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Education and Child Labor in a Non-cooperative Household Bargaining Framework

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Education and Child Labor in Non-cooperative Household Bargaining

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I Introduction

As the world is advancing through the 21st century, as countries take pride in their social progresses and cheer for the ones of their peers, a large part of the human population is still struggling with a problem that the luckiest of us only know from the history books : child labor. According to the International Labor Organization (ILO), while the number of children at work has declined by nearly one third since 2000, there are still an estimate 168 million children affected by what is considered by most as a tragedy. While the Asia-Pacific region counts almost half of them, it is in Sub-Saharan Arica, where over 21% of the child population is at work, that the issue seems to be the most endemic.

Nevertheless, as many kinds of child labor exists (Agriculture, Industry, Services, Domestic work, etc.), it would be too much of a shortcut to say that all of them have the same incidence on the lives of the children who are victims of it. In view of this, the ILO, through its Convention No. 182 (1999), made some forms of child labor their priority. Among them we count practices seen as similar to slavery, prostitution, illicit activities (drugs traffics, etc.), and health, safety and moral-harming works. This amounts to say that not all types of works are to be considered as child labor. For instance, in many places, it is common for students to get a job beside school-time or to help their parents in everyday life. In general terms, as long as it does not interfere with a child health or his general development, an activity is not considered as child labor.

Defining child labor as the different activities suggested as "the worst" by the ILO, this thesis will be dedicated to the understanding of the factors influencing the causes that maintain their existence, and the trade-off between them and education. Among other things, we will see that not sending their children to school is a result of parents' poverty more than a consequence of their greed. This conclusion of course in accordance with the fact the working-children is a phenomenon that happens in a far greater extend in poor countries, where, for survival reasons, parents have no choice but to send them earn some additional incomes. An explanation of why the "easy solution" of simply banning child labor might,

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in the short term at least, not be the "right solution".

This thesis models the decisions of a family in which husband and wife attempt to maximize their own utility, while being interdependent in that their individual welfare depend on public goods. Because what one of the spouse will unilaterally choose to invest in one of their child will affect the utility of the other, the public goods are represented by the level of human capital that their children accumulate. Our results are thus based on Cournot-Nash equilibria, that is, equilibria that come from the maximization process of each parent who treat the level of consumption and public good provision chosen by his/her wife/husband as fixed.

The exercise of modeling the household decision process can take various forms. In the mid-50's, the common preferences approach (also called unitary approach) was born, and the first step was made by Samuelson (1956) in his so-called *consensus models*. In that model, the household, while composed of many individuals, maximizes a single utility function as if there was only one decision maker. The budget constraint is consequently given by the pooled incomes of all members of the household. This does not necessarily mean that all of them have the same preferences. The underlying assumption, however, is that the different individuals somehow manage to reach a consensus regarding the social utility function they want to maximize. Nevertheless, the way this consensus is reached is a total blackbox, as the mechanism was left unexplained. Nearly 20 years later Becker (1974) introduces in this framework the concept of altruism. He does so through a model that shows that a single altruistic parent (who has the income-redistribution role) is sufficient to make everyone participate to increasing the family income even though they are themselves not altruistic toward the parent who has the managing duties. Despite its attracting theoretical features, the income pooling assumption has however been seriously challenged by empirical studies for, among others, the fact that incomes from husband and wife seldom have the same affectation in household expenditures. This critique will be discussed more in depth later as our model, depending on the hypotheses made on specific parameters, sometimes goes against the income pooling assumption, and sometimes does not.

