How to Deal with Covert Child Labour, and Give Children an Effective Education, in a Poor Developing Country: An Optimal Taxation Problem with Moral Hazard

Alessandro Cigno

CESIFO WORKING PAPER NO. 3077
CATEGORY 5: ECONOMICS OF EDUCATION
JUNE 2010

CESifo *Working Paper No. 3077*

How to Deal with Covert Child Labour, and Give Children an Effective Education, in a Poor Developing Country: An Optimal Taxation Problem with Moral Hazard

Abstract

Given that credit and insurance markets are imperfect, and given also that intra-household transfers, and much of the work a child does, are private information, the second-best policy uses a combination of need and merit based education awards, together with a mix of taxes on parental income, and on the return to educational investment. It also makes school enrollment compulsory and, if the child wage rate is sufficiently high, sets a ceiling, decreasing in parental income, on overt child labour.

JEL-Code: D82, H21, H31, I28, J24.

Keywords: child labour, education, uncertainty, moral hazard.

Alessandro Cigno
University of Florence
Faculty of Political Science
Via delle Pandette 21
Italy – 50127 Florence
cigno@unifi.it

June 6, 2010
Work on this paper was completed while the author was visiting the Institute of Economic Research at Hitotsubashi University. Comments by Moriguki Chiaki, Tomoki Fuji, Takashi Kurosaki and Arimoto Yutaka are gratefully acknowledged. Remaning errors are the author's responsibility.

1 Introduction

Developing country governments and international development agencies have long realized that human, more than physical, capital accumulation is the mainspring of economic and civil progress. Yet, many children in poor developing countries fail to complete even the primary education cycle, and some do not go to school at all. The reasons are well known.[1] Baland and Robinson (2000) demonstrate that child labour will be inefficiently high if parents are credit or bequest constrained.[2] As one could have expected in the light of a result in Loury (1981), that parental inability to diversify or insure against the risk of a low return deters educational investment, Pouliot (2006) shows that uninsurability causes child labour to be inefficiently high even if credit and bequests are interior. Similar considerations apply to the risk of a downturn in parental income. Evidence that parental inability to borrow discourages education, and encourages child labour, is reported by a host of authors, including Jacoby (1994), Jacoby and Skoufias (1997), and Fuwa et al. (2009). Evidence that parental inability to insure against the risk of a low return also discourages education is reported in Kodde (1986) and Johnson (1987). Evidence in Beegle et al. (2007), that parents respond to a downturn in their own income by making their children work more, suggests that households cannot insure against that kind of risk. Fitzsimons (2007) reports, however, that parents respond in this way to a downturn not in their own, but in village aggregate income, suggesting that idiosyncratic income shocks are neutralized by informal insurance arrangements at the local level.[3] As the government faces less risk than individual households (because idiosyncratic shocks wash out on average) and, partly thanks to that, has easier access to international money markets than most of households, the former can reduce the consequences of credit and insurance market imperfections by, in effect, insuring and lending to the latter. But there are two moral hazard problem.

Only a small part of the work children do in developing countries goes through the formal labour market.[4] Of the rest, a very small (but never small enough) part involves physically or morally damaging activities. These are the "worst forms" of child labour, which national governments are committed by international treaty to eradicate. But the great bulk of this informal work consists of activities, like helping in the home, or working in the family farm, conducted for and under the supervision of the children's own parents. While comparatively harmless in themselves, these activities conflict with education, and have thus an opportunity-cost in terms of forgone future earnings. A moral hazard problem arises from the fact that the policy maker has statistical information about the nature and extent of this work, but cannot regulate it directly, be-

[1] See Cigno and Rosati (2005) for a systematic exposition.

[2] The latter reflects the impossibility of a legally binding contract between parents and young children. Cigno (2006) shows, however, that a self-enforcing, renegotiation-proof family constitution serves the same purpose as a contract.

[3] Evidence of such arrangements in a developing country are reported by, among others, Besley (1995) and Townsend (1994).

[4] See Cigno and Rosati (2005).

cause it does not know who does what. Something similar may be said if we look at the issue from the educational standpoint. As every parent or teacher knows, a child's scholastic performance depends not only on total study time (hours spent attending lessons, plus time spent doing homework), but also on how alert the child is during that time. In other words, the effectiveness of any given amount of time spent studying is affected positively by the amount of time the child spends resting, and negatively by the amount of time the child spends doing physically demanding work. As homework, rest and a good part of work time are not observable by the government, both the size and the effectiveness of total study time are then to be regarded as private information. If unobservables were positively correlated with observables, the government could stimulate effective total study time by rewarding school attendance (as in Mexico's PROGRESA, and other time-buying schemes of the kind), but there is evidence that the correlation is actually negative. Ravallion and Woodon (2000) find that the increase in school attendance elicited by an enrollment subsidy is four to eight times larger than the corresponding reduction in child labour. Conversely, Fuwa et al. (2009) estimate that a credit constraint reduces average school attendance by 60 percent, but raises child labour by double that percentage.

The other moral hazard problem arises from the fact that the government does not observe transfers between parents and children, and cannot thus be sure that a public subsidy intended for the latter will not end up as extra consumption for the former. The present paper sets out to characterize the second-best policy, and compare the outcome of this policy with two benchmarks, a low one represented by *laissez faire*, and a high one represented by the first best, in a situation where parents are better informed than the government about their own children's time allocation, and the government does not observe intra-household transfers. We take the return to education to be uncertain. Parental income may be uncertain too, but we will allow for that only informally towards the end of the paper, because it makes no qualitative difference to the policy prescription. We assume that parents can neither borrow, nor insure (allowing for partial, local-level mutual insurance arrangements makes no qualitative difference to the results). As the implications of an educational externality are well understood,[5] we abstract from it, but will find that the policy itself gives rise to a fiscal externality. As the worst forms of child labour raise moral issues that transcend the materialistic calculations underlying the present paper,[6] we leave them out of the analysis, but the policies we will propose would discourage child labour in all its forms. The policy optimization has an optimal taxation (or principal-agent) format.[7] As the focus is on poor developing countries, school age is taken to mean primary school age.[8] Assuming that children in that age

[5] See, for example, Hanushek *et al.* (2003).

[6] But, see Dessy and Pallage (2005) for a strictly economic analysis.

[7] For a survey of the ways in which optimal taxation, or principal-agent, concepts can be used in a family policy context, see Cigno (2009).

[8] For an an analysis focussed on a rich developed country, see, for example, Hanushek *et al.* (2003).

range are under parental control, we take it that the agents are their parents. Section 2 of the paper lays down the technical assumptions, and characterizes parental decisions. Section 3 examines the *laissez faire* equilibrium. Section 4 derives the first and second best policy. Section 5 discusses the results, and concludes.

2 Households

There is a large number of households, labelled $i = 1, 2...n$. Each household consists of a couple of adults, and one child. Neither the parents, nor the children, have access to credit and insurance markets. For brevity, we refer to the child in the ith household as i. There are two periods, labelled $t = 1, 2$. Children are of school age in period 1, and of working age in period 2. Parents are alive only in period 1. The income i's parents would produce, in period 1, if i did not work for them ("parental income") is denoted by y_i. We assume that this income varies across households, but is exogenously given for each of them. Later in the paper, we will discuss the implications of allowing for this to be a random variable.

Let e_i denote i's effective total study time. In general, e_i will be equal to i's total study time, multiplied by a productivity factor increasing in i's rest time, and decreasing in i's work time. To simplify, we will measure e_i by the amount of time that i does not work. Denoting by L_i the amount of time i spends working in the child labour market, the amount of time she spends working for her parents will then be $(1 - e_i - L_i)$.[9] The former is paid at the child wage rate, w_1. The latter is unpaid, but raises household income by $z(1 - e_i - L_i)$, where $z(.)$ is a revenue function, increasing and concave, with $z(0) = 0$. Let w_2 denote the unskilled adult wage rate. If i does not enroll for school, e_i will be equal to zero. She will then earn w_1 in period 1, and w_2 in period 2. If she enrolls for school, by contrast, she will earn $L_i w_1$, $0 \leq L_i \leq 1$, in period 1, and $w_2 + x_i$, where x_i is the skill premium, in period 2.

While w_1 and w_2 are certain, x_i is not. In Levhari and Weiss (1974) the uncertainty arises from the fact that a child's learning ability is revealed only after the educational investment is made. In Razin (1976), it arises from imperfect information about the lifetime earning ability of a person with a given level of education. While learning ability (the rate at which a child accumulates human capital per unit of effective total study time) is clearly idiosyncratic, earning ability conditional on education (the rental price of the human capital accumulated through education) may depend not only on individual luck, but also on the state of the economy. As our present focus is on parental decisions, we will leave the effects of uncertainty about the future state of the economy for later discussion, and assume that x_i is i.i.d. over the closed interval $[0, \overline{x}] \in R^+$,

[9] Especially if the child is female, this work may consist of replacing her parents (typically her mother) in the performance of domestic chores, and thus allowing them to spend more time generating income. If the child is male, it is more likely to involve direct participation in an income generating activity run by the family.

with density $f(.|e_i)$ conditional on e_i, and $f(.|0) = 0$. As x_i then reflects only i's learning ability and effective total study time, we can use this variable to measure both i's school result, and i's skill premium.

To capture the fact that the more, and more effectively, i studies, the better are her chances of achieving a good result in her school career, and thus of attracting a high skill premium in the adult labour market, we will assume that the cumulative distribution of x_i, $F(x_i|e_i)$, associated with a higher e^i, first-order stochastically dominates the one associated with a lower e^i,

$$F_{e_i}(x_i|e_i) \leq 0. \tag{1}$$

For each e_i, there will be values of x_i such that (1) holds as an inequality. We impose the standard convexity-of-distribution-function (CDF) restriction that $F\left(x^i|e_i\right)$ is convex in e_i, and equally standard monotone-likelihood-ratio (MLR) restriction that $\frac{f_{e_i}(x_i|e_i)}{f(x_i|e_i)}$ is increasing in x_i.

Ex post, i's utility will be given by

$$U_i = u(c_{i1}) + u(c_{i2}),$$

where c_t^i denotes i's consumption in period t. By postulating that utility depends only on consumption, we are implicitly assuming that work affects utility only indirectly, via present and future income. This is tenable only because we are abstracting from the worst forms of child labour. Assuming descending altruism, the ex-post utility of i's parents will be given by

$$V_i = v(a_i) + \beta U_i, \;\; 0 < \beta < 1,$$

where a_i denotes parental consumption, and the constant β is a measure of altruism. We further postulate that the functions $u(.)$ and $v(.)$ are increasing and concave, thus implying risk aversion, and that $u'(0) = v'(0) = \infty$, thus implying that the subsistence level of consumption is normalized to zero.

Let m_i denote the parental subsidy, and γ_i the government subsidy, received by i in period 1. Let θ_i be a tax paid by i in period 2. Each of these transfers may be positive, negative or zero. Anticipating a result that will obtain in Section 4, we take γ_i to be independent of L_i, and θ_i to be contingent on x_i. Let p denote the price of school enrollment. For the time being, we will take this to be equal to the average total cost of tuition, but later in the paper we will consider the possibility of a price subsidy. Parents make their decisions in period 1, after the government has announced its policy.

If i is not enrolled for school, and assuming, for the time being, that time allocation and intra-household transfers are not regulated by law, i's parents will choose (L_i, m_i) so as to maximize

$$V_i \equiv v(y_i + z(1 - L_i) - m_i) + \beta\left[u(m_i + w_1 L_i) + u(w_2)\right],$$

subject to

$$L_i \geq 0. \tag{2}$$

The first-order conditions are

$$-v'(y_i + z(1 - L_i) - m_i)z'(1 - L_i) + \beta u'(m_i + w_1 L_i) w_1 + \xi_i = 0 \quad (3)$$

and

$$-v'(y_i + z(1 - L_i) - m_i) + \beta u'(m_i + w_1 L_i) = 0, \quad (4)$$

where ξ_i is the Lagrange-multiplier of (2), equal to zero if the constraint is not binding.

By contrast, if i is enrolled for school, and again assuming that that time allocation and intra-household transfers are unregulated, i's parents will choose (e^i, L^i, m^i) so as to maximize

$$E\left(V^i\right) \equiv v_i + \beta\left(u_{i1} + \int_{x_i} u_{i2} f^i dx_i\right),$$

where $v_i \equiv v(y_i + z_i - m_i)$, $z_i \equiv z(1 - L_i - e_i)$, $u_{i1} \equiv u(m_i + w_1 L_i + \gamma_i - p)$, $u_{i2} \equiv u(w_2 + x_i - \theta_i)$ and $f^i \equiv f(x_i|e_i)$, subject to (2). As $E\left(V^i\right)$ is concave in e_i for the MLR and CDF assumptions, the first-order conditions are now

$$-v_i' z_i' + \beta \int_{x_i} u_{i2} f_{e_i}^i dx_i = 0, \quad (5)$$

$$-v_i' z_i' + \beta u_i' w_1 + \xi_i = 0 \quad (6)$$

and

$$-v_i' + \beta u_{i1}' = 0 \quad (7)$$

3 Laissez faire

In *laissez faire*, school enrollment is not compulsory, L_i is not regulated, and

$$\gamma^i \equiv \theta^i \equiv 0.$$

The pay-off of not enrolling i at school is

$$\pi(y_i) \equiv \max_{(L_i, m_i)} V(L_i, m_i), \text{ s.t. } (2). \quad (8)$$

That of enrolling her is

$$\pi^*(y_i, p) \equiv \max_{(L_i, e_i, m_i)} E\left(V^i\right), \text{ s.t. } (2). \quad (9)$$

The child will be enrolled if and only if $\pi^*(y_i, p)$ is at least as large as $\pi(y_i)$. There is a value of y_i, $\widetilde{y}$, implicitly defined by

$$\pi^*(\widetilde{y}, p) = \pi(\widetilde{y}),$$

below which i is not enrolled. As $\widetilde{y}$ is the same for every i, because children are ex-ante identical, if any children do not go to school at all, it will then be children whose parents have a low income. This result differs from the one in Ranjan (2001), where a child's learning ability is known, and the income threshold is consequently lower for parents of high-ability, than for parents of low-ability children.

In view of $(3)-(4)$, if y_i is lower than $\widetilde{y}$, either $z'(1-L_i)=w_1$ or $L_i=0$. Conversely, in view of $(6)-(7)$, if y_i is at least as large as $\widetilde{y}$,

$$\text{either } -z_i' + w_1 = 0 \text{ or } L_i = 0. \tag{10}$$

Suppose that w_1 is so low, that $L_i=0$. If y_i is lower than $\widetilde{y}$, i will then work full time for her parents. By contrast, if y_i is at least as high as $\widetilde{y}$, i will go to school, and her effective study time will be non-decreasing (the amount of work she does for her parents will be non-increasing) in y_i. Alternatively, suppose that w_1 is sufficiently high for L_i to be positive. If y_i is lower than $\widetilde{y}$, i will not go to school, and the way she will divide her time between working for her parents and working for the market will depend only on w_1. Otherwise, she will go to school, and e_i will be non-decreasing in y_i. But the way she will divide the rest of her time between working for her parents and working for the market will again depend only on w_1.

As the expected return to education is the same for every i, and assuming this return to be positive, the efficient level of e_i will be positive, and the same for every i. The *laissez-faire* level of educational investment, e_i^{LF}, is thus inefficiently low in every household i where it depends on y_i.

> *Proposition 1. In laissez faire, educational investment is inefficiently low. In households with parental income below a certain threshold, children do not enroll for school. Above that threshold, children enroll for school, and their effective education time increases with parental income.*

4 Government

If an action is private information, the government must give agents an incentive to undertake that action at the socially optimal level. If an action is common knowledge, by contrast, it does not make sense for the government to offer costly incentives, because the same result can be costlessly achieved by threatening agents with a sufficiently severe penalty if they do not.[10] In our context, effective study time, and transfers between parents and children, may be private information, but school enrollment and the amount of work a child does in the formal labour market are common knowledge. Having assumed that the expected return to education is positive for all children, the government will then make school enrollment compulsory, and fix L_i. Depending on whether (e_i, m_i) is common knowledge or private information, the government will either fix those variables too, or influence parental decisions by its choice

[10] In principal-agent language, this is called a "forcing contract".

of (γ_i, θ_i). Having assumed imperfect credit and insurance markets, equity and efficiency cannot be separated. Therefore, we formulate the policy optimization as a welfare maximization problem.

Let the government's preferences be represented by the Benthamite social welfare function,

$$SW = \sum_{i=1}^{n} E(V_i). \tag{11}$$

Unlike parents, the government does not face any budget uncertainty, because parents and children are many, and risks are i.i.d.. Partly for this reason, the government is also free to borrow or lend in the international credit market. Making the usual "small country" assumption, we will treat the real interest rate as a constant, and normalize it to zero. As the optimization can determine only relative tax rates, we will normalize the one implicit in w_2 to zero (and thus avoid having the account for the revenue). The government then chooses $\left(e^i, L^i, m^i, \gamma^i, \theta^i\right)$, for $i = 1, 2, ...n$, so as to maximize (11), subject to the budget constraint,

$$\sum_{i=1}^{n} \left(\gamma_i - \int_{x_i} \theta_i f^i dx_i \right) = 0 \tag{12}$$

and (2). If $\left(e^i, m^i\right)$ is private information, the maximization will be subject also to incentive-compatibility constraints. As $E\left(V^i\right)$ is concave in $\left(e^i, L^i, m^i\right)$, SW will be concave too. For the i.i.d. assumption, the socially optimal $\left(\gamma^i, \theta^i\right)$ can depend only on $\left(e^i, m^i, x^i, y^i\right)$, and not also on any $\left(e^j, m^j, x^j, y^j\right)$, $j \neq i$.

4.1 First best

In first best, there are no incentive-compatibility constraints. In addition to making school enrollment compulsory, the government will then prescribe (e_i, L_i, m_i), and use personalized lump-sum transfers (γ_i, θ_i) for each i to re-distribute and insure. The first-order conditions for the maximization of (11) subject to(2) and (12) are (3), (7),

$$-v_i' z_i' + \int_{x_i} (\beta u_{i2} + \lambda \theta_i) f_{e_i}^i dx_i = 0, \tag{13}$$

$$\beta u_{i1}' - \lambda = 0 \tag{14}$$

and, for each possible realization of x_i,

$$-\left(\beta u_{i2}' - \lambda\right) f^i = 0, \tag{15}$$

where λ is the Lagrange-multiplier of the government budget constraint.

We can see from (13) that the marginal opportunity-cost of e_i, $v_i' z_i'$, is equated to the sum of the expected marginal benefit of this investment for i's parents, $\beta \int_{x_i} u_{i2} f_{e_i}^i dx_i$, and of the expected marginal benefit of a larger tax revenue for society at large, $\lambda \int_{x_i} \theta_i f_{e_i}^i dx_i$. It is thus clear that effective study time is higher in first best than in *laissez faire* because, in the latter, parents do not take account of the fiscal externality. As all children are ex-ante identical, (7) and (14) – (15) imply

$$a_i = a^{FB},\ c_{i1} = \ c_{i2} = c^{FB}\ ,\ e_i = e^{FB} \text{ and } m_i = m^{FB}.$$

Although e^{FB} is greater than e_i^{LF} for every i, there is nothing to say that it will be equal to unity. Not even an all-seeing, all-powerful government might want to eliminate child labour altogether.

> *Proposition 2. In first best,*
>
> (*i*) *all school-age children attend school, and allocate their time between study and work activities in the same way;*
>
> (*ii*) *effective education time is greater than in laissez faire, but work time is not necessarily zero;*
>
> *(iii) the government uses personalized lump-sum taxes and subsidies to achieve perfect equity, full insurance, and perfect consumption smoothing.*

4.2 Second best

In second best, e_i and m_i are private information. We will refer to L_i as overt, and $(1 - e_i - L_i)$ as covert child labour. In addition to making school enrollment compulsory, the government will now fix L_i, and announce how L_i, γ_i and θ_i are calculated on the basis of the information available at the relevant time. If it seems odd that a benevolent government would actually oblige children to do a certain amount of paid work, think of the second-best value of L_i as a legal maximum. Since γ_i is received in period 1, this government subsidy can depend only on (L_i, y_i). The same applies also to the legal ceiling on L_i. Since θ_i is payable in period 2, this tax can depend also on x_i.

The maximization of (11) is now subject not only to (2) and (12), but also to the incentive-compatibility constraints on (e_i, m_i). Denoting by ϕ_i the Lagrange-multiplier of (5), and by μ_i that of (7), the first-order conditions are now

$$-\left[v_i' + (\mu_i + \phi_i z_i')\, v_i''\right] z_i' - \phi_i v_i' z_i'' + \int_{x_i} \left[(\beta u_{i2} + \lambda\theta_i)\, f_{e_i}^i - \phi_i \beta u_{i2} f_{e_i e_i}^i\right] dx_i = 0, \tag{16}$$

$$-\left(z_i' + \phi_i z_i''\right) v_i' + \beta \left(u_{i1}' - \mu_i u_{i1}''\right) w_1 + \xi_i - \left(\phi_i z_i' + \mu_i\right) v_i'' z_i' = 0, \tag{17}$$

$$-v_i' + \beta u_{i1}' - \mu_i \left(v_i'' - \beta u_{i1}''\right) - \phi_i z_i' v_i'' = 0, \tag{18}$$

$$\beta \left(u_{i1}' - \mu_i u_{i1}''\right) - \lambda = 0 \tag{19}$$

and, for each possible realization of x_i,

$$-\beta \left(f^i - \phi_i f_{e_i}^i\right) u_{i2}' + \lambda f^i = 0. \tag{20}$$

Let us start by characterizing the second-best policy schedules. Using (7),we can re-write (19) as

$$1 + \mu_i r_i = \frac{\lambda}{v_i'},$$

where

$$r_i \equiv -\frac{v_i''}{v_i'}$$

is the Arrow-Pratt measure of absolute risk aversion. Given that v_i' is decreasing, and assuming that r_i is non-increasing in y_i,[11] we can then write

$$\gamma_i = \gamma(y_i), \tag{21}$$

where $\gamma(.)$ is a decreasing function. Condition (20) may be similarly re-written as

$$\beta\left(1 - \phi_i \frac{f_{e_i}}{f^i}\right) = \frac{\lambda}{u_{i2}'}.$$

As u_{i2}' is increasing in θ_i, and having assumed that $\frac{f_{e_i}}{f^i}$ is increasing in x_i, we can then write

$$\theta_i = \theta(x_i), \tag{22}$$

where $\theta(.)$ is an increasing function.

Having established that $\gamma(.)$ is a decreasing function, and $\theta(.)$ an increasing one, it is clear that the policy redistributes from the rich to the poor, and provides insurance for all, as in first best. Comparing (19) with (14), and (20) with (15), however, it is also clear that the policy does not go as far as in first best. As it cannot use personalized lump-sum transfers, the government must in fact limit its recourse to distortionary policy instruments. As there is nothing to prevent γ_i from falling below zero for y_i sufficiently small, we can interpret this period-1 transfer as the difference between a flat-rate education grant, and a tax on parental income. Similarly, as there is nothing to stop θ_i being negative for x_i sufficiently small, we can interpret this period-2 transfer as the difference between a tax on the individual skill premium, and a scholarship increasing in the individual school result. Stepping outside the formal model for a moment, we can think of the scholarship as being paid "at the beginning" of period 2, when the final school result is revealed,[12], and of the tax as being collected "in the course" of that period as the skill premium gradually unfolds.

We now go on characterize the second-best L_i. Condition (17) may be re-written as

$$\text{either } -z_i' + w_1 = \phi_i z_i'' - [\mu_i w_1 + (\mu_i + \phi_i z_i') z_i'] r_i \text{ or } L_i = 0. \tag{23}$$

The LHS of the first equation in (23) is the same as in (10), but the RHS is a negative number, increasing in y_i, rather than zero as in the latter. If w_1

[11] Evidence of diminishing absolute risk aversion in an educational context is reported by Kodde (1986) among others.

[12] If partial school results are available in the course of period 1, the child could receive advances in the course, and the balance at the end, of that period.

is large enough for L_i to be interior, the marginal product of i's covert child labour will then be higher than the child wage rate, and this type of labour will be decreasing in y_i. To see what happens to covert child labour when overt child labour is constrained to zero, we must look at what happens to effective study time.

Using the incentive-compatibility constraints, (16) and (18), simplify to

$$-\left(\mu_i+\phi_i z_i'\right) v_i'' z_i' - \phi_i v_i' z_i'' + \int_{x_i} \left[\lambda\theta_i f_{e_i}^i - \phi_i \beta u_{i2} f_{e_i e_i}^i\right] dx_i = 0 \tag{24}$$

and

$$\left(\mu_i+\phi_i z_i'\right) v_i'' - \mu_i \beta u_{i1}'' = 0. \tag{25}$$

Having found that period-1 redistribution stops short of full consumption equalization, it is clear from $(24)-(25)$ that effective study time and parental transfers are not equalized across households. All these conditions say is then that children from poor households study and consume less than children from rich ones. But we can go a little further using the incentive-compatibility constraints.

Given the policy, (e_i, m_i) is determined by $(5)-(7)$. Taking total differentials, and solving by Cramer, we find

$$\frac{de_i}{d\gamma_i} = \frac{v_i'' z_i' \beta u_{i1}''}{H_i} > 0 \tag{26}$$

and

$$\frac{dm_i}{d\gamma_i} = -\frac{\beta u_{i1}''}{H_i}\left[v_i' z_i'' + v_i''\left(z_i'\right)^2 + \frac{\partial}{\partial e_i} E\left(MU_{e_i}\right)\right] < 0, \tag{27}$$

where H_i is the Hessian determinant (positive at a maximum), and

$$E\left(MU_{e_i}\right) \equiv \int_{x_i} u_{i2} f_{e_i}^i dx_i$$

the expected marginal utility of i's effective education time, decreasing in e_i. It is clear from $(26)-(27)$ that, if γ_i is positive, i's parents will appropriate part of this subsidy, but will allow i to work less than he otherwise would. Conversely, if γ_i is negative, i's parents will partially compensate i for this tax, but will make him work more.

On the one hand, as $\gamma(.)$ is a decreasing function, the policy then encourages educational investment in poor households, and discourages it in rich ones, because it relaxes the credit constraint in the former and tightens it in the latter. On the other hand, however, as $\theta(.)$ is increasing, the policy encourages educational investments in all households, because it makes this form of investment less risky for everybody. Therefore, the policy is likely to encourage all households except possibly the richest to invest in their children's education. This makes sense of the rule on overt child labour. In order to limit its recourse to distortionary taxation, the government must allow children from poor households to produce a certain amount of income. If w_1 is high enough to make waged work worthwhile, the government will then impose a positive ceiling on the amount of paid work children do, and make this maximum a decreasing function of parental income. If w_1 is very low, by contrast, there is no point in imposing a ceiling on overt child labour, because covert child labour is more productive. As covert child labour cannot be regulated by law, however, the government will then lose a policy instrument. Other things being equal, a high child wage rate is better than a low one, not only because it expands the household budget set, but also because it brings more child labour out into the open.

Proposition 3. In second best,

(i) all school-age children attend school;

(ii) effective education time is higher than in laissez faire for most children;

(ii) the government uses a combination of taxes, education grants, obligations and prohibitions to redistribute and insure, but stops short of perfect equity, full insurance, and perfect consumption smoothing.

4.3 Extensions

Would there be any point in the government subsidizing school enrollment, or taxing overt child labour? If $\gamma(.)$ and $\theta(.)$ are in place, the answer is clearly no. The answer may change, however, if $\gamma(.)$ is not available. In the absence of any form of subsidization, and given credit rationing, making primary school enrollment compulsory would in fact make the poorest households (those with parental income lower than $\widetilde{y}$) worse-off than in *laissez faire*. An enrollment subsidy would obviously raise welfare if it were financed by foreign donors. It would raise welfare also it it were financed by a tax on parental income, but would not be as good as our $\gamma(.)$, because a price subsidy cannot be equal to more than a hundred per cent of the price, and that might not be enough. An enrollment subsidy financed by a poll tax would have no effect, because parents would then take a lump-sum subsidy with one hand, and pay a lump-sum tax of the same amount with the other. If $\theta(.)$ is not in place, an enrollment subsidy, however financed, will not be sufficient for a second best, and could actually reduce welfare, because it encourages school attendance at the expense of rest and homework. A tax on overt child labour would lower welfare in any case, because it would drive some of this labour underground.

In the analysis so far, we have assumed that parental incomes are certain, and individual skill premia subject only to idiosyncratic shocks. What difference would it make if not only x_i, but also y_i, were a random variable, and both were subject to aggregate, as well as idiosyncratic shocks? If x_i reflects the state of the economy when i enters the adult labour market, and that state is not known with certainty when e_i is chosen, the government must use its ability to borrow and lend for redistributing not only within, but also across cohorts. Formally, therefore, the government's time horizon must be extended from two to an infinite number of periods. That done, however, the policy schedules will remain qualitatively the same as if the optimization concerned only two periods. The same applies if y_i also is a random variable, because $\gamma(.)$ will then serve the purpose of insuring parents against the risk of a downturn in their own income, as well as that of redistributing among them.

5 Conclusion

Given financial market imperfection, the *laissez-faire* level of effective education time is inefficiently low. In households where parental income lies below a certain threshold, children do not even enroll for school. As already established in the theoretical literature, and confirmed by the empirical one, the reason is not only that parents cannot borrow against the expected return to their educational investments, but also that they cannot insure against the risk of this return being low.

In first best, all children study at the efficient level, the same for all of them. But there is nothing to indicate that the efficient level of work time is zero. The government makes school enrollment compulsory, and uses personalized lump-sum transfers to achieve perfect equity, full insurance, and perfect consumption-smoothing. In second best, all children attend school, but effective study time is inefficiently low. The government makes school enrollment compulsory, and uses a combination of taxes on parental incomes and the children's skill premia, together with a mix of merit and need based education awards. If the child wage rate is sufficiently high, it also imposes a legal ceiling, decreasing in parental income, on overt child labour. This policy redistributes and insures, and relaxes the credit constraint, but does not go far enough to achieve perfect equity, full insurance, and perfect consumption-smoothing.

In reality, primary school enrollment is officially compulsory, and labour at a very young age officially forbidden, in most countries. In poor developing ones, however, education is subsidized, if at all, only through the price of school enrollment. As we have shown, enforcing school enrollment, or making the ban on child labour effective, without offering parents any kind of subsidy, in a situation where they can neither borrow nor buy insurance, would push social welfare below the *laissez-faire* level. An enrollment subsidy financed by a tax on parental income, or by foreign donations, might be better than nothing, but not enough for a second best.

References

Baland, J. M. and J. A. Robinson (2000), Is Child Labor Inefficient? *Journal of Political Economy* 108, 663-679

Cigno, A. (2006), A Constitutional Theory of the Family, *Journal of Population Economics* 19, 259-283

——— (2009), Agency in Family Policy: A Survey, CESifo Working Paper N° 2664

——— and F. C. Rosati (2005), *The Economics of Child Labour*, New York and Oxford: Oxford University Press

Beegle, K., Dehejia, R. H., Gatti, R. (2007), Child Labour, Income Shocks, and Access to Credit, *Journal of Development Economics*, forth.

Besley, T. (1995), Non-Market Institutions for Credit and Risk-Sharing in Low-Income Countries, *Journal of Economic Perspectives* 9, 115–127

Dessy, S. E. and S. Pallage (2005), A Theory of the Worst Forms of Child Labor, *Journal of Development Economics* 115, 68-87

Fitzsimons, E. (2007), The Effects of Risk on Education in Indonesia, *Economic Development and Cultural Change* 56, 1–25

Fuwa, N., S. Ito, K. Kubo, T. Kurosaki and Y. Sawada (2009), How Does Credit Access Affect Children's Time Allocation? Evidence from Rural India. IDE Discussion Paper N° 183

Hanushek, E. A., C. K. Y. Leung, and K. Y. I. Yilmaz (2003), Redistribution Through Education and Other Transfer Mechanisms, *Journal of Monetary Economics* 50, 1719-50

Jacoby, H. (1994), Borrowing Constraints and Progress Through School: Evidence from Peru, *Review of Economics and Statistics* LXXVI, 151-160

——— and E. Skoufias (1997), Risk, Financial Markets and Human Capital in Developing Countries, *Review of Economic Studies* 64, 311-335

Johnson, W. R. (1987), Income Redistribution as Human Capital Insurance, *Journal of Human Resources* 22, 269-280

Kodde, A. D. (1986), Uncertainty and the Demand for Education, *Review of Economics and Statistics* 68, 460-467

Levhari D. and Y. Weiss (1974), The Effect of Risk on the Investment in Human Capital, *American Economic Review* 64, 950-963

Loury, G. (1981), Intergenerational Transfers and the Distribution of Earnings, *Econometrica* 49, 843-67

Pouliot, W. (2006), Introducing Uncertainty in Baland and Robinson's Model of Child Labour, *Journal of Development Economics* 79, 264-272

Ranjan, P. (2001), Credit Constraints and the Phenomenon of Child Labor, *Journal of Development Economics* 64, 81-102

Ravallion, M. and Q. Woodon (2000), Does Child Labour Displace Schooling? Evidence on Behavioural Responses to an Enrollment Subsidy, *Economic Journal* 110, C158-C175

Razin, A. (1976), Lifetime Uncertainty, Human Capital and Physical Capital, *Economic Enquiry* 14, 439-448

Townsend, R. (1994), Risk and Insurance in Village India, *Econometrica* 62, 539 –592

CESifo Working Paper Series

for full list see www.cesifo-group.org/wp
(address: Poschingerstr. 5, 81679 Munich, Germany, office@cesifo.de)

3013 Frederick van der Ploeg and Steven Poelhekke, The Pungent Smell of "Red Herrings": Subsoil Assets, Rents, Volatility and the Resource Curse, April 2010

3014 Vjollca Sadiraj, Jan Tuinstra and Frans van Winden, Identification of Voters with Interest Groups Improves the Electoral Chances of the Challenger, April 2010

3015 Guglielmo Maria Caporale, Davide Ciferri and Alessandro Girardi, Time-Varying Spot and Futures Oil Price Dynamics, April 2010

3016 Scott Alan Carson, Racial Differences in Body-Mass Indices for Men Imprisoned in 19^{th} Century US Prisons: A Multinomial Approach, April 2010

3017 Alessandro Fedele, Paolo M. Panteghini and Sergio Vergalli, Optimal Investment and Financial Strategies under Tax Rate Uncertainty, April 2010

3018 Laurence Jacquet, Take it or Leave it: Take-up, Optimal Transfer Programs, and Monitoring, April 2010

3019 Wilhelm Kohler and Jens Wrona, Offshoring Tasks, yet Creating Jobs?, April 2010

3020 Paul De Grauwe, Top-Down versus Bottom-Up Macroeconomics, April 2010

3021 Karl Ove Aarbu, Demand Patterns for Treatment Insurance in Norway, April 2010

3022 Toke S. Aidt and Jayasri Dutta, Fiscal Federalism and Electoral Accountability, April 2010

3023 Bahram Pesaran and M. Hashem Pesaran, Conditional Volatility and Correlations of Weekly Returns and the VaR Analysis of 2008 Stock Market Crash, April 2010

3024 Stefan Buehler and Dennis L. Gärtner, Making Sense of Non-Binding Retail-Price Recommendations, April 2010

3025 Leonid V. Azarnert, Immigration, Fertility, and Human Capital: A Model of Economic Decline of the West, April 2010

3026 Christian Bayer and Klaus Wälde, Matching and Saving in Continuous Time: Theory and 3026-A Matching and Saving in Continuous Time: Proofs, April 2010

3027 Coen N. Teulings and Nick Zubanov, Is Economic Recovery a Myth? Robust Estimation of Impulse Responses, April 2010

3028 Clara Graziano and Annalisa Luporini, Optimal Delegation when the Large Shareholder has Multiple Tasks, April 2010

3029 Erik Snowberg and Justin Wolfers, Explaining the Favorite-Longshot Bias: Is it Risk-Love or Misperceptions?, April 2010

3030 Doina Radulescu, The Effects of a Bonus Tax on Manager Compensation and Welfare, April 2010

3031 Helmut Lütkepohl, Forecasting Nonlinear Aggregates and Aggregates with Time-varying Weights, April 2010

3032 Silvia Rocha-Akis and Ronnie Schöb, Welfare Policy in the Presence of Unionised Labour and Internationally Mobile Firms, April 2010

3033 Steven Brakman, Robert Inklaar and Charles van Marrewijk, Structural Change in OECD Comparative Advantage, April 2010

3034 Dirk Schindler and Guttorm Schjelderup, Multinationals, Minority Ownership and Tax-Efficient Financing Structures, April 2010

3035 Christian Lessmann and Gunther Markwardt, Decentralization and Foreign Aid Effectiveness: Do Aid Modality and Federal Design Matter in Poverty Alleviation?, April 2010

3036 Eva Deuchert and Conny Wunsch, Evaluating Nationwide Health Interventions when Standard Before-After Doesn't Work: Malawi's ITN Distribution Program, April 2010

3037 Eric A. Hanushek and Ludger Woessmann, The Economics of International Differences in Educational Achievement, April 2010

3038 Frederick van der Ploeg, Aggressive Oil Extraction and Precautionary Saving: Coping with Volatility, April 2010

3039 Ainura Uzagalieva, Evžen Kočenda and Antonio Menezes, Technological Imitation and Innovation in New European Union Markets, April 2010

3040 Nicolas Sauter, Jan Walliser and Joachim Winter, Tax Incentives, Bequest Motives, and the Demand for Life Insurance: Evidence from two Natural Experiments in Germany, April 2010

3041 Matthias Wrede, Multinational Capital Structure and Tax Competition, April 2010

3042 Burkhard Heer and Alfred Maussner, A Note on the Computation of the Equity Premium and the Market Value of Firm Equity, April 2010

3043 Kristiina Huttunen, Jukka Pirttilä and Roope Uusitalo, The Employment Effects of Low-Wage Subsidies, May 2010

3044 Matthias Kalkuhl and Ottmar Edenhofer, Prices vs. Quantities and the Intertemporal Dynamics of the Climate Rent, May 2010

3045 Bruno S. Frey and Lasse Steiner, Pay as you Go: A New Proposal for Museum Pricing, May 2010

3046 Henning Bohn and Charles Stuart, Population under a Cap on Greenhouse Gas Emissions, May 2010

3047 Balázs Égert and Rafal Kierzenkowski, Exports and Property Prices in France: Are they Connected?, May 2010

3048 Thomas Eichner and Thorsten Upmann, Tax-Competition with Involuntary Unemployment, May 2010

3049 Taiji Furusawa, Kazumi Hori and Ian Wooton, A Race beyond the Bottom: The Nature of Bidding for a Firm, May 2010

3050 Xavier Vives, Competition and Stability in Banking, May 2010

3051 Thomas Aronsson and Erkki Koskela, Redistributive Income Taxation under Outsourcing and Foreign Direct Investment, May 2010

3052 Michael Melvin and Duncan Shand, Active Currency Investing and Performance Benchmarks, May 2010

3053 Sören Blomquist and Laurent Simula, Marginal Deadweight Loss when the Income Tax is Nonlinear, May 2010

3054 Lukas Menkhoff, Carol L. Osler and Maik Schmeling, Limit-Order Submission Strategies under Asymmetric Information, May 2010

3055 M. Hashem Pesaran and Alexander Chudik, Econometric Analysis of High Dimensional VARs Featuring a Dominant Unit, May 2010

3056 Rabah Arezki and Frederick van der Ploeg, Do Natural Resources Depress Income Per Capita?, May 2010

3057 Joseph Plasmans and Ruslan Lukach, The Patterns of Inter-firm and Inter-industry Knowledge Flows in the Netherlands, May 2010

3058 Jenny E. Ligthart and Sebastian E. V. Werner, Has the Euro Affected the Choice of Invoicing Currency?, May 2010

3059 Håkan Selin, Marginal Tax Rates and Tax-Favoured Pension Savings of the Self-Employed – Evidence from Sweden, May 2010

3060 Richard Cornes, Roger Hartley and Yuji Tamura, A New Approach to Solving Production-Appropriation Games with Many Heterogeneous Players, May 2010

3061 Ronald MacDonald and Flávio Vieira, A Panel Data Investigation of Real Exchange Rate Misalignment and Growth, May 2010

3062 Thomas Eichner and Rüdiger Pethig, Efficient Management of Insecure Fossil Fuel Imports through Taxing(!) Domestic Green Energy?, May 2010

3063 Vít Bubák, Evžen Kočenda and Filip Žikeš, Volatility Transmission in Emerging European Foreign Exchange Markets, May 2010

3064 Leonid V. Azarnert, Après nous le Déluge: Fertility and the Intensity of Struggle against Immigration, May 2010

3065 William E. Becker, William H. Greene and John J. Siegfried, Do Undergraduate Majors or Ph.D. Students Affect Faculty Size?, May 2010

3066 Johannes Becker, Strategic Trade Policy through the Tax System, May 2010

3067 Omer Biran and Françoise Forges, Core-stable Rings in Auctions with Independent Private Values, May 2010

3068 Torben M. Andersen, Why do Scandinavians Work?, May 2010

3069 Andrey Launov and Klaus Wälde, Estimating Incentive and Welfare Effects of Non-Stationary Unemployment Benefits, May 2010

3070 Simon Gächter, Benedikt Herrmann and Christian Thöni, Culture and Cooperation, June 2010

3071 Mehmet Bac and Eren Inci, The Old-Boy Network and the Quality of Entrepreneurs, June 2010

3072 Krisztina Molnár and Sergio Santoro, Optimal Monetary Policy when Agents are Learning, June 2010

3073 Marcel Boyer and Donatella Porrini, Optimal Liability Sharing and Court Errors: An Exploratory Analysis, June 2010

3074 Guglielmo Maria Caporale, Roman Matousek and Chris Stewart, EU Banks Rating Assignments: Is there Heterogeneity between New and Old Member Countries? June 2010

3075 Assaf Razin and Efraim Sadka, Fiscal and Migration Competition, June 2010

3076 Shafik Hebous, Martin Ruf and Alfons Weichenrieder, The Effects of Taxation on the Location Decision of Multinational Firms: M&A vs. Greenfield Investments, June 2010

3077 Alessandro Cigno, How to Deal with Covert Child Labour, and Give Children an Effective Education, in a Poor Developing Country: An Optimal Taxation Problem with Moral Hazard, June 2010