

Working versus Schooling: the Impact of Social Expenditure

Abstract

We develop a theoretical model where child labour results from a household's trade-off between sending a child to school or to work. Education is considered as a risky investment, since the survival of the child is not certain. We explore the effects of public expenditure on education and health on child labour. On the one hand, we establish that health expenditure reduces child labour more when child mortality rate is high. On the other hand, a moderate aversion to risk is a necessary condition for expenditure on education to have a positive effect on child labour. Our theoretical results are tested empirically on data from 66 developing countries between 1985 and 2000.

Key-Words: child labour, education spending, health spending.

Classification JEL : J20, K31, D60.

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According to the International Labour Office (2000), approximately 211 million children from 5 to 14 are at work, 48 million of them in sub-Saharan Africa, and 127 million in the Asia-Pacific region. Moreover, 73 million working children are under 10 (ILO, 2002). However, education for all by 2015 is one of the Millennium Development Goals (MDGs) as defined by the United Nations. Beyond the banning of child labour, which remains a debatable measure (see Dessy and Pallage, 2005), the governments of the affected countries, as well as the international financial institutions such as the World Bank or the International Monetary Fund, have several political instruments they can use to provide incentives for reducing child labour. This paper focuses on one of these instruments, namely social expenditure, distinguishing between public expenditure on education and health. Burgess and Stern (1993) note that the distribution of public spending between education and health is much more skewed towards education in less developed countries.¹ Indeed, a structural difference appears between rich and poor countries with regard to the relative weights of the two kinds of spending: the poorer the country, the more it invests in education compared to health. This is illustrated in Figure 1.²

Insert Figure 1 about here

In the field of development economics, education and health expenditure are often aggregated as a composite index of social spending. The paper by Devarajan, Swaroop, and Zou (1996), that includes one of the rare analyses of the optimal composition of social spending, provides a striking illustration. By summing them these authors suggest a perfect substitutability between the two kinds of expenditure, or in other words an identical impact for the two policies. The main intent of our study is to go beyond this, somewhat too simple, hypothesis and specify a transmission mechanism for each type of social spending.

Following Basu (1999) and Baland and Robinson (2000), we present the decision to

¹ See Table 1 and the comments in Burgess and Stern (1993) (pp. 765-6).

² The correlation coefficient between the per capita GDP (expressed in logarithms) and the ratio of education to health public expenditure is 34%.

send a child out to work as resulting from an inter-temporal trade-off between working and schooling by the household. This trade-off depends on both the return on education investment and the risk of this investment. This risk can be explained by the probability that the child dies before becoming an adult and leaving the household.³ The originality of our approach is to present the impact of social spending on a such trade-off. We assume that public spending on education improves the return to education while public spending on health reduces the riskiness of this investment by improving the child's health status.

We determine theoretically the conditions under which public expenditure will reduce child labour. When households are not taxed (i.e. when a balanced budget constraint is lacking), public health expenditure always has the expected negative effect on child labour, while the impact of education expenditure is conditioned by households' moderate risk aversion (absolute as well as relative). Taking into account the tax needed to finance these expenditures changes our conclusions by adding an inter-temporal smoothing to households' behaviour. On the hand, a low absolute risk aversion is necessary for health expenditure to have the desired effects. On the other hand, the respective impacts of the two kinds of public expenditure on the education return and the health status (i.e. the quality and effectiveness of the expenditure) have to be high enough. Our theoretical findings are tested on data from 66 developing countries. Health expenditure has a significant negative impact on child labour, which is all the higher as the risk increases. Education public expenditure is linked to decreases in child labour if and only if households risk aversion is low, or under the assumption of decreasing relative risk aversion (DRRA) preferences, if the households are rich enough. We conclude that massive investments, as has happened in some developing countries, may not be the best way to solve the issue of child labour. There is also a need to consider health.

The rest of the paper is organised as follows. The first section develops the theoretical model and its results. In the second section, the main theoretical results are tested with

³ Without relevant data for the sample, we will assume that the risk of death in childhood is higher when health status is low. Following the literature on health economics in less developed countries (see for instance Sach's report for World Health Organisation (2001); Kakwani (1993); Anand and Ravallion (1993); Sen (1998)) we measure a population's health status through the survival rate of children under 5.

an empirical analysis. The final section presents our conclusions.

1 The model

We will first introduce the hypothesis of our model, and then define the specific effect of each kind of social spending more precisely.

1.1 Preliminaries

Like Baland and Robinson (2000) and Dessy and Pallage (2001), we consider a two-periods economy ($t = 1, 2$) with a unique consumption good. In the first period, the household is constituted by an adult worker, the parent (p), and a child (c). In the second period, when the child is grown up, there are two adults (p and a). We denote the household's utility W_p as $W_p = W_p(c_p^1, c_p^2, W_c(c_c))$, where c_p^1 , c_p^2 and c_c are the first-period parental consumption, the second-period parental consumption and the consumption of the child who became an adult respectively. We suppose that each child has one unit of time to distribute between schooling ($\gamma \in [0, 1]$) and working ($1 - \gamma$).⁴ Given the child's risk of dying, we consider the parental choice of sending the child to school (γ) to be a portfolio choice between a safe investment (child labour) and a risky one (schooling), the latter being more profitable in the long-term (depending on the return from education).

We assume that the parental utility ($W_p(\cdot)$) is additively separable. Moreover, we assume that the parent's behaviour towards the child is altruistic (unilateral altruism) and we normalise the children's consumption to zero. This yields the following expression:⁵

$$W_p(c_p^1, c_p^2, W_c(c_c)) \equiv U(c_p^1) + U(c_p^2) + \delta E[W_c(c_c)], \quad (1)$$

where U and W_c are the parental utility function and that of the child who became an adult, respectively. These are both strictly increasing and concave. The parame-

⁴ This choice is made by the parents, the child being considered too young to make a rational decision (see Glomm (1997)).

⁵ We denote the mathematical expectancy by $E[\cdot]$.

ter δ is the degree of altruism, that induces the inter-generational link. Without this link the parents do not have any incentive to invest in their children's education.⁶ The child's mortality risk involves a mathematical expectancy in (1) given by: $E[W_c(c_c)] = \phi W_c(c_c) + (1 - \phi) W_c(0)$, where the parameter ϕ is the probability of the child surviving to adulthood (i.e. the child survival rate).⁷ The normalisation of the function $W_c(\cdot)$ implies $W_c(0) = 0$. Any health status improvement obviously results in a decrease in the risk. In the following sub-section, the probability (ϕ) will be determined by expenditure on the public health.