However, the probably most used form of intra-household bargaining approach in the literature is the cooperative model. Unlike the common preference models, the cooperative model acknowledges the existence of multiple utility functions within the household. Typically, such a model maximizes a utility function (the Nash product is one example of a function that can be maximized in this situation) that delivers what is called a Nash bargaining solution; dependent on the bargaining power of the spouses (which itself depends on various factors as culture, relative earnings, etc.). The main feature of this model is the existence of a threat point, i.e., a minimum level of utility that both parents get when they do not reach an agreement through the bargaining process. This feature is necessary because there usually is an incentive for both parties to deviate from the cooperative equilibrium, and enforcing the equilibrium contributions through some kind of intra-marital contract does not seem to be a viable alternative. The threat point can take different forms. The

first that comes to mind is divorce. The level of utility reachable in such a case is influenced by *extra-household environmental parameters* such as the remarriage market or the financial situation of the spouses. This topic is largely discussed by McElroy (1990), but we do not explore it further as it is not our focus¹. Unlike the previous case, the second form is internal to the marriage. This means that instead of getting divorced (which is for many reasons not possible everywhere in the world), the spouses stop to cooperate and thence maximize their own utility function. Lundberg and Pollak (1993) introduced this concept, while Haddad and Kanbur (1994) or Chen and Woolley (2001) (who introduce the concepts of altruism and public goods) for instance, followed.

In our model however we consider the situation of a family where the threat has already been triggered; the family does not cooperate. In addition to being related to the literature on voluntary provision of public goods², our model fits within a third form of bargaining approach: the non-cooperative models. The key feature of these models are the asymmetries between decision makers that cause them to adopt different equilibrium behaviors. The idea behind non-cooperative models, although not yet mentioned as such, was first developed by Leuthold (1968), who, in a labor supply model on working behaviors, supposed the existence of two interacting decision makers who differ in their personal characteristics (wage rates and leisure preferences); and Becker (1974)³, who, analyzes the interactions between the within-marriage-behaviors of two persons who cares about each other, and who therefore have interdependent utility functions. Since then, several non-cooperative models have been developed. Konrad and Lommerud (2000) propose a two-stage family bargaining model where human capital investments are made non-cooperatively in the first stage, and where, in the second stage, happens a cooperative bargaining for the day-to-day division of housework with a non-cooperative bargain fall-back in case of disagreement; Tauchen, Witte and Long (1991) developed a model about domestic violence where the male decides whether or not to beat his wife, while the female must choose whether to obey; Del Boca and Flinn (1994), in order to understand the expenditures pattern on children in divorced couples, discuss the interaction between the custodial parent, and the other one who decides to make child support transfers; and more recently, Deopke and Tertilt (2014) developed a non-cooperative model interested in showing the impact of targeting transfers to women on expenditures on children when there is a pay gap between spouses, and where there is a continuity of household public goods, the production of which differ in their time and good-intensity. One of the great feature of the non-cooperative models is that their equilibria are self-enforcing. We discussed above that the need in cooperative models for a threat was due to the fact that it was in every individual's interest to deviate from the equilibrium. In non-cooperative models instead, since the agents maximize their own utility taking the

1. Manser and Brown (1980) and McElroy and Horney (1981) pioneered the use of divorce as a threat point in cooperative games.

2. See Bergstrom, Blume and Varian (1986) for an extensive discussion on that topic.

3. This paper, called *A Theory of Marriage*, is different from Becker's (1974) mentioned above, *A Theory of Social Interaction*.

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other's decision as fixed, each agent's strategy is the *best response* to the strategy of the other. Following the very definition of a *best response*, this means that in no situation will one of them be willing to deviate, and that there is therefore no need for threats, nor for some hypothetical intra-marital contract to force the spouses to stay on the collective optimum. Importantly, a difference between non-cooperative models and the other two we discussed, lies in the concept of Pareto efficiency. In the common preferences approach, the assumption of pooled incomes and social utility, directly implies Pareto efficiency. In the cooperative model, by assuming, among other, free-communication between individuals, the Pareto efficiency is de facto verified. A non-cooperative model though has the characteristic to have multiple equilibria. Sometimes therefore the equilibrium will be Pareto efficient, sometimes it will not. Nothing though will be neither assumed nor implied. We discuss this concept later, in Section IV.

Our analysis is developed around several concepts more or less broadly discussed in the literature. In Section II & III, when the hypothesis is made that parents, although valuing education differently, do not have different preferences toward the education of one of their children, we show that the pooling assumption cannot be gone against⁴. This means that, as many studies suggest, income transfers from husband to wife, or payment transfers given to the female rather than to the male do not increase expenditures on children or time spent in school⁵. Similarly, we suggest that an increase in incomes has a positive impact on the level of human capital of children. Whether this increase comes from a raise in male's wages or in female's is not important, and that even though one of them values education much more than the other. On the other hand, when parents do not give the same importance to the education of all of their children⁶, our analysis shows that targeted transfers do have an impact on the level of education of the kids. Although the solution is not Pareto improving, we show in Section IV how payment transfers to the female rather than to the male could make the gender gap smaller by increasing the level of human capital of girls.

As many before we find that child labor is as a consequence of poverty⁷. This means that parents agree to prevent their children from going to school only as far as it is needed for the family survival. We show that if parents' incomes are high enough, or if child wages are too low, it will be in no adult's interest to send their children to work. While our model does not allow us to clearly study the effect of wages and the importance of

4. Attanasio and Lechene (2002), among others, show empirical evidence against income pooling in Mexico.

5. For empirical studies that shows the relation between women higher income share and children expenditures, see for instance Thomas (1993) for both non-labor and total income in Brazil; Lundberg, Pollak, and Wales (1997) who test a policy change in the 1970s United Kingdom; Haddad, Hoddinott, and Alderman (1997); Duflo (2003) who evaluates the impact of a large cash transfer program in South Africa; or Bobonis (2009).

6. Tuwor and Sossou (2008) for instance discuss the case of gender discrimination in education in Western Africa with poverty and household duties as contributing factors

7. See Rosenzweig (1981), Grootaert and Kanbur (1995), Easwaran (1996), Basu and Van (1998), Baland and Robinson (2000) for a few examples in the empirical and theoretical literature.

education for parents on fertility, we analyze the effect of fertility on the household utility. Our analysis shows that the way fertility influences utility strongly depends on parameters, and that depending on the family characteristics, it is not necessarily the case that having more children in order to increase incomes increases the household welfare. Indeed, as, like Grootaert and Kanbur (1995), we assume that there is a trade-off between child labor and education (and that altruistic parents do not like having uneducated children), we find that having more children increases utility when parents' incomes are high. On the other hand, it seems that the utility function is actually inverted u-shaped in fertility when incomes are low, or even decreasing when they are low enough. To some extent, this challenges the empirical negative relationship between fertility and incomes⁸, and a argument that invoke the rationality for parents to increase the number of children they choose to have⁹.

This thesis hopes to contribute to the literature in several ways. The first is to expand the theoretical landscape on child labor, and what is understood of it regarding its relation with different factors as the perceived importance of education by parents, the household income characteristics, or the way the educational system is constructed. Moreover we embedded it in a pure non-cooperative framework, which, to our knowledge, has not really been done when aiming at analyzing child labor. While some of our results confirm what is generally accepted in the literature, or what should have been expected from this kind of framework, others results do not. Also, although our model analyzes child labor, the presence of public good makes our results also relevant to a more general literature on the private provision of public goods.

In the following Section we develop the basic Cournot-Nash model with private consumption and schooling expenditures when parents consider education as as important for all their kids. In Section III we extend the basic model by introducing the trade-off parents face between sending the children to work and the time they spend at school. Section IV is dedicated to the situation where the education of all of their children is not seen by parents as equally desirable, and Section V presents a conclusion.

II The Basic Model : Private Consumption and Schooling Expenditures

In our model, there are $2 + n$ family members, the husband (m), the wife (f), and n children (c). Only the two parents are decision-makers and there is only one period. Parents supply labor inelastically and, as we do not consider the labor market, receive an exogenous income $w_m > w_f >> 0$. The economy is composed of a single consumption good, c , which is the numeraire and whose price is normalized to 1. Each spouse has the same preferences over c and privately consumes it in an amount c_p for $p = m, f$. We suppose that the n children,

8. Rosenzweig and Evenson (1977), Jones and Tertilt (2006), among many

9. An interesting discussion on that topic is made by Jones, Schoonbroodt, and Tertilt (2008).

while not consuming anything, can go to school. In the basic model we consider a situation where children go to school full-time, and consequently cannot be sent to work. However, as we here assume that school is not state-subsidized, education is strongly heterogeneous in its quality, which solely depends on the amount of money parents choose to spend on the schooling system. The Education Production Function is given by $h_c = \alpha \log E$, where α is the factor representing the efficiency of total expenditures, E , in producing human capital. In contrast to consumption, education is considered as a public good in that it enters both parents utility function; each of them choosing $e_{p,i}$ with $\sum_{p=m,f} e_{p,i} = E_i, \forall i = 1, \dots, n$. Parental utility is denoted $U_p(c_p, h_c)$ and is assumed to be separable in c_p and h_c so that

$$U_p(c_p, h_c) = \log c_p + \delta_p \sum_{i=1}^n \alpha \log E_i$$

facing the budget constraint

$$c_p + \sum_{i=1}^n e_{p,i} = w_p$$

and where $\delta_p > 0$ is a factor representing the importance for parents to have educated children. Assuming that parents know, to some extent, the benefits education is likely to bring to their children, this factor could be seen as the altruism of parents toward their children. Nevertheless, as it is common in the literature we do not restrict it to be smaller than 1, and therefore assume that parents may care about their children more than they care about themselves. Also, since utility is increasing and concave in E_i and because δ_p is the same for all children, we know that we will have a maximum when $E_i = E_j, \forall i \neq j$, following Becker (1991). Hence, the utility function can be simplified to

$$U_p(c_p, h_c) = \log c_p + n\delta_p\alpha \log E \tag{1}$$

subject to

$$c_p + ne_p = w_p \tag{2}$$

While, through δ_p , caring each one differently for the children they have in common, we make the assumption that the spouses do not act as they care about each other, although one could assume they do¹⁰. Formally, this means that their personal utilities do not take into account the utility of the other. While this could seem as an odd assumption in a usual marriage situation, it arguably makes sense in our non-cooperative framework.

Because of the existence of the public good and the fact the both partners maximize their utility function independently, the model is solved by a Nash-Cournot equilibrium. This means that, in his optimization problem, a spouse will take his partner's decision as

10. As Chen and Woolley (2001), for instance, proposed, we could introduce a factor ν that takes the 'love' of the partners into account. The utility function of spouse p would then become $U_p = \log c_p + n\delta_p\alpha \log E + \nu U_{-p}$. Nevertheless, this alternative does not seem to add anything analytically interesting to our model. The only difference it makes in the expressions we find below, is that δ_p becomes $(\delta_p + \nu\delta_{-p})$.

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given and as if he had himself maximized following the same process. From the First Order Conditions, we then find the reaction functions, i.e., the optimal decision rule of one of the spouse for each possible decision of the other. Maximizing (1) subject to (2) with respect to e_p , we get the following Kuhn-Tucker condition for spouse p

$$\frac{\partial U_p}{\partial e_p} = \frac{-n}{w_p - ne_p^*} + \frac{n\delta_p\alpha}{e_p^* + e_{-p}^*} \leq 0$$

We assume that there is an interior optimum level of expenditures for each parent, which makes the partial derivative hold with equality. Solving the system of two equations for e_f^* and e_m^* we get

$$e_f^* = \frac{1}{n\delta_f + n\delta_m + n^2\delta_f\delta_m\alpha} [\delta_f(1 + n\delta_m\alpha)w_f - \delta_m w_m] \quad (3)$$

$$e_m^* = \frac{1}{n\delta_f + n\delta_m + n^2\delta_f\delta_m\alpha} [\delta_m(1 + n\delta_f\alpha)w_m - \delta_f w_f] \quad (4)$$

which gives us

$$E^* = \frac{\delta_f\delta_m\alpha}{\delta_f + \delta_m + n\delta_f\delta_m\alpha} [w_f + w_m] \quad (5)$$

where both parents cooperate in the financing of the education of their children.

First, this result shows that, even though one of the parents is assumed to be more altruistic than the other, intra-household transfers of income do not affect the total amount that will be spent in schooling. Indeed we see that individual expenditures in education are positively linked with one's income, that is $\partial e_p^*/\partial w_p > 0$, while negatively linked with the income of the other, $\partial e_p^*/\partial w_{-p} < 0$. Result (5) shows that only the sum of incomes matters and that the way it is distributed between the husband and his wife has no real importance. With this respect, our model support the pooled income assumption. Similarly, whether potential school subsidies would be paid to the mother or to the father does not matter neither. Nevertheless, while not impacting the total expenditures, transfers do have an effect on the relative contribution of parents in the funding of education. Let $t \geq 0$ be the net transfer of income from husband to wife (such that $E^* = (\delta_f\delta_m\alpha)/(\delta_f + \delta_m + n\delta_f\delta_m\alpha)[(w_f+t)+(w_m-t)]$), then from (3) and (4) we recover $\partial e_f^*/\partial t \geq 0$ and $\partial e_m^*/\partial t \leq 0$, while keeping $\partial E^*/\partial t = 0$.

We also show that as E^* increases in both δ_f and δ_m , we observe a negative relationship between the contribution of one spouse with the δ of his partner. For instance, if, for whatever reason, education becomes more important in the eyes of one of the parents, the father, say ($\delta_m \uparrow$), then we will observe an increase in E^* , an increase in e_m^* and a decrease in e_f^* . Consequently we know that $de_m^* > -de_f^*$, that is, the increase in e_m^* caused by an increase in δ_m is greater than the decrease in e_f^* it generates.

Let us now check the impact of fertility on parents' utility. Quickly enough we notice that there is a trade-off for parents in choosing the number of children they want to have. Indeed while, on the one hand, U_p is reduced through (5) and the equilibrium private consumption level, c_p^* ¹¹, it is increased directly through the number n of children who go to school. Whether therefore one effect or the other dominates, strongly depends on the δ 's and the wages. In fact if the total incomes of the family are high enough, each additional child will be profitable for the household's utility. Intuitively, utilities being concave in consumption, we can suppose that parents, from a certain level of income, will bestow their money solely to their children's education. That is because each children can be viewed as an additional public good and that the additivity of the education production function makes every educated child contribute to the utility separately (as $|\varepsilon_{E^*,n}| < 1$). Conversely if the wages or the δ 's are low, U_p will be U-shaped in n or even strictly decreasing when they are low enough. Hence having a high fertility rate is not necessarily rational for parents whose incomes are very low. This challenges the negative relationship between fertility and incomes that has been observed in many empirical studies.

Before going further, it seems interesting to compare our model to an other one featuring the cooperative paradigm we quickly mentioned in Section I. We do that in order to check what would happen to expenditures in education if parents, instead of unilaterally maximizing their utility functions, chose to work together. One could expect indeed that an household where some cooperation exists would attain a different equilibrium. In that perspective, let us compare the solution we got in (5) with a solution obtained by optimizing only one utility function that takes into account both parents' preferences. Assume their utility functions are still represented by the same U_f and U_m we described in our model, but that instead of having both spouses choosing E^* through individual contributions, they now choose \tilde{E} by going through a bargaining process where, say, the wife has a bargaining power of $\mu \in [0, 1]$, and the husband a bargaining power of $(1 - \mu)$. In order to be able to properly compare the solutions, we built a model which more or less features the same properties than ours. Hence, the equilibrium expenditure level, \tilde{E} , is found by maximizing the weighted sum of utilities, under a pooled incomes budget constraint. That is,

$$\max_{c_f, c_m, E} U_h = \mu[\log c_f + n\delta_f\alpha \log E] + (1 - \mu)[\log c_m + n\delta_m\alpha \log E]$$

such that

$$c_f + c_m + nE = w_f + w_m$$

Solving this model, we get

$$\tilde{E} = \frac{\mu\delta_f\alpha + (1 - \mu)\delta_m\alpha}{1 + \mu\delta_f n\alpha + (1 - \mu)\delta_m n\alpha} [w_f + w_m] \quad (6)$$

11. From (2) and (5) we retrieve $c_p^* = \frac{\delta_p}{\delta_f + \delta_m + n\delta_f\delta_m\alpha} [w_f + w_m]$

Comparing (5) to (6) we find that $\tilde{E} > E^*, \forall \mu$. Making the assumption that education benefits children, we infer that introducing some kind of cooperation between spouses makes the children better off. And indeed, a known feature of the non-cooperative model is the underprovision of public goods. As the increase in schooling expenditures comes at the expense of consumption (which strongly depends on μ), this cooperation, while clearly in the interest of the children, is not necessarily Pareto improving. For instance, if μ is low¹², the mother's consumption will be low as well; and there is no way for her to compensate, through E only, the utility she would have had when not cooperating. We mentioned in the introduction that in cooperative models, what justified the need for a threat point was that agents usually had an incentive to deviate from their equilibrium. This low bargaining power for one of the spouses could therefore be an example of such an incentive for the one member of the household who endures it, to move toward a non-cooperative way of bargaining. Hence, assuming a child will be more educated as his/her parents cooperate in financing his/her education, it seems important to work on keeping a balanced bargaining power so that nobody wants to deviate toward the non-cooperative equilibrium. This suggests of course some work on the factors that define it.

III Child Labor and Time spent in School

We now extend the Basic Model we presented in Section II by introducing the concepts of Child Labor. As we assumed there is a trade-off between child labor and education, this translate in our model by parents choosing for their kids how much time they will spent working and how much time they will be at school. As in (1), parent's utilities are still defined over their private consumption and their children's level of human capital. What changes is that instead of having the Education Production Function $h_c = \alpha \log E$ as in Section II, we now have $h_c = \alpha(\gamma \log E + (1 - \gamma) \log t_c)$, where $t_c \in [0, 1]$ is the proportion of a child's time spent in school¹³. α keeps the same meaning, and γ is to be interpreted as the weight that time and money have in accumulating human capital. For instance, if γ is high we are in a system where money is a relatively important factor in the production of human capital. In reality this could correspond to a system where the level of public school is relatively weak compared to private school and where therefore, investing a lot in education is a real advantage in the human capital accumulation process. Moreover, as we choose not to take the children utilities into account, the model does not encompass the issue of child labor having a direct negative impact on children welfare. This disutility is, for instance, used by Bommier and Dubois (2002). The new utility function is defined as follows

12. It has been shown in many papers that μ , the bargaining power, is influenced by the distribution of wage, earnings, etc., and therefore influences the way money is spent in the household. See Lundberg, Pollak and Wales (1997), Duflo and Udry (2004), Schultz (1990), for a few examples.

13. In Section I, we assumed children had to go full-time to school ($t_c = 1$), which thus gave us $\log t_c = 0$

$$U_p(c_p, h_c) = \log c_p + n\delta_p\alpha(\gamma \log E + (1 - \gamma) \log t_c) \quad (7)$$

Suppose now that each spouse unilaterally decides to bring his child to work with him/her for an amount of time $l_c^p \in [0, 1]$. For this time spent working, a child earns an income $w_c l_c^p$ that will be entirely controlled by the parent who decides to send him to work. The intra-familial supply of child labor is therefore given by $n(l_c^f + l_c^m)$, and the time spent in school is defined $t_c = 1 - l_c^f - l_c^m$ for each n children. In this Section, as in the previous one, w_f and w_m , w_c will be regarded as exogenous. Moreover we assume $0 \ll w_c < w_f < w_m$. Parents face the budget constraint,

$$c_p + ne_p = w_p + nw_c l_c^p \quad (8)$$

Maximizing (7) subject to (8) with respect to e_p and l_c^p , we get the following Kuhn-Tucker conditions for spