

Buying Out Child Labor[★]

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Abstract

In this paper we view child labor as a negative externality exerted by some poor countries on richer nations. We inquire into the feasibility of international transfers as a way of addressing this externality. We build a two-country growth model with human capital and child labor. We then calibrate our model to the United States and a poor country, solve it numerically and provide a quantitative description of the minimum transfers necessary to induce the poor to give up child labor. We then check their sustainability from the point of view of the rich.

Key words: Child labor, poverty trap, international transfers

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1 Introduction

Beside the main road from downtown Yaoundé to the suburb of Nkolbisson, Cameroon, children ages 8 to 15 break stones in what appears to be a small improvised gravel factory. There is no machinery. Children and adults work alike. You can see the children early in the morning. They are still at work if you venture the same way nine hours later. These children belong to the mass of child laborers, probably unaccounted for by the International Labor Organization's already substantial statistical portrait of child labor [see, e.g., ILO (1996b)].

According to this source, child labor embraces 26% of children ages 10 to 14 in Africa, 13% of them for the world overall in 1995. More striking is the fact that in many poor countries child labor does not seem to disappear [ILO (1996b, 1998)].

It is quite easy for an outsider to perceive this child labor as a case of child abuse. This in fact seems to be how child labor is widely perceived in industrialized countries.¹ The perception that there is some child abuse in each form of child labor is not necessarily wrong.² Even though a careful analysis of the numbers would reveal that most of child laborers in Africa perform much less harmful tasks than those reported above and operate at home or within farms, Sylvain Dessy points out that corporal punishment is a widely used practice to both discipline and motivate child laborers.³ Whether the outsider's perception is indeed accurate can be discussed extensively. The fact

¹ Citizens of industrialized countries are still haunted by the treatment reserved to children in their own economic development. Notwithstanding their understanding that child labor during the industrial revolution served an economic role, 20th century historians view it as morally contemptible [Nardinelli (1982)]. According to Nardinelli (1982), "social and economic historians have long deplored the employment of children in 19th century Britain. Although most observers regard child labor as an evil in itself, they believe that the cruel treatment of children compounded the evil... Employers whipped, hit, kicked, slapped and thrashed their child employees" (p. 283).

² It is important not to confuse child labor with child work performed by teenagers during their Summer time in industrialized countries, which are usually encouraged by their parents. The type of child labor which this paper targets is not the Summer time job of 15-year old US citizens, it is the full-time work of younger children, which displaces schooling. ILO Convention C138 (ILO, 1973), which aims at the elimination of child labor, explicitly bans any form of employment below age 15 which interferes with the child's education. We adopt this definition. Admittedly, there might be learning-by-doing in this type of work as Dessy and Pallage (2005) have argued. We have chosen to abstract from this issue here, for simplicity.

³ Private discussion with Sylvain Dessy, September 20, 2001.

remains that it is real. To see this, the following test should be illuminating: Gather a crowd in a football stadium in any North American city and submit to popular vote a ban on child labor in Africa. No doubt people would quasi-unanimously vote for the ban. The citizens of industrialized countries dislike the fact that children are working in developing nations. Of course, they may not be willing to pay a fortune to support such a ban. This is a pure case of negative externality. In the present paper, we wish to measure the extent of the support a ban on child labor might raise in rich countries.

Precisely, we ask whether there exists a Pareto improving transfer from rich to poor countries that would be effective in suppressing child labor and thus the externality. Some readers may still question the existence of the externality. Admittedly, legislators in industrialized countries may have different motives than their citizens when advocating bans on child labor. There may be hidden agendas on law-makers' behalf, but the platform they push to the voters is that of the externality. Machiavelli might applaud the art of simultaneously satisfying various lobbies and the common crowd, genuinely concerned about the wellbeing of child laborers. The skeptical readers may nevertheless find something of interest in our paper, a quantification of how much income supplement altruistic but credit-constrained parents may need to avoid resorting to child labor. Bourguignon et al. (2003) show that such transfers can be effective in bringing children away from work and into schools.

Whatever the true political motive, rich countries seem to find child labor unacceptable and have tried through bans and decrees to press poor countries to abandon this practice.⁴ Academics are not as straightforward about the banning of child labor — it is far from obvious that banning child labor is welfare improving for poor families [see Basu (1999) for an excellent review of the literature] —, they are nevertheless uneasy about the idea of children working. In this paper, we explore the cost and feasibility of an alternative to bans, i.e. international transfers.

The practice of child labor is a very old institution. In many child labor contracts, parents rent their children's labor in exchange for a given income. The very nature of such contracts, in which the worker himself is often not a party, makes child labor a close relative to slavery. The institution is somewhat self-perpetuating, since parents, by not providing their children with much human capital, deprive them of future opportunities on the job market for adult labor. As a consequence, once adults, they may themselves rely on their children's labor to make ends meet. We have just described the mechanics of a poverty

⁴ See for instance the list of 90 governments adhering to ILO's IPEC program against child labor [ILO (1996a, 1999)]: Among these countries are most European countries, the United States, Canada and Australia. Trade sanctions have been suggested and even applied to mobilize against child labor [for examples and a critical assessment of these sanctions, see Jafarey and Lahiri (2002)].

trap. This is not to say that parents are malevolent. They may be altruistic but in such state of poverty that the family cannot afford to avoid sending children to work.

Most closely related to our research is the seminal paper by Basu and Van (1998). In this paper, the authors model the choices of altruistic parents, resorting to child labor only out of necessity. The authors show that provided child labor and adult labor are substitutes, there may exist multiple equilibria on the labor market, one in which children work and salaries are low, another, Pareto superior, in which children do not work and wages are high. In this context, a ban on child labor is justified in that it pushes the economy from the “bad” equilibrium to the “good” one. In our model, parents are also altruistic towards their offspring and child labor is driven purely by poverty. Multiple equilibria (steady states) also arise in our model, but the move from one equilibrium to another is not instantaneous. It requires time and sacrifices by parents. Unlike in Basu and Van (1998), a ban on child labor in our environment is never Pareto improving. Transfers are needed to compensate parents for the welfare loss inflicted by the ban. Our goal is precisely to measure the necessary transfers. We build on Basu and Van (1998) and add intertemporal dynamics and the possibility to accumulate human capital through education.