Without any savings or borrowings, the consumption corresponds to the available income at each period. Moreover, following the child labour literature (see Basu (1999)), we suppose a competitive labour market. Potential coordination failures between supply and demand in this market are not considered here (see Basu and Van (1998)). Wages equal the marginal productivity of the worker. Over the first period, the household's earnings are the sum of the parent's wages (w) and the child's income (dw). The parameter d (< 1) reflects the lesser productivity of a child compared to an adult (see Baland and Robinson (2000)). The opportunity cost of the child's education has to be subtracted from this potential first period income ($-\gamma dw$) since the time the child spends at school (γ) is not available for paid work at the wage rate of dw . In the second period, the parent still earns w .⁸

The grown-up child earns an income that depends on the initial investment in education: a child who has spent a part of his or her time γ at school earns a wage of $(1 + \gamma e) w$, where the factor e (> 0) represents the return on education. Consumptions can therefore be summarised as follows:

$$c_p^1 \equiv (1 + d - \gamma d) w, \quad c_p^2 \equiv w, \quad \text{et } c_c \equiv (1 + \gamma e) w. \quad (2)$$

⁶ This factor δ enables us to capture, at least implicitly, a potential transfer from the children to their parents once the children have grown up.

⁷ Chakraborty (2004) and Chakraborty and Das (2005) consider health status to be an explanation of the discount rate. Here, we assume a unitary discount rate without any loss of generality.

⁸ Assuming that the parent is still working during the second period has no impact on the level of child labour at equilibrium. Two other possibilities would be to consider the parents as dead or retired.

When consumption (2) is substituted in the utility function (1), the level of equilibrium of the child’s education, γ^* , results from maximising:

$$\gamma^* \equiv \arg \max_{\gamma \in [0,1]} \{U((1+d-\gamma d)w) + U(w) + \delta \phi W_c((1+\gamma e)w)\}. \quad (3)$$

The first order condition (FOC) provides an implicit solution for γ^* :⁹

$$-dU'((1+d-\gamma^*d)w) + \delta \phi e W_c'((1+\gamma^*e)w) = 0. \quad (4)$$

Here, we obtain the classical inter-temporal trade-off, already developed by Baland and Robinson (2000): the more the parent invests in the child’s education, the smaller their first period income. This loss is offset in the second period by the increase in the grown-up child’s skills, and so in his or her expected income.

1.2 Public intervention

The main innovation of this paper is to consider two sorts of public intervention and their respective impacts on child labour: public expenditure on education and on health. These are often aggregated as “social expenditure” in the literature, implying a perfect substitutability between them. Here, we suggest that each kind of public expenditure has an impact on children’s schooling (γ^*) through a specific mechanism. We assume that public expenditure on education improves the return from education, while public expenditure on health increases the health status of the population and reduces child mortality. Like Chakraborty and Das (2005) who find a positive relationship between parental health and children’s education, we explain child labour by the population’s health status.¹⁰ This enables us to model the risky characteristic of the environment through the child survival rate.

The efficiency of public expenditure on health is debatable. Studies measuring health

⁹ The second order condition (SOC) is respected since the functions $U(\cdot)$ and $W_c(\cdot)$ are assumed to be concave.

¹⁰ In contrast to Chakraborty and Das (2005) who use private health expenditure to explain adults mortality, we focus on child mortality and the effect of public health expenditures.

status by either infant (under 1) or child (under 5) mortality differ widely in their estimates of the impact of health expenditure. On the one hand, Anand and Ravallion (1993) show a significant positive relationship.¹¹ On the other hand, Filmer, Hammer, and Pritchett (2000) conclude, from a cross-sectional analysis over 100 countries, that public expenditure on health has a non-significant impact of health status. Finally, Bidani and Ravallion (1997) and Gupta, Verhoeven, and Tiongson (2001) find that health expenditure has a positive impact on the health status of the poorest, but a non-significant impact on the whole population. Unlike Strulik (2004), Chakraborty (2004) and Chakraborty and Das (2005), we focus only on public expenditure, ignoring private spending. Moreover, we limit our investigation to the impact of health expenditure on child health status. We define the under-five survival probability as a function of the public expenditure on health, namely H . More formally, we assume $\phi \equiv \phi(H)$,¹² where:

$$\phi(H) \in [0, 1], \quad \phi'(H) > 0, \quad \phi''(H) < 0, \quad \phi(0) = 0, \quad \lim_{H \rightarrow \infty} \phi(H) = 1. \quad (5)$$

Even if substantial private resources are allocated to education, their share of total expenditure on education remain very low in most countries (see Glomm (1997) and Patrinos and Psacharopoulos (2004)). Here, public expenditure on education, denoted by E , is treated as the only way to increase the returns from education ($e \equiv e(E)$). These returns are an augmented skilled-wage in the second period. When the survival rate is high, the incentives for schooling will be all the stronger, as the return to education will be high. Rosenzweig (1990) has shown how exogenous changes in the return to education can increase the investment in education. We pose:

$$e'(E) > 0, \quad e''(E) < 0, \quad e(0) = 0. \quad (6)$$

As a first stage we will consider the households to be too poor to contribute to the pub-

¹¹ However, their econometric validation relies on only 22 observations.

¹² Of course mother's education has a significant impact on child health, but we do not take this kind of interaction between public expenditures into account here.

lic tax needed to finance education and health expenditure. These can be financed by an external source, such as international aid, official development assistance, or grants. This assumption enables us to study the impact of each kind of public intervention without considering the financing side of this spending. We denote the optimal allocation to education when the household is exempt from any public taxation by γ_a^* . The maximisation program (3) becomes:

$$\gamma_a^* \equiv \arg \max_{\gamma \in [0,1]} \{U((1+d-\gamma d)w) + U(w) + \delta \phi(H) W_c((1+\gamma e(E))w)\}. \quad (7)$$

The First Order Condition (FOC) is then:

$$-dU'((1+d-\gamma_a^* d)w) + \delta \phi(H) e(E) W_c'((1+\gamma_a^* e(E))w) = 0. \quad (8)$$

We study the impact of a change in each sort of public spending through a comparative static analyses. We denote the absolute risk aversion and the relative risk aversion by $A(\cdot)$ and $R(\cdot)$ respectively. This gives the following proposition:

Proposition 1 *Under the assumptions of our model and when public expenditure is not financed by the households,*

(i) *public expenditure on education reduces child labour if and only if*

$$\left. \frac{\partial \gamma}{\partial E} \right|_{\gamma_a^*} > 0 \Leftrightarrow 1 - R((1+\gamma_a^* e(E))w) + wA((1+\gamma_a^* e(E))w) > 0,$$

(ii) *public expenditure on health always reduces child labour* $\left(\left. \frac{\partial \gamma}{\partial H} \right|_{\gamma_a^*} > 0 \right)$.

Proof. see APPENDIX A1. ■

When the cost of public expenditure is not paid by households, health expenditure reduces child labour $(1-\gamma_a^*)$ whatever the households' risk aversion. We show empirically (below) that the impact of health expenditure on child labour increases with risk, or in other words it decreases with the probability of a child's survival. On the other hand, we establish that the relationship between public expenditure on education and child labour depends on the relative risk aversion of the households. We note that the expression

$(1 - R(.) + wA(.))$ is relatively common in the portfolio choice literature when analysing the demand for risky assets with changing returns (see Hadar and Seo (1990); Gollier (2001), PROPOSITION 9 page 60). We deduce that a relative risk aversion less than unity ($R(.) < 1$) is a sufficient condition for education expenditure to have the desired effect on child labour.

Assessing the risk aversion, in particular the relative aversion, remains a contentious issue in the theoretical as well as the empirical literature. Arrow (1965) deduced an increasing relative risk aversion from the decreasing marginal utility. This was promptly criticised, notably by Stiglitz (1969). Amongst the studies relying on surveys or experiments, Barsky, Juster, Kimball, and Shapiro (1997) highlight the heterogeneity in the parameters of individual preferences and show in particular that the relative risk aversion first increases and then decreases when the income of the individual under consideration rises.¹³ This result has been criticised by Ogaki and Zhang (2001) who emphasize that Barsky et al.'s survey is not suitable for identifying high values of relative aversion when the households are poor. These authors show, using Pakistani data, that relative aversion decreases with income. This result validates Binswanger (1981) analysis, which was based on Indian villages. Here, we adopt this approach and assume that households' relative risk aversion decreases with income. We will attempt to demonstrate empirically whether public expenditure on education reduces child labour as income increases, or, in other words, whether relative risk aversion decreases.

Following Barro (1990), we now consider the situation when public expenditure is financed by a first period tax. For simplicity, we define a tax, T , per capita.¹⁴ The net first period consumption is then: $c_p^1 - T$, where T respects the budgetary constraint $T = E + H$. Once public expenditure and tax contributions are taken into account, the

¹³ More formally, the utility function is first IRRA (increasing relative risk aversion) and then DRRA (decreasing relative risk aversion).

¹⁴ A tax which was proportional to income would induce additional substitution and income effects which would complicate any interpretation of comparative static results.

FOC (8) becomes

$$-dU' \left((1 + d - \gamma_p^*) w - E - H \right) + \delta \phi(H) e(E) W'_c \left((1 + \gamma_p^* e(E)) w \right) = 0, \quad (9)$$

where γ_p^* is the optimal allocation of the child's time at school, when public expenditure is financed by a *per capita* tax, and the government budgetary constraint is bounded. A static comparative analysis leads to the following proposition

Proposition 2 *Under the assumptions of our model and with household taxation which finances social expenditure, we establish that:*

(i) *public expenditure on education reduces child labour if and only if*

$$\left. \frac{\partial \gamma}{\partial E} \right|_{\gamma_p^*} > 0 \Leftrightarrow A \left((1 + d - \gamma_p^* d) w - E - H \right) < \frac{e'(E)}{e(E)} \left[\frac{1 - R \left((1 + \gamma_p^* e(E)) w \right)}{+wA \left((1 + \gamma_p^* e(E)) w \right)} \right],$$

(ii) *public expenditure on health reduces child labour if and only if*

$$\left. \frac{\partial \gamma}{\partial H} \right|_{\gamma^*} > 0 \Leftrightarrow A \left((1 + d - \gamma^* d) w - E - H \right) < \frac{\phi'(H)}{\phi(H)}.$$

Proof. see APPENDIX A2. ■

The first period costs of financing public expenditure have now been added to the previous effects of PROPOSITION 1. Two additional elements can be ferred from this cost: the absolute risk aversion of households in the first period ($A \left((1 + d - \gamma^* d) w - E - H \right)$) and the relative productivity of education and health expenditure (respectively $\frac{e'(E)}{e(E)}$ and $\frac{\phi'(H)}{\phi(H)}$). Absolute aversion has to be low for the expenditure to reduce child labour; more accurately, it has to be less than a threshold which depends on the relative productivity of the respective expenditure. The absolute risk aversion expressed in PROPOSITION 2 can be explained by the inter-temporal smoothing induced by the first-period taxation used to finance the second-period public consumption. The household's behaviour toward risk determines the impact of each kind of social expenditure. Finally, our analysis reinforces that by Devarajan and Hammer (1998) which highlighted the favourable effect on welfare of risk-reduction public spending, in particular in health.¹⁵ Several different cases can occur, depending on the household's risk aversion: (i) health and education expenditure

¹⁵ Devarajan and Hammer (1998) (p. 26) write

both reduce child labour; (ii) neither social expenditure reduces child labour; (iii) only public expenditure on health reduces child labour; (iv) only public expenditure on education reduces child labour. The following econometric studies will explore which cases actually occur.

Before turning to our empirical analyses, we establish two sufficient conditions which yield to corner solutions: the available child's time is fully allocated either to school ($\gamma_a^* = 1$) or to work ($\gamma_a^* = 0$).

Corollary 1 *Under the assumptions of our model and without any taxation, we establish that:*

(i) *the child's time is fully allocated to work if*

$$\frac{\phi(H)e(E)}{d} < \frac{U'((1+d)w)}{\delta W'_c(w)} \implies \gamma_a^* = 0, \quad (10)$$

(ii) *the child's time is fully allocated to education if*

$$\frac{\phi(H)e(E)}{d} > \frac{U'(w)}{\delta W'_c((1+e(E))w)} \implies \gamma_a^* = 1. \quad (11)$$

Proof. see APPENDIX A3. ■

The conditions for the corner solutions are expressed in terms of the household's marginal substitution rate (MSR) between the first and the second period (right term of the inequalities in expressions (10) and (11)). The marginal utility $W'_c(w)$ is naturally weighted by the degree of intergenerational altruism (δ). This inter-temporal MSR is compared to a threshold (left term) reflecting the effects of the two kinds of expenditure, in terms of the productivity of a child working during the first period.

When all the child's time is allocated to work ($\gamma_a^* = 0$), the first-period marginal utility is not only a (decreasing) function of the adult wage (w), but also of the child's wage (dw). The marginal utility of the grown-up child depends only on the adult wage rate (w). A sufficient condition for $\gamma_a^* = 0$ is a MSR superior to the product of the two kinds of expenditure outputs ($\phi(H)e(E)$) related to the child's productivity (d). Any increase in

“... the benefits of public expenditure in health should take into account the improvement in welfare from risk reduction as well as any direct benefit of the services...”

E or H , if sufficient, could lead to this solution.¹⁶ Moreover we can unambiguously state that decreasing a child's productivity, d , make the condition (10) less likely.¹⁷

When the whole of a child's time is allocated to education ($\gamma_a^* = 1$), the first-period marginal utility does not depend only on the adult's wage (w). In this case the marginal utility of the grown-up children depends not only on the wage rate (w) but also on the return to education ($e(E)$). A sufficient condition to obtain this corner solution is that the product of the output of the two kinds of expenditure ($\phi(H)e(E)$) in terms of the child's productivity (d) is superior to the inter-temporal MSR. While increasing health expenditure always leads to the corner solution, a similar variation in education expenditure is not sufficient, since the return to education appears simultaneously in the numerator of the left term and in the denominator of the right one.¹⁸

The econometric analysis at the country level does not enable us to distinguish between households, which do and do not finance public expenditure. However, we consider that households where children work, or at least are not fully educated ($0 \leq \gamma < 1$), are unable to pay the taxes needed to finance social expenditure. Moreover, in developing countries where child labour is substantial, international development assistance, such as grants or loans at reduced rates, provides significant financial resources. For these reasons we will mainly focus on PROPOSITION 1 when interpreting the econometric findings.

¹⁶ Note that taxation induces more ambiguous results. In that case we have

$$\frac{\phi(H)e(E)}{d} < \frac{U'((1+d)w - E - H)}{\delta W'_c(w)} \implies \gamma_p^* = 0.$$

Indeed, the increase in E and in H induce not only an augmentation in the left term of the inequality, but also in the right term (MSR). In that case, the impact of the increase in public expenditure on education and/or on health, is ambiguous, depending on the condition on risk aversion previously established. On the other hand, improving either the education return ($e(E)$) or the health spending effect ($\phi(H)$), for a constant level of expenditure, leads to augment the left hand side term of the inequality and henceforth to leave this corner solution.

¹⁷ The way a ban on child labour impacts on children's productivity is not addressed in this paper.

¹⁸ As usual, when households are taxed the results become more ambiguous, given that taxation induces risk aversion and inter-temporal smoothing:

$$\frac{\phi(H)e(E)}{d} > \frac{U'(w - E - H)}{\delta W'_c((1 + e(E))w)} \implies \gamma_p^* = 1,$$

2 Econometric analyses

The panel data we use in this section cover 66 developing countries over three five year periods (1986 1990, 1991 1995, 1996 2000). The first test concerns an essential hypothesis for our purposes: the impact of the risk level on the trade-off between schooling and working for the children. The second test directly focuses on the PROPOSITION 1 by estimating the impact of expenditure on public education and health on child labour.

2.1 Child labour and survival probability

Child labour is measured as the proportion of children aged between 10 and 14 who are working. An increase (decrease) in this ratio represents a change towards more children working (schooling). A fundamental hypothesis in our approach is the connection between child labour and the risk (proxied by health status): any improvement in health status implies a decrease in the extent of risk of the child dying, and should lead to a decrease in child labour.¹⁹

According to the litterature on macroeconomics and health, one of the most consistent indicators of health status²⁰ is the under-five survival rate. We use a logit transformation of this rate, which is more relevant than the *log – log* specification in assessing bounded human development indicators such as survival, and literacy rates (see Kakwani (1993); Franses and Hobijn (2001); Grigoriou and Guillaumont (2003)). We also consider the impact of income, since the relationship between poverty and child labour is well established in the literature (see Rosenzweig (1981); Labenne (1997); Grimsrud (2003)). Finally, a fixed effect is included, enabling us to control for time-invariant unobservable country heterogeneity.

We test the equation

$$lc_{it} = \alpha_0 + \alpha_1 y_{it} + \alpha_2 csr_{it} + \eta_i + \varepsilon_{it}, \quad (12)$$

¹⁹ See APPENDIX A5 for the origins and definitions of the variables.

²⁰ See for instance World Health Organisation (2001).

where lc_{it} is the logarithm of the proportion of children aged between 10 and 14 working; y_{it} is the logarithm of the per capita GDP in 1995 constant dollars; csr_{it} is the logit transformation of the under-five mortality rate; η_i is the country specific effect and ε_{it} is the error term with the usual properties. We get the following results in the table 1.

Insert Table 1 about here

Once controlled for income, proxied by the per capita GDP (the impact of which is, as expected, significantly negative) as well as for the country specific effect, any increase in health status substantially reduces the extent of child labour. This result enables us to justify the use of a portfolio choice model in our theoretical development by validating the hypothesis of a strong correlation between the degree of risk and the trade-off between schooling and working.

2.2 Trade-off between working and schooling

The impact of public intervention with regard to health and education is tested by including health and education expenditure as a percentage of per capita GDP successively in our model. We denote the logarithm of public expenditure on health and education as a percentage of per capita GDP by he_{it} and ee_{it} respectively. The impact of public expenditure on health on child labour is expected to be negative, any increase in this expenditure inducing a decrease in child labour. The health expenditure variable (he_{it}) is therefore included both additively and as an interaction with the variable csr_{it} (the logit transformation of the under-five mortality rate). The impact of education expenditure (ee_{it}) is also expected to be negative, but to depend on the degree of risk aversion of the households (see PROPOSITION 1). Assuming DRRA utility functions, we test the second relationship of PROPOSITION 1 by including the education expenditure variable not only additively but also in interaction with the per capita GDP: the higher the per capita GDP, the lower the relative risk aversion of the households, and so more education expenditure

is expected to reduce child labour. We test the regression

$$lc_{it} = \alpha_0 + \alpha_1 y_{it} + \alpha_2 csr_{it} + \alpha_3 he_{it} + \alpha_4 he_{it} csr_{it} + \alpha_5 ee_{it} + \alpha_6 ee_{it} y_{it} + \eta_i + \varepsilon_{it}, \quad (13)$$

where η_i is the country specific effect and ε_{it} the error term. The expected signs of the coefficients are:

$$\alpha_1 < 0, \quad \alpha_2 < 0, \quad \alpha_3 < 0, \quad \alpha_4 > 0, \quad \alpha_5 < 0, \quad \alpha_6 < 0.$$

We get the following results in the table 2.

Insert the table 2 here

Beyond its impact on under-five survival, public expenditure on health has a significantly negative impact on child labour, which decreases as health status increases ($\alpha_3 < 0$, $\alpha_4 > 0$).²¹ This result is robust to the inclusion of the education expenditure variable, either additively or in interaction with the variable y_{it} . On the other hand, considering only the education expenditure additively results in a non significant impact.²² This result echoes that of Patrinos and Psacharopoulos (2004), who found that public expenditure on education did not increase the return to education, and considered that education has suffered from "inadequate education policies". In accord with the results of our theoretical model (see PROPOSITION 1), we found a non-linear relationship between child labour and education expenditure by including education expenditure in interaction with per capita GDP. Given a decreasing relationship between households' risk aversion and per capita income, education expenditure reduce child labour when per capita GDP is high enough.²³

In conclusion, we have shown a non-linear decreasing relationship between public expenditure on health and education and child labour. The impact of health expenditure

²¹ Without reversing the sign of this impact, the turning point being outside the our sample.

²² This regression is not included in the tables.

²³ With $\alpha_5 > 0$ and $\alpha_6 < 0$, we get $\frac{\partial lc_{it}}{\partial ee_{it}} < 0$ when per capita GDP is higher than $e^{\frac{0.177}{0.03}} = 365$, which corresponds to a poverty line of 1 US dollar per capita by day.

is stronger when the level of risk (characterised by the under-five mortality rate) is high. The impact of public expenditure on education depends on the households' risk perception and is higher when their aversion is low (*i.e.* when the households are rich).

2.3 Robustness

2.3.1 Fixed effects and serial correlation

The use of panel econometrics with country specific effects (η_i) enables us to control for time-invariant unobservable heterogeneity. Moreover, if the within transformation eliminates some of the potential serial correlation, Wooldridge (2002) shows a potential serial correlation in the error term ε_{it} , the subsequent standard deviations from the within estimator being biased. Following Drukker (2003), we specify Newey-West's standard-deviation adapted to the use of fixed effect models in order to correct the heteroskedastic and serial correlated error term structure.

2.3.2 Stability and functional form tests

Very little data is available on the distribution of expenditure between private and public education health or between private or public education. Using Glomm (1997) data, we tested the stability of our model with the reduced form of the Chow test. From these data, five countries in our sample spend more on private than on public.²⁴ In four other countries²⁵ the number of children in private education is greater than the number in public education. The stability of the model was tested on the countries with the highest rate of expenditure on private education, then on those with the highest rate of private schooling, then on both of these groups of countries together. None of these tests resulted in the rejection of the hypothesis of stability for our model. We also tested the functional form of our model with a Ramsey-Reset test which did not reject the hypothesis of good specification.²⁶

²⁴ Honduras, India, Panama, Thailand and Venezuela during 1970s (1970-1980).

²⁵ Cameroon, Lesotho, Swaziland and Zimbabwe (1965-1979).

²⁶ Under the null hypothesis of good specification of our model, the Ramsey-Reset test provides a type 1 error of 75% (the F statistic is $F_{169}^3 = 0, 40$), which means that we cannot reject the hypothesis that

2.3.3 Reverse causality

A potential criticism of our empirical analysis could be that there is a reverse causality between education expenditure and child labour, which would induce a simultaneity bias, and so an endogeneity problem. On this basis, the level of education expenditure would be higher (lower) as the level of child labour was lower (higher). However, it seems obvious in the context of developing countries, and particularly with regard to public expenditure on education and health, that it is the supply-side that constitutes the constraint. Then, we assume that the causal relationship runs from the supply to the demand side.

3 Conclusion

This paper has analysed the impact of public expenditure on education and health on child labour. A household's decision to send their child to work or to school is presented as a portfolio choice, education being a risky investment. Each kind of public expenditure has its own transmission mechanism impacting this trade-off: education expenditure increases the return from the investment in education, while health expenditure reduces the risk of this investment. We have established a theoretical and empirical relationship between public expenditure on health and child labour. Moreover it appears empirically that the impact of health public expenditure is higher when the environment is risky. On the other hand, for public expenditure on education to have an impact requires that the household's risk aversion be moderated. Under the hypothesis of DRRA utility function, public expenditure on health reduces child labour when the households are rich enough. Including a tax to finance social expenditure modifies the previous results by adding an inter-temporal smoothing commonly observed when future expenditure is financed by a tax in the first period.

If the simplicity of our model leads naturally to interpret cautiously our results, it provides insights that considering public expenditure on education and health as substitutes is not realistic. If the intention is to decrease the extent of child labour, we contend that

the model is well specified.

public expenditure on health should take priority over public expenditure on education, or at the very least be considered equally as important. This conclusion is reinforced by FIGURE 1 (presented in the introduction) which shows a systematic imbalance between social expenditure on education at the expense of health in developing countries. An extension of this study would consist of explaining the origin of such an imbalance beyond strictly demographic reasons. Another extension would be to determine the optimal composition of public expenditure to minimise child labour for a given amount of tax.

References

- ANAND, S., AND M. RAVALLION (1993): "Human Development in Poor Countries: On the Role of the Private Incomes and Public Services," *Journal of Economic Perspectives*, 7, 133–150.
- ARROW, K. J. (1965): *Aspects of the Theory of Risk-Bearing*. Yrjö Hahnsson Foundation, Helsinki.
- BALAND, J.-M., AND J. A. ROBINSON (2000): "Is Child Labor Inefficient?," *Journal of Political Economy*, 108, 663–679.
- BARRO, R. J. (1990): "Government Spending in a Simple Model of Endogenous Growth," *Journal of Political Economy*, 98, 103–125.
- BARSKY, R. B., F. T. JUSTER, M. S. KIMBALL, AND M. D. SHAPIRO (1997): "Preference Parameters and Behavioral Heterogeneity: An Experimental Approach in the Health and Retirement Study," *The Quarterly Journal of Economics*, 112, 537–79.
- BASU, K. (1999): "Child Labor: Cause, Consequence, and Cure, with Remarks on International Labor Standards," *Journal of Economic Literature*, 37, 1083–1119.
- BASU, K., AND P. H. VAN (1998): "The Economics of Child Labor," *American Economic Review*, 88, 412–427.
- BIDANI, B., AND M. RAVALLION (1997): "Decomposing Social Indicators Using Distributional Data," *Journal of Econometrics*, 77, 125–139.
- BINSWANGER, H. (1981): "Attitudes towards Risk: Theoretical Implications of an Experimental Study in rural India," *Economic Journal*, 91, 867–890.
- BURGESS, R., AND N. STERN (1993): "Taxation and Development," *Journal of Economic Literature*, 31, 762–830.
- CHAKRABORTY, S. (2004): "Endogeneous Lifetime and Economic Growth," *Journal of Economic Theory*, 116, 119–137.
- CHAKRABORTY, S., AND M. DAS (2005): "Mortality, Fertility and Child Labor," *Economics Letters*, 86, 273–278.
- DESSY, S. E., AND S. PALLAGE (2001): "Child Labor and Coordination Failures," *Journal of Development Economics*, 65, 469–476.
- (2005): "A Theory of the Worst Forms of Child Labour," *Economic Journal*, 115, 68–87.
- DEVARAJAN, S., AND J. S. HAMMER (1998): "Risk Reduction and Public Spending," World Bank Policy Research Working Paper No. 1869.
- DEVARAJAN, S., V. SWAROOP, AND H. ZOU (1996): "The Composition of Public Expenditure and Economic Growth," *Journal of Monetary Economics*, 37, 313–344.

- DRUKKER, D. (2003): “Testing for Serial Correlation in Linear Panel-Data Models,” *Stata Journal*, 3, 168–177.
- FILMER, D., J. HAMMER, AND L. PRITCHETT (2000): “Weak Links in the Chain: A Diagnosis of Health Policy in Poor Countries,” *World Bank Research Observer*, 15, 199–224.
- FRANSES, P., AND B. HOBIJN (2001): “Are Living Standard Converging?,” *Structural change and Economic Dynamics*, 12, 171–200.
- GLOMM, G. (1997): “Parental Choice of Human Capital Investment,” *Journal of Development Economics*, 53, 99–114.
- GOLLIER, C. (2001): *The Economics of Risk and Time*. The MIT Press, Cambridge, Massachusetts.
- GRIGORIOU, C., AND P. GUILLAUMONT (2003): “A Dynamic Child Survival Function: Natural Convergence and Economic Policy,” *Etudes et Documents du CERDI* (33), 29p.
- GRIMSRUD, B. (2003): “Millenium Development Goals and Child Labour,” Understanding Children’s Work Project, UNICEF.
- GUPTA, S., M. VERHOEVEN, AND E. TIONGSON (2001): “Public Spending on Health Care and the Poor,” IMF Working Paper, WP/01/127.
- HADAR, J., AND T. K. SEO (1990): “The Effects of Shifts in a Return Distribution on Optimal Portfolios,” *International Economic Review*, 31, 721–736.
- ILO (2002): *Every Child Counts- New Global Estimates on Child Labour*. International Program on the Elimination of Child Labour (IPEC).
- KAKWANI, N. (1993): “Performance in Living Standards: An International Comparison,” *Journal of Development Economics*, 41, 307–336.
- LABENNE, S. (1997): “The Determinants of Child Labor in India,” Manuscript. Namur, Belgium: Univ. Namur, Center Res. Econ. Development.
- OGAKI, M., AND Q. ZHANG (2001): “Decreasing Relative Risk Aversion and Tests of Risk Sharing,” *Econometrica*, 69, 515–526.
- PATRINOS, H.-A., AND G. PSACHAROPOULOS (2004): “Returns to Investment in Education: A Further Update,” *Education Economics*, 12, 111–134.
- ROSENZWEIG, M. (1981): “Household and Non-Household Activities of Youths: Issues of Modelling, Data and Estimation Strategies,” in *Child Work, Poverty and Underdevelopment*, ed. by G. Rodgers, and G. Standing, Geneva. ILO.
- (1990): “Economic Growth and Human Capital Investments: Theory and Evidence,” *Journal of Political Economy*, 53, 202–211.
- SEN, A. (1998): “Mortality as an indicator of economic success and failure,” *The Economic Journal*, 108, 1–25.

- STIGLITZ, J. E. (1969): “The Effects of Income, Wealth, and Capital Gains Taxation on Risk-taking,” *The Quarterly Journal of Economics*, 83, 263–283.
- STRULIK, H. (2004): “Child Mortality, Child Labour, and Economic Development,” *Economic Journal*, 114, 547–568.
- WOOLDRIDGE, J. (2002): *Econometric Analysis of Cross-Section and Panel Data*. MIT Press, Cambridge, MA.
- WORLD BANK (2004): *the World Development Indicators 2004*, CD-ROM.
- WORLD HEALTH ORGANISATION (2001): *Macroeconomics and Health: Investing in Health for Economic Development*. Geneva, available at <http://www.cid.harvard.edu/cidcmh/CMHReport.pdf>.

A Appendices

A.1 Proposition 1

Differentiating Equation (8) and applying the theorem of implicit functions with respect to H , yields

$$\left. \frac{\partial \gamma}{\partial E} \right|_{\gamma_a^*} = - \frac{\delta \phi(H) e'(E)}{SOC'} (W'_c((1 + \gamma_a^* e(E)) w) + \gamma_a^* e(E) w W''_c((1 + \gamma_a^* e(E)) w)), \quad (14)$$

where the denominator, SOC' , is the Second Order Condition of Expression (7). From the FOC (8), we can deduce that

$$\frac{d}{\delta \phi(H) e(E)} U'((1 + d - \gamma_a^* d) w) = W'_c((1 + \gamma_a^* e(E)) w). \quad (15)$$

Using Equation (15) in Equation (14) and dividing by $W'_c((1 + \gamma_a^* e(E)) w) (> 0)$, we conclude that

$$\text{sign} \left(\left. \frac{\partial \gamma}{\partial E} \right|_{\gamma_a^*} \right) = \text{sign} (1 - R((1 + \gamma_a^* e(E)) w) + wA((1 + \gamma_a^* e(E)) w)),$$

where $R(\cdot)$ is the relative risk aversion and $A(\cdot)$ the absolute risk aversion.²⁷

Similarly, differentiating Equation (8) with respect to H yields

$$\left. \frac{\partial \gamma}{\partial H} \right|_{\gamma_a^*} = - \frac{\delta \phi'(H) e(E) W'_c((1 + \gamma_a^* e(E)) w)}{SOC'} > 0.$$

A.2 Proposition 2

We use a similar method to establish PROPOSITION 2 as we used to establish PROPOSITION 1. Differentiating (9) with respect to E yields

$$\left. \frac{\partial \gamma}{\partial E} \right|_{\gamma_p^*} = - \frac{dU''((1 + d - \gamma_p^* d) w - E - H) + \delta \phi(H) e'(E) \left[\begin{array}{c} W'_c((1 + \gamma_p^* e(E)) w) \\ + e(E) \gamma_p^* w W''_c((1 + \gamma_p^* e(E)) w) \end{array} \right]}{SOC''}, \quad (16)$$

where $SOC'' (< 0)$ corresponds to the Second Order Condition of the maximisation program (*i.e.* that with a global tax). Using Equation (9), Equation (16) is equivalent to

$$\left. \frac{\partial \gamma}{\partial E} \right|_{\gamma_p^*} = - \frac{\delta \phi(H) e(E)}{CSO''} \left(\frac{U''((1 + d - \gamma_p^* d) w - E - H)}{U'((1 + d - \gamma_p^* d) w - E - H)} + \frac{e'(E)}{e(E)} \left[1 + e(E) \gamma_p^* w \frac{W''_c((1 + \gamma_p^* e(E)) w)}{W'_c((1 + \gamma_p^* e(E)) w)} \right] \right)$$

We can deduce that

$$\text{sign} \left(\left. \frac{\partial \gamma}{\partial E} \right|_{\gamma_p^*} \right) = \text{sign} \left(-A((1 + d - \gamma_p^* d) w - E - H) + \frac{e'(E)}{e(E)} \left[1 - R((1 + \gamma_p^* e(E)) w) + wA((1 + \gamma_p^* e(E)) w) \right] \right)$$

In addition

$$\left. \frac{\partial \gamma}{\partial H} \right|_{\gamma_p^*} = - \frac{dU''((1 + d - \gamma_p^* d) w - E - H) + \delta \phi'(H) e(E) W'_c((1 + \gamma_p^* e(E)) w)}{CSO'}$$

²⁷ We have: $A(x) = -\frac{u''(x)}{u'(x)}$ and $R(x) = -x \frac{u''(x)}{u'(x)}$.

and, from Equation (9), this becomes

$$\text{sign} \left(\frac{\partial \gamma}{\partial H} \Big|_{\gamma_p^*} \right) = \text{sign} \left(\frac{\phi'(H)}{\phi(H)} - A \left((1 + d - \gamma_p^* d) w - E - H \right) \right).$$

A.3 Corollary 1

From the FOC (9), we can deduce two conditions for the two corner solutions $\gamma_p^* = 1$ and $\gamma_p^* = 0$. We have

$$\forall \gamma \in [0, 1], \quad \frac{\partial W_p(c_p^1, c_p^2, W_c(c_c))}{\partial \gamma} \geq 0 \Leftrightarrow \frac{\phi(H) e(E)}{d} \geq \frac{U'((1 + d - \gamma_p^* d) w - E - H)}{\delta W'_c((1 + \gamma_p^* e(E)) w)}.$$

We define the function $f(\gamma; \cdot)$ as

$$f(\gamma; w, d, \delta, E, H) \equiv \frac{U'((1 + d - \gamma d) w - E - H)}{\delta W'_c((1 + \gamma e(E)) w)}.$$

From the definition of $f(\gamma; \cdot)$ and the concavity of the functions $U(\cdot)$ and $W_c(\cdot)$, we deduce that $\frac{\partial f(\gamma; w, d, \delta, E, H)}{\partial \gamma} > 0$. Thus,

$$\forall \gamma \in [0, 1], \quad f(\gamma; w, d, \delta, E, H) < f(1; w, d, \delta, E, H) = \frac{U'(w - E - H)}{\delta W'_c((1 + e(E)) w)}.$$

A sufficient condition to have the corner solution $\gamma_p^* = 1$ is then

$$\frac{\delta \phi(H) e(E)}{d} > \frac{U'(w - E - H)}{\delta W'_c((1 + e(E)) w)}.$$

Similarly we establish that

$$\forall \gamma \in [0, 1], \quad f(\gamma; w, d, \delta, E, H) > f(0; w, d, \delta, E, H) = \frac{U'(w - E - H)}{\delta W'_c((1 + e(E)) w)}$$

$$\frac{\phi(H) e(E)}{d} < \frac{U'((1 + d) w - E - H)}{\delta W'_c(w)} \implies \gamma_p^* = 0.$$

Setting $T = 0$, we can immediately deduce the inequalities (10) and (11) of COROLLARY 1.

A.4 List of countries

Algeria; Arab Rep.; Argentina; Bahrain; Bangladesh; Barbados; Belize; Benin; Bolivia; Botswana; Brazil; Burkina Faso; Cambodia; Cameroon; Chad; Chile; China; Colombia; Comoros; Dominican Republic; Ecuador; Egypt; El Salvador; Ethiopia; Guatemala; Honduras; India; Iran Islamic Rep.; Ivory Coast; Jamaica; Jordan; Kenya; Kuwait; Lesotho; Malaysia; Maldives; Mali; Mauritania; Mauritius; Mexico; Mongolia; Morocco; Mozambique; Namibia; Nepal; Nicaragua; Niger; Nigeria; Oman; Panama; Paraguay; Peru; Philippines; Saudi Arabia; Senegal; South Africa; Sri Lanka; Swaziland; Syria; Thailand; Trinidad and Tobago; Tunisia; Turkey; United Arab Emirates; Venezuela; Zambia; Zimbabwe.

A.5 Definitions and origin of the data

Variables	Definition	Origin of the data
lc_{it}	Proportion of children aged 10-14 who are working (in logarithms)	World Bank (2004)
y_{it}	Per capita GDP in constant 1995 US dollars (in logarithms)	World Bank (2004)
csr_{it}	Logit transformation of under-5 survival ($=\ln(\frac{childsurvival}{1-childsurvival})$)	World Health Organisation (2001)
he_{it}	public expenditure on health as % of GDP (in logarithms)	Fiscal affairs department, IMF
ee_{it}	public expenditure on education as % of GDP (in logarithms)	Fiscal affairs department, IMF

A.6 Figure and Tables

Figure 1- Education to health public expenditure ratio and per capita GDP (1990-2000)

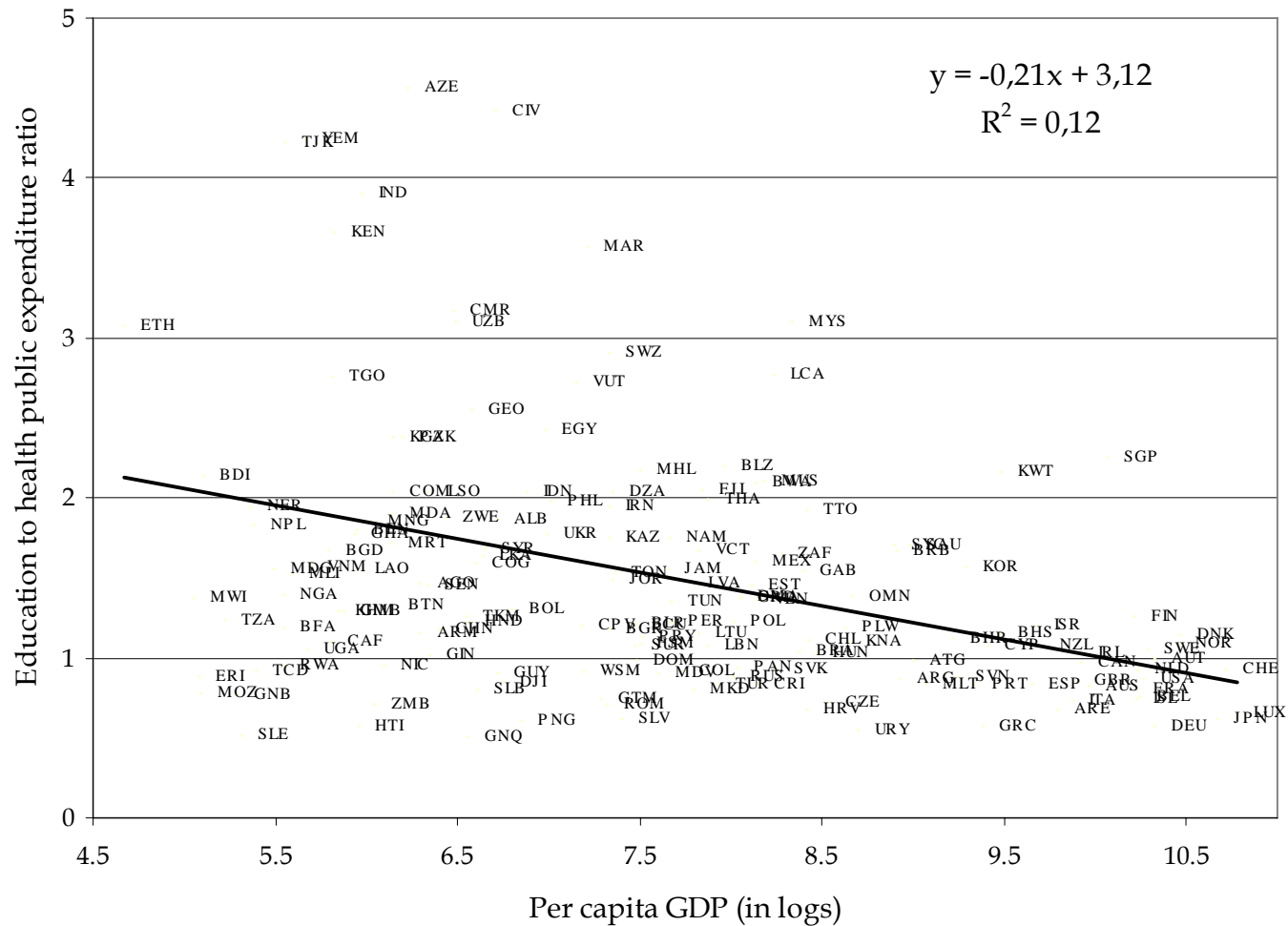


Table 1: Child labor, child mortality rate and degree of risk aversion

Dependent variable is child labour (in log)	
	(3)
y_{it}	-0.05*** (0.00)
csr_{it}	-0.03*** (0.00)
Constant	-0.53*** (0.00)
R ² -Within	0.36
Observations	179
Countries	66
*** represents threshold of 1%	
p-values are given in brackets beneath the coefficients	

Within estimates with robust standard errors (Newey-West corrections)

Table 2: Child labor, child survival rate and social expenditures

Dependent variable is child labour (in logs)		
	(4)	(5)
y_{it}	-0.04*** (0.00)	0.004 (0.79)
csr_{it}	-0.05*** (0.00)	-0.05*** (0.00)
he_{it}	-0.05*** (0.01)	-0.08*** (0.00)
$csr_{it}.he_{it}$	0.01*** (0.01)	0.03*** (0.00)
ee_{it}	-0.01 (0.35)	0.18*** (0.00)
$ee_{it}.y_{it}$		-0.03*** (0.00)
Constant	0.50*** (0.00)	0.25*** (0.00)
R ² -Within	0.43	0.48
Observations	179	179
Countries	66	66
*** represents threshold of 1%		
p-values are given in brackets beneath the coefficients		

Within estimates with robust standard errors (Newey-West corrections)