(c_c)}{1-\delta\lambda}h'(1-l_c)\right] \\ &- \left\{ \left[\delta V''(c_c) + U''(c_2^a)\right] \left[-U''(c_1)\right] - U''(c_2^a) \left[p\frac{\delta V''(c_c)}{1-\delta\lambda}h'(1-l_c)\right] \right\} \left[\frac{U'(c_2^a)}{1-\delta\lambda} - U'(c_2^d)\right] \\ &= \left\{ \left[\delta V''(c_c) + U''(c_2^a)\right] \left[U''(c_1) + (1-p)U''(c_2^d)\right] + p\frac{U''(c_2^a)}{1-\delta\lambda}\delta V''(c_c) \right\} \left[-\frac{\delta V'(c_c)}{1-\delta\lambda}h'(1-l_c)\right] \\ &+ \left\{ \left[\delta V''(c_c) + U''(c_2^a)\right] U''(c_1) + U''(c_2^a) \left[p\frac{\delta V''(c_c)}{1-\delta\lambda}h'(1-l_c)\right] \right\} \left[\frac{U'(c_2^a)}{1-\delta\lambda} - U'(c_2^d)\right] \end{aligned} \quad (32)$$

Combining (29) and (30) we obtain

$$\frac{\delta V'(c_c)}{1-\delta\lambda}h'(1-l_c) = \frac{U'(c_2^a)}{1-\delta\lambda} + \frac{1-p}{p}U'(c_2^d) \quad (33)$$

Replacing (33) into (32), combining it with (21) and simplifying the resulting equation, we obtain

$$\begin{aligned} \frac{dl_c}{dp} &= -pU'(c_2^d)U''(c_2^a)\frac{\delta V''(c_c)}{1-\delta\lambda} - (1-p)\frac{[U'(c_2^d)]^2}{U'(c_2^a)}U''(c_2^a)\delta V''(c_c) \\ &- \frac{1}{p}U'(c_2^d)[U''(c_1)\delta V''(c_c) + U''(c_1)U''(c_2^a)] \\ &- \left[\frac{U'(c_2^a)}{1-\delta\lambda} - \frac{1-p}{p}U'(c_2^d)\right] [(1-p)U''(c_2^d)\delta V''(c_c) + (1-p)U''(c_2^d)U''(c_2^a)] < 0 \end{aligned} \quad (34)$$

□

The case of filial transfers can be obtained upon request from the authors.

Département des Sciences Économiques
de l'Université catholique de Louvain
Institut de Recherches Économiques et Sociales

Place Montesquieu, 3
1348 Louvain-la-Neuve, Belgique

ISSN 1379-244X D/2005/3082/040