Other possible causes of child labor and policy options have been explored in the theoretical literature. Dessy (2000) suggests that policies that raise the return to schooling when accompanied by measures that lower the return from having children can be sufficient to ensure the disappearance of child labor. Doepke (2004) quantifies the impact of those policies and highlights the importance of banning child labor. In Baland and Robinson (2000), banning child labor can be a Pareto improvement in an environment in which children cannot credibly commit to transfer part of their future income to their parents as a compensation for not having sent them out to work as children. In Dessy and Pallage (2001), child labor arises because of a lack of coordination between the decisions of parents to send their children to school and those of entrepreneurs to invest in skill-biased technology. A ban in this context may help coordinate expectations. Krueger and Tjornhom Donohue (2005) compare different policy options towards child labor in 19th-century U.S. and find mandatory schooling to be more welfare enhancing than a child labor ban within a dynamic heterogeneous agent model.⁵

Whether good or bad, the absence of a ban disturbs richer countries. We view child labor as a negative externality exerted by poor countries on richer nations. There is no *a priori* reason why poor countries should comply with

⁵ Other theoretical explanations for the prevalence of child labor include social norms and the absence of a strong social stigma associated with the practice (see López-Calva (2002)).

rich nations' desires without seeking compensation. Our goal is to compute the minimum transfer from rich to poor necessary to eradicate child labor. We then ask whether this transfer enters the range of payments acceptable by the rich.

This paper is also related to the literature on human capital and growth and to that on self-enforcing dynamic contracts. Human capital as an engine for growth is key in Lucas (1988), Azariadis and Drazen (1990), Becker et al. (1990), Azariadis (1996), Galor and Tsiddon (1997), Moe (1998). A general result in this literature is that models of human capital investment can generate poverty traps. Hazan and Berdugo (2002) show that it is eventually possible to escape from such traps if there is technical progress, and that a child labor ban can speed this process up. The literature on self-enforcing dynamic contracts goes back to the seminal work of Azariadis (1975). In the context of international treaties, the absence of explicit enforcement mechanisms makes self-enforcing contracts particularly relevant. A previous attempt at quantifying international transfers to sustain bilateral treaties can be found in Pallage (2000).

We proceed in two stages. We first construct a one-country overlapping generation model with education and show that a multiplicity of equilibria may arise. We also show that the eradication of child labor is a natural consequence of time, as long as the country is not stuck in a development trap. Abolishing child labor may therefore be beneficial if the accompanying transfers allow the poor country to move out of this trap. We then move to the more general two-country model with an international externality: the world-wide level of child labor. We calibrate our model to the United States and a poor country, solve it numerically and provide a quantitative description of optimal decisions and their dynamics. In addition to replicating key statistics of the two regions, our calibration has to yield multiple equilibria with and without child labor. The latter significantly restricts the parameter space.

The rest of the paper is organized as follows. Section 2 briefly sketches some facts about child labor. Section 3 describes a simple growth model with education and discusses its possible steady states. Section 4 introduces the two-country version of this model. Section 5 is devoted to measurement and computational issues. Section 6 presents our results and Section 7 concludes.

2 A brief statistical portrait of child labor

Child labor is an important phenomenon on at least three continents. Canagarajah and Coulombe (1997) document that in Ghana, in 1992, about 30% of children ages 7 to 14 were involved in some sort of child labor. This estimate

does not account for those children doing household tasks for the family. Child labor contributed 5.3% of total labor hours. According to the authors, poverty does not seem to be a good determinant of child labor, whereas the education of parents tends to reduce the incidence of child labor.⁶ Educational attainment in the Ghanaian labor force was 3.86 years of schooling in 1985 [reported in Benhabib and Spiegel (1994) based on computations by Kyriacou (1991)]. As a comparison, the average years of schooling in the US labor force was 12.09, according to the same source.

Grootaert (1998) provides similar estimates for Côte d'Ivoire: in 1985, 18.5% of children ages 7 to 14 were in the labor force, 19.3% in 1988. The participation rate of adolescents (15 to 18 years old) was more than twice that number. In 1988, the average educational attainment at age 17 in Côte d'Ivoire was respectively 6 years of schooling in urban areas and 3.1 in rural areas. Unlike in Ghana, the choice between education and work seems exclusive in Côte d'Ivoire, yet child labor incidence and educational attainment are comparable [Coulombe (2001)].

For South America, Patrinos and Psacharopoulos (1997), Cartwright (1999) and Cartwright and Patrinos (1999) provide participation rates of children for respectively Peru, Colombia and Bolivia, between 10 and 20% below age 17. Incidence rates seem to be higher in rural areas and for boys.

Child labor is not limited to Africa or South America. Asia has its share of child laborers. In the Philippines, Sakellariou and Lall (1999) report that 12.3% of children ages 10 to 17 were working in 1991-1992. According to Ray (2000), in 1991, 27.8% of Pakistani children in the same age bracket were also involved in the labor market.

This brusque set of numbers suggests that child labor is a significant practice of poor countries. It is typically accompanied by very low educational attainment, particularly in Africa. All child labor numbers above are conservative: we have only documented in this section the 'visible' part of child labor, but there is also child work at home, especially for girls. In Ghana, for instance, 88% of children 7 to 14 perform household tasks for an average of 15.2 hours a week [Coulombe (2001)].

3 A "simple" growth model with education

Our first model economy is a one-country overlapping generation economy. The country is inhabited by a continuum of agents of measure 1. Agents live

⁶ Very precise and detailed data can be found in Coulombe (2001).

for two periods, one period as children, one period as adults. Each adult bears one child. A family is made of an adult and his child. Children will be indexed by 1, adults by 2.

There is a single good in this world. It is produced using labor and human capital. The quantity of that good produced by a child at time t is given by:

$$y_t^1 = An_t^1 h_t^1$$

where n_t^1 is the time spent at work by the child, h_t^1 is its human capital endowment. Children's unit endowment of time can be spent at work or at school (e_t):

$$n_t^1 + e_t = 1$$

Their human capital as adults is a function of their initial level of human capital, the time they spent at school and the human capital of their parents: $h_{t+1}^2 = f(h_t^1, h_t^2, e_t)$. We make the following assumptions on the shape of the function f :

$$[A1] \frac{\partial f}{\partial h_t^1} > 0, \quad [A2] \frac{\partial f}{\partial e_t} > 0, \quad [A3] \frac{\partial f}{\partial h_t^2} > 0, \quad [A4] \frac{\partial^2 f}{\partial e_t \partial h_t^2} > 0.$$

Similar assumptions were made in Galor and Tsiddon (1997). Assumptions A1 and A2 are straightforward. A3 and A4 require some discussion: They imply that parental human capital positively influences both the future level of human capital of their child and the marginal return from schooling. The law of motion of human capital thus assumes complementarities between the human capital of parents and schooling effort. We further assume that children are born 'naked,' that is they are all endowed with the same level of human capital: $h_t^1 = h^1 \forall t$.⁷

Adults work full-time and make household decisions. Their production function is given by:

$$y_t^2 = An_t^2 h_t^2 \quad \text{with} \quad n_t^2 = 1$$

⁷ We do not think that this assumption is particularly controversial, and do not wish to take any stand on possible genetic differences. The human capital accumulated by parents, however, does play a role in the human capital accumulation process of the children as a complement to education. Our assumption simply states that the starting point is the same for every child. If we were to assume that the initial human capital was a function of the parents', it would become all the more difficult for the poor to catch up with the rich. The convergence dynamics would be slower. This would eventually reinforce our results.

They manage the family budget, and choose how to divide their children's time between labor and schooling. The family resource constraint is:

$$y_t^1 + y_t^2 = c_t^1 + c_t^2$$

where c stands for consumption.

We assume that adults dislike child labor (or equivalently enjoy the education of their child), care about family consumption and about the well-being of their child when adult. They wish to maximize the following utility function:

$$u_t^2 = u(c_t^1 + c_t^2, e_t) + \beta u_{t+1}^2$$

where β is their time discount factor and $u(\cdot, \cdot)$ is strictly increasing and concave. As children take no decision, we normalize their utility to zero: $u_t^1 = 0$.⁸

The problem of a parent is recursive and admits the following Bellman equation:

$$v^2(h^1, h^2) = \max_e u(A(1-e)h^1 + Ah^2, e) + \beta v^2(h^1, f(h^1, h^2, e))$$

An example

We undertake a steady-state analysis, assuming the following functional forms for preferences and the law of motion of human capital:

$$u_t^2 = \alpha \ln(c_t^1 + c_t^2) + (1 - \alpha) \ln(e_t) + \beta u_{t+1}^2$$

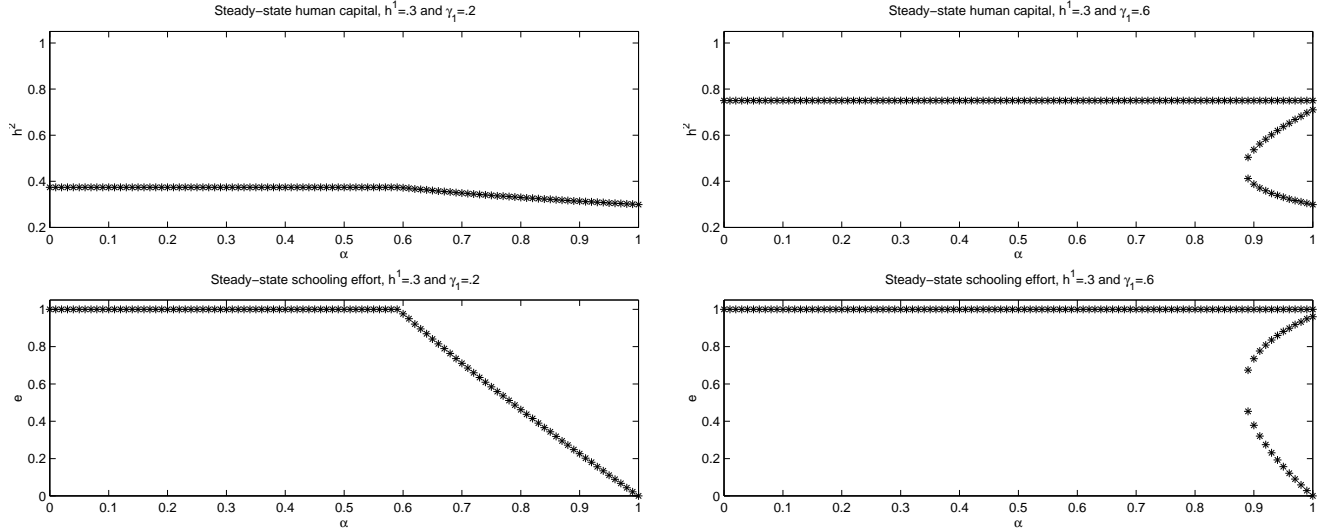
$$h_{t+1}^2 = h_t^1 + \gamma_1 (h_t^2)^{\gamma_2} e^{\gamma_3}$$

At a steady state, the first order conditions for a parent are given by:

$$\begin{cases} e = (1 - \alpha) \frac{h^1 + h^2}{h^1} + \alpha \frac{\beta \gamma_3 \frac{h^2 - h^1}{h^1}}{1 - \beta \gamma_2 + \beta \gamma_2 \frac{h^1}{h^2}} \\ h^2 = h^1 + \gamma_1 h^2 \gamma_2 e^{\gamma_3} \end{cases}$$

⁸ We therefore abstract from those children who do make their own choices. Since in Section 5 we will focus on children below age 15 in Ghana, we do not think this reality is quantitatively important.

Fig. 1. steady states



Note: The figure presents steady state human capital and education choices as a function of the preference parameter α when $\gamma_2 = \gamma_3 = 1$ and $\gamma_1 = 0.2$ (left panel) or $\gamma_1 = 0.6$ (right panel). Multiple steady states can be recorded as γ_1 and α become large.

Depending on the values of γ_1 , γ_2 , γ_3 and α , there can be single or multiple steady states. For $\beta = .5$, $\gamma_2 = \gamma_3 = 1$, Figure 1 shows the steady-state human capital and schooling effort as a function of α and γ_1 . The figure also indicates that a limited parameter space will be available for a calibration with multiple equilibria. This figure supports a possible theory of poverty traps. Countries may indeed be trapped in a low human capital steady state. In such a case, a transfer from abroad may lessen the need for child labor, increase the level of human capital and help the country move out of the trap.

Note that these poverty traps are similar to those described in Azariadis and Drazen (1990). In their overlapping generation model, adults transfer directly some of their human capital to their children. They obtain underdevelopment traps with no education because the private return to education is much lower than the social return and because of increasing returns to human capital. In our model economy, we have the same relation between returns and human capital, but children must start from “scratch” at each generation. Becker et al. (1990) also find multiple steady states with poverty traps in a model economy with fertility decisions: one steady state has abundant human capital and few child laborers, the other has low human capital and many children at work.

Unlike Azariadis and Drazen (1990) and Becker et al. (1990), we find that underdevelopment traps do not necessarily mean zero education, which is consistent with empirical observations. The returns to education are high enough for the children to seek some schooling.

4 The two-country model

We now introduce the international version of this model. The world is made of two countries whose respective population is of measure 1. Countries differ in their initial level of human capital and their preferences towards child labor. The country with high initial level of human capital, hereafter labeled the “rich,” dislikes child labor both at home and abroad or equivalently in this model enjoys world-wide education. The other country, whose variables will be marked with an asterisk *, dislikes child labor at home only, or equivalently enjoys domestic education.⁹ In other words, the “poor” exerts a unilateral externality on the “rich” through the use of education versus child labor.

Preferences of parents in both countries can thus be written as:

$$u_t^2 = u(c_t^1 + c_t^2, e_t + e_t^*) + \beta u_{t+1}^2,$$

$$u_t^{2*} = u^*(c_t^{1*} + c_t^{2*}, e_t^*) + \beta u_{t+1}^{2*}.$$

In a Markov equilibrium without transfers, the representative parent in the poor country solves the same problem as in autarky:

$$[P^*] \quad v^{2*}(h^{1*}, h^{2*}) = \max_{e^*} u^*(A(1 - e^*)h^{1*} + Ah^{2*}, e^*) + \beta v^{2*}(h^{1*}, f(h^{1*}, h^{2*}, e^*))$$

In such a Markov equilibrium without transfers, the rich country’s representative parent now solves a more sophisticated version of the Bellman equation above, taking as given the decision rule $e^*(h^{1*}, h^{2*})$ of the poor:

$$[P] \quad v^2(h^1, h^2; h^{1*}, h^{2*}, e^*) = \max_e u(A(1 - e)h^1 + Ah^2, e + e^*)$$

$$+ \beta v^2(h^1, f(h^1, h^2, e); h^{1*}, f(h^{1*}, h^{2*}, e^*), e^*)$$

We assume that countries do not differ in the initial human capital level of children: $h^1 = h^{1*}$.

Our next step is to find the appropriate sequence of transfers from the rich country to the poor that would induce the latter to give up child labor. The agreement must be such that at any given time, the poor country obtains a higher present-value of utility under the agreement than outside of it: a participation constraint needs to be satisfied. The optimal sequence of transfers

⁹ As discussed later on, this assumption has no quantitative implication, but simplifies computations greatly.

$\{\tau_t\}$ solves the following problem for the rich:

$$\begin{aligned}
[P'] \quad & \max_{e_t, \tau_t} \sum_{t=0}^{\infty} \beta^t u(Ah_t^2 - \tau_t, e_t + e_t^*) \\
\text{subject to, } \forall t \quad & \begin{cases} h_{t+1}^2 = f(h^1, h_t^2, e_t) \\ h_{t+1}^{2*} = f(h^{1*}, h_t^{2*}, e_t^*) \\ h_0^2 = \bar{h}_0, \quad h_0^{2*} = \bar{h}_0^*, \\ \sum_{s=t}^{\infty} \beta^s u^*(Ah_s^{2*} + \tau_s, e_s^*) \geq v^{2*}(h^{1*}, h_t^{2*}) \\ e_t^* = 1 \end{cases}
\end{aligned}$$

This problem will be solved numerically in the coming sections.

5 Parameterization and computation

Parameterizing our model implies making three sorts of assumptions. First, it requires assumptions on the functional forms of preferences, production and laws of motion of human capital. Second, it requires assumptions on how current economic data relate to long term aggregates. Third, it also implies an assumption on the equilibrium that is currently reached. This proves particularly difficult in dynamic games for which the set of equilibria is likely to be large. In order to avoid that problem, we calibrate the model to the United States and Ghana, assuming they have reached an autarkic steady state. In our numerical simulations, we will then test how the use of transfers may perturb that steady state.¹⁰ We take the United States as a representative of countries that dislike child labor abroad. Ghana is a well-studied country, which we will use as a representative of Africa. We work throughout as if the rich and the poor countries were equally populous.

We assume preferences in both countries to be of the following form:

$$\begin{aligned}
u_t^2 &= \alpha \ln(c_t^1 + c_t^2) + (1 - \alpha) \ln(e_t + e_t^*) + \beta u_{t+1}^2 \\
u_t^{2*} &= \alpha \ln(c_t^{1*} + c_t^{2*}) + (1 - \alpha) \ln(e_t^*) + \beta u_{t+1}^{2*}
\end{aligned}$$

The sum of education in both countries enters the utility of parents in the rich country. This implies that they care about child labor at home and abroad.

¹⁰ Our goal is not to explain how the two countries reached their initial conditions, but to see, given those initial conditions, which equilibria may obtain.

It is important to note, however, that they do care substantially more about the education of their own children because they care about the future utility of their children, which is clearly affected by their education. But they do not care about the future utility of children in the other country. Apart from preferences, all functional forms we assume are symmetrical. Human capital evolves in both countries according to the following law of motion:

$$h_{t+1}^2 = h^1 + \gamma_1 (h_t^2)^{\gamma_2} e_t^{\gamma_3}$$

Production functions are assumed linear as before:

$$y_t^1 = An_t^1 h^1 \quad \text{and} \quad y_t^2 = Ah_t^2$$

We choose γ_1 , γ_2 , γ_3 and α such that the following conditions are satisfied: 1) the economy admits two stable steady states: one with child labor, one without; 2) the ratio of human capital at the high and low steady states is about 3 [corresponding to the ratio of human capital between the US and Ghana reported in Benhabib and Spiegel (1994) and Barro and Lee (1993)]; 3) there is no child labor at the high steady state; 4) the fraction of time spent at work by children at the low steady state lies around 54% [or 17.3 hours a week in a school week of 32 hours, computed from Coulombe (2001)]. It should be noted that very few parameter choices satisfy these criteria. Table 1 presents the best fit in a least-square sense.¹¹

Table 1
Calibration

α	γ_1	γ_2	γ_3	β	$h^1 = h^{1*}$	h_{ss}^2	h_{ss}^{2*}	n^{1*}
0.985	0.835	1.07	0.17	0.50	0.30	3.15	1.24	0.54

We normalize the US steady state production to 1. Since adults care for the future only through their children, we choose $\beta = .5$, which corresponds to a period length of 15 years at a yearly discount rate of 4%. We also assume that children that are born at any given time are endowed with a positive initial level of human capital $h^1 = h^{1*}$ which we set at 0.3, without loss of generality.

Several items in our calibration need to be discussed. First, the economic literature has not yet converged on what is the proper measure of human capital. In our analysis, we need a measure that is consistent in the United States and in Ghana. We use the data computed by Benhabib and Spiegel

¹¹ The parameters γ_1 , γ_2 and γ_3 in the calibration for the human capital accumulation process, together with the preference parameter α are free parameters. The best combination of these four variables that gives us two steady states while matching the data on other dimensions is the one reported in our calibration Table 1.

(1994) for 1985, based on Kyriacou (1991). The latter tries to infer relations between average years of schooling in the labor force and past enrollment ratios in primary, secondary and post-secondary education. He then extrapolated to fill gaps in his data and used the average years of schooling in the labor force (our h^2) as the proxy for human capital. In 1985, this amounts to 12.086 for the USA and 3.859 for Ghana. Barro and Lee (1993) have built another dataset on the educational attainment of people ages 25 and over for 129 countries, also filling gaps with extrapolation methods. They find, for example, a score of 11.787 for the United States and 3.216 for Ghana in 1985.

Second, a potentially controversial item of calibration is the measure of child labor. According to Coulombe (2001), 27.4% of children in Ghana ages 7-14 work on the market, but not all full-time. On average, they spend 14.2 hours a week on the job. However, this hides considerable discrepancies between rural and urban areas, the former having significantly higher incidence of child labor (and lower levels of human capital). Also, 88.1% of children in this age bracket perform housekeeping tasks. They devote on average 15.2 hours a week to these activities. Based on the data described in Coulombe (2001), we found the average number of hours worked to be 17.3 a week.

Note also that α is calibrated in an indirect fashion. We do not envision a feasible way to determine empirically the dislike of parents for child labor, but we can obtain what values of α would yield equilibria like those we observe in the data. Thus, we measure the child labor externality indirectly. As the numerical examples in the previous sections show, the mere fact that we require the model to yield two equilibria, one rich, one poor, limits very much the possible values for α . This gives us more confidence in this indirect measure.¹²

To compute the Markov equilibrium without transfers, we proceed as follows. First, we discretize the state space. Since $h^1 = h^{1*}$ and does not evolve through time, there are only two relevant state variables: h^2 and h^{2*} . The state space is thus the product of two vectors $H^2 \times H^{2*}$. The poor country's problem is simpler than that of the rich in the sense that its decision does not depend on h^2 or on the decision of the rich. We therefore start by iterating on the value function of the poor to obtain its decision rule. We then do the same for the rich, taking as given the poor's optimal decision rule.¹³

¹² Our calibration delivers an equilibrium without child labor in the rich country. This is consistent with the fact that there is virtually no child labor in the United States in the sense described above (full-time work of children younger than 15).

¹³ Had we not assumed asymmetry of preferences across countries, a potentially large multiplicity of equilibria would have arisen, as is often the case in dynamic games. Since we are interested in a case in which the rich country is far from having child labor, the set of decision rules in the vicinity of this equilibrium is equivalent to that of the simpler problem we compute.

We finally compute, for each state of the world, the transfers that would make the poor indifferent between giving up child labor and remaining in autarky for the rest of times. These transfers ensure that the participation constraint is binding at any given state. In the last step of computations, we verify for which states of the world the rich agrees on the transfer scheme, i.e. for which states the transfers are *sustainable*. A transfer sequence will be called sustainable if its transfers are sustainable at every state along the development path.

6 Buying out child labor

We now undertake the task of measuring how much the poor country would require in order to comply with ILO's Convention C138, that is a complete ban on child labor. We then verify if the rich country is willing to transfer such an amount.

6.1 The complete ban

Solving problem [P*], we obtain the optimal human capital accumulation rule of the poor country, the solid curve in Figure 2-a. The optimal rule is characterized by two stable and one unstable steady states as the curve crosses the 45° line. The low stable steady state is a poverty trap. It involves a positive but small level of schooling. We then compute the minimum transfer rule that makes the poor country indifferent between a world in which it renounces child labor immediately and one of autarky forever. The optimal human capital accumulation rule subject to that transfer schedule is also depicted in Figure 2-a (broken curve). It admits only one steady state, corresponding to the upper-stable steady state in autarky. Indeed, once transfers are introduced to avoid child labor, schooling shifts the dynamics of human capital upwards, doing away with poverty traps.

The minimum transfer path required to induce the poor to give up child labor is presented in Figure 2-b. It implies a very large transfer in the first 15-year period (1.6% of the gross domestic product of the rich), slowly converging to zero in subsequent periods. In present-value terms, the necessary transfers amount to 2.58% of the GDP of the rich. As we can expect from its size, this transfer path is not sustainable. Interestingly, though, the rich country would be willing to pay a transfer in the vicinity of 0.90% of its GDP to abolish child labor. What our results suggest, however, is that we cannot find transfers such that a complete and immediate ban on child labor is Pareto improving.

The rich does not quite care *enough*. Yet we have given the model economy the best chance of finding sustainable transfers by making the poor country dislike

its own child labor and by making it care about future generations at the same (low) discount rate as the rich.¹⁴ Moreover, the model abstracts from several aspects that would inflate the required transfers. One is fertility: countries with child labor typically have a larger share of children in their population, thus they would grow in size over time, making aggregate transfers even larger. Another aspect is that the poor country could act strategically in two ways: choose the number of children to extract the largest possible rent from the rich and/or increase the rate of child laborers to the same effect.¹⁵ Consequently, our estimate of transfers should be seen as a lower bound.

Figure 2-c shows the paths of human capital under the two equilibria. With transfers, the poor converges towards the steady state of the rich in about 90 periods. Without transfers, the poor is stuck in a poverty trap.¹⁶ It is important to note that all transfers from the rich to the poor are consumption taken away from the rich since there is no savings technology in our model. It is all the more remarkable that the rich is willing to give up 0.90% of its income.

Figure 3 shows the transfers required by the poor for any possible initial states. While the poor would require positive transfers for many states East of the unstable steady state, the rich is unwilling to sustain them: for those initial states of the world, the rich knows that child labor is a temporary phenomenon that will disappear naturally as the country evolves towards the upper steady state.

6.2 *A partial ban*

Applying Coase theorem to the problem at hand, we know that there must exist a Pareto optimal level of child labor, achievable using transfers. Our results only establish that 0 is not the optimum. Our next task is to find out the level of child labor that should optimally be tolerated in this environment. For this purpose, we use our computation procedure again, imposing

¹⁴ For the same initial states, we computed the highest α for which cooperation between the rich and the poor would be sustained. At $\alpha = 0.96$, the poor would require a transfer of 1.31% of the rich's GDP and the rich would agree to it. In this case, however, there would be only one steady state, and sustainability would then be easier.

¹⁵ Of course, one could argue that the rich could strategically use its children as well. This, however, seems even more unrealistic.

¹⁶ With technological progress and capital accumulation, development would be more rapid in this model economy, though convergence might require a similar number of years: catching up a growing country takes more time than reaching its initial level of development.

Fig. 2. Results

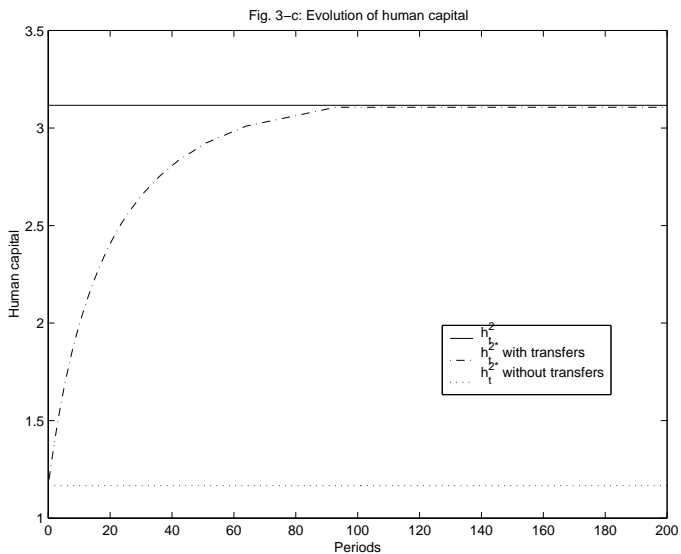
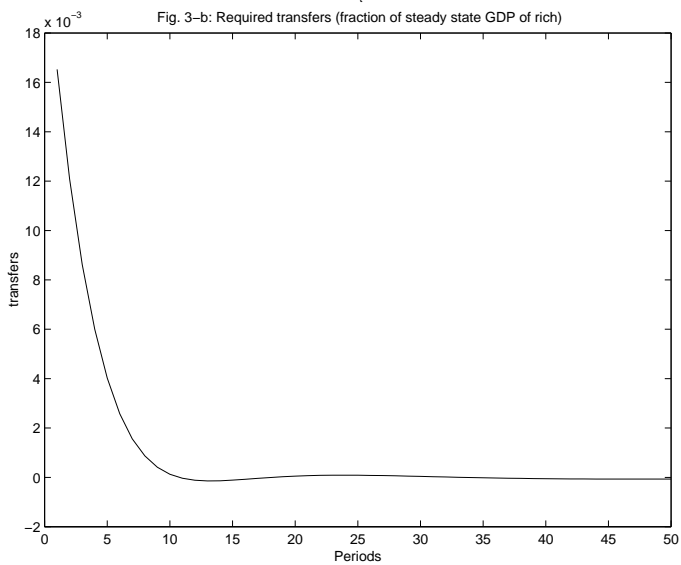
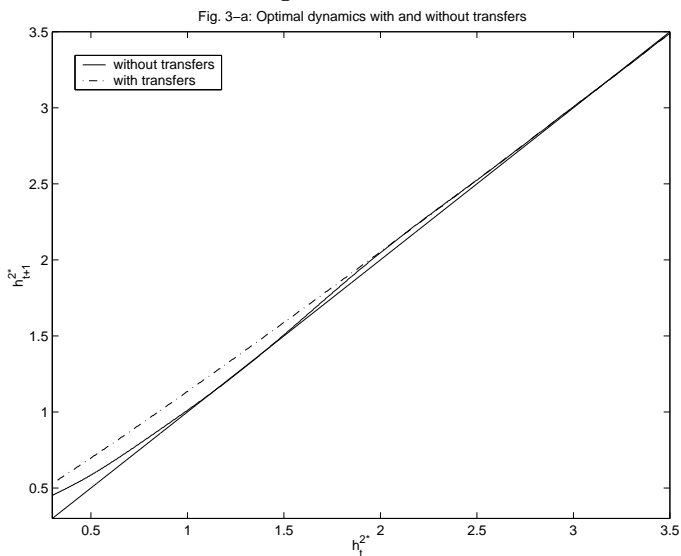
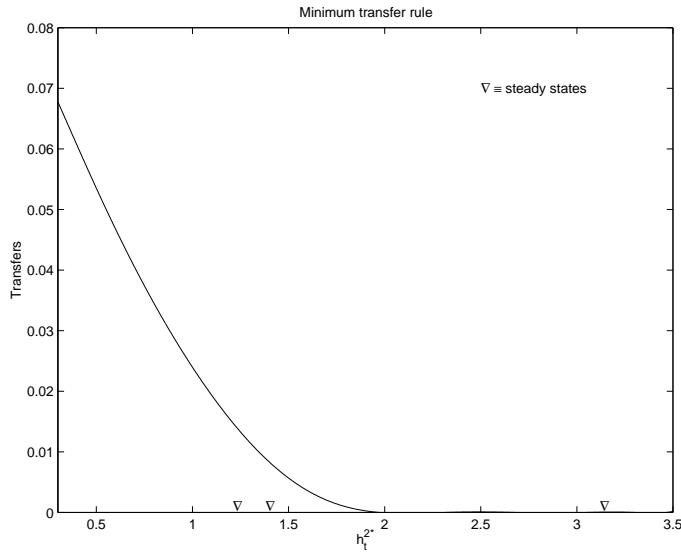


Fig. 3.



successively different ceilings \bar{n}^1 on child's time spent at work. For each such ceiling, we extract the required transfer from the rich to the poor and verify its sustainability. Table 2 summarizes the findings.

A partial ban can in fact be achieved via transfers. It would cost rich countries 0.22% of their gross domestic product to enforce such a ban,¹⁷ one in which children spend no more than 40% of their time at work (a reduction of 25% from the steady-state value of child labor). This partial ban generates a new low stable steady state at $h^{2*} = 1.37$ (instead of 1.24 without transfers).

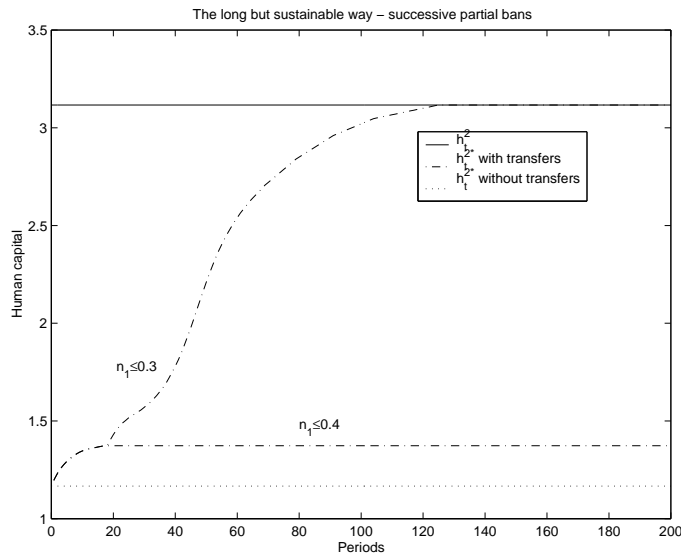
Interestingly, an adequately designed sequence of partial bans can be sustainable and lead to the complete disappearance of child labor in the long run. One such sequence implies two successive caps on child labor: $\bar{n}^1 = 0.4$ for the first 18 periods until the new low steady state, $\bar{n}^1 = 0.3$ afterwards. The evolution of human capital under these sequential regimes is explored in Figure 4. The transfers required in present value terms amount to 0.22% of the rich country's gross domestic product in order to enforce the first ban, then another 0.13% (valued at $t + 18$), to enforce the second. Following the second ban, the evolution of human capital in the poor country will be such that child labor, though tolerated, will naturally disappear. As can be seen from a comparison of Figures 2-c and 4, under these successive bans, the poor country would eventually converge to the upper steady state, though in a larger number of periods than under a complete ban. The necessary transfers are much smaller than those required for a complete and immediate ban on child labor. 0.22% of gross domestic product in present-value terms is by no means an extraordinary number. It corresponds roughly to the amount disbursed an-

¹⁷ Note that the transfer path is such that the ban is in fact self-enforcing once transfers are sustainable.

Table 2
Sustainable transfers

Ceiling on child labor \bar{n}^1	Transfer Present-val. (% GDP of rich)	Sustainable?
0	2.58%	no
0.1	1.81%	no
0.2	1.14%	no
0.3	0.60%	no
0.35	0.39%	no
0.375	0.30%	no
0.4	0.22%	yes

Fig. 4.



nually by the United States or the United Kingdom in the form of foreign aid over the last 30 years [Pallage and Robe (2001)]. An interesting conclusion of this section is that the only way, in our model, to eliminate child labor is to tolerate it partially.

7 Conclusion

Rich countries have all adhered to organizations such as IPEC, pressuring the poor to adopt bans on child labor. Yet, child labor prevails in many countries.

Our goal in this paper was to verify if the ‘dispute’ could be resolved using a dynamic contract between rich and poor nations involving transfers.

Our model economy is a dynamic, two-country model with an international externality: the world-wide level of child labor. Human capital is the only engine of development in this model. Two stable steady states arise: one with a rich economy, the other one characterized by a poverty trap with child labor and poor schooling. For a calibration of the model to the United States and Ghana as a representative of Africa, we show that buying out child labor requires substantial transfers from the rich. In our quite conservative modeling and calibration, the rich country does not care enough about this issue to allow transfers of this magnitude. A succession of carefully chosen partial bans, however, is sustainable using transfers and, in the long run, leads to the disappearance of child labor.

References

- Azariadis, C., 1975. Implicit contracts and underemployment equilibria. *Journal of Political Economy* 83, 1183–1202.
- Azariadis, C., 1996. The economics of poverty traps. part one: Complete markets. *Journal of Economic Growth* 1 (4), 449–486.
- Azariadis, C., Drazen, A., 1990. Threshold externalities in economic development. *Quarterly Journal of Economics*, 501–526.
- Baland, J.-M., Robinson, J. A., 2000. Is child labor inefficient? *Journal of Political Economy* 108 (4), 663–679.
- Barro, R. J., Lee, J.-W., 1993. International comparisons of educational attainment. *Journal of Monetary Economics* 32, 363–394.
- Basu, K., 1999. Child labor: Cause, consequence, and cure, with remarks on international labor standards. *Journal of Economic Literature* 37 (3), 1083–1119.
- Basu, K., Van, P. H., 1998. The economics of child labor. *American Economic Review* 88 (3), 412–427.
- Becker, G. S., Murphy, K. M., Tamura, R., 1990. Human capital, fertility, and economic growth. *Journal of Political Economy* 98 (5), 12–37.
- Benhabib, J., Spiegel, M. M., 1994. The role of human capital in economic development: Evidence from aggregate cross-country data. *Journal of Monetary Economics* 34, 143–173.
- Bourguignon, F., Ferreira, F., Leite, P., 2003. Conditional cash transfers, schooling and child labor: Microsimulation of Bolsa Escola, working Paper 477, Departamento de Economia, Pontifícia Universidade Católica do Rio de Janeiro.
- Canagarajah, S., Coulombe, H., 1997. Child labor and schooling in Ghana, the World Bank, Working Paper 1844.
- Cartwright, K., 1999. Child labor in Colombia. In: Grootaert, C., Patrinos, H. A. (Eds.), *The Policy Analysis of Child Labor, A Comparative Study*. St. Martin's Press, New York.
- Cartwright, K., Patrinos, H. A., 1999. Child labor in urban Bolivia. In: Grootaert, C., Patrinos, H. A. (Eds.), *The Policy Analysis of Child Labor, A Comparative Study*. St. Martin's Press, New York.
- Coulombe, H., 2001. Child labor and schooling in West Africa: A three-country study, doctoral Thesis: University of Warwick.
- Dessy, S. E., 2000. A defense of compulsory measures against child labor. *Journal of Development Economics* 62 (1), 261–275.
- Dessy, S. E., Pallage, S., 2001. Child labor and coordination failures. *Journal of Development Economics* 65 (2), 469–476.
- Dessy, S. E., Pallage, S., January 2005. A theory of the worst forms of child labour. *The Economic Journal* 115 (500), 68–87.
- Doepke, M., 2004. Accounting for fertility decline during the transition to growth. *Journal of Economic Growth* 9 (3), 347–383.
- Galor, O., Tsiddon, D., 1997. The distribution of human capital and economic

- growth. *Journal of Economic Growth* 2 (1), 93–124.
- Grootaert, C., 1998. Child labor in Côte d'Ivoire: Incidence and determinants, the World Bank, Working Paper 1905.
- Hazan, M., Berdugo, B., 2002. Child labour, fertility, and economic growth. *The Economic Journal* 112, 810–828.
- ILO, 1973. C138 Minimum Age Convention. International Labor Organization, Geneva.
- ILO, 1996a. Child Labour: Targeting the Intolerable. International Labor Organization, Geneva.
- ILO, 1996b. Economically Active Populations: Estimates and Projections, 1950-2010. International Labor Organization: Geneva.
- ILO, 1998. Child labour is growing in Africa. *World of Work* 23, international Labor Organization: Geneva.
- ILO, 1999. IPEC Implementation Report 1998-99. International Labor Organization, Geneva.
- Jafarey, S., Lahiri, S., 2002. Will trade sanctions reduce child labour: The role of credit markets. *Journal of Development Economics* 68 (1), 137–56.
- Krueger, D., Tjornhom Donohue, J., 2005. On the distributional consequences of child labor legislations. *International Economic Review* 46 (3), 785–815.
- Kyriacou, G. A., 1991. Level and growth effects of human capital: A cross-country study of the convergence hypothesis, c.V. Starr Center for Applied Economics, Working Paper 91-26.
- López-Calva, L. F., July-Dec. 2002. A social stigma model of child labor. *Estudios Economicos* 17 (2), 193–217.
- Lucas, R. E. J., Jan. 1988. On the mechanics of economic development. *Journal of Monetary Economics* 22, 3–32.
- Moe, K. S., 1998. Fertility, time use, and economic development. *Review of Economic Dynamics* 1 (3), 699–718.
- Nardinelli, C., 1982. Corporal punishment and children's wages in nineteenth century Britain. *Explorations in Economic History* 19 (3), 283–295.
- Pallage, S., 2000. On the enforcement of cooperative environmental policies. *Review of Economic Dynamics* 3 (3), 572–596.
- Pallage, S., Robe, M. A., 2001. Foreign aid and the business cycle. *Review of International Economics* 9 (4), 637–668.
- Patrinos, H. A., Psacharopoulos, G., 1997. Family size, schooling and child labor in Peru - an empirical analysis. *Journal of Population Economics* 10, 387–405.
- Ray, R., 2000. Child labor, child schooling, and their interaction with adult labor: Empirical evidence from Peru and Pakistan. *World Bank Economic Review* 14 (2), 347–367.
- Sakellariou, C., Lall, A., 1999. Child labor in the Philippines. In: Grootaert, C., Patrinos, H. A. (Eds.), *The Policy Analysis of Child Labor, A Comparative Study*. St. Martin's Press, New York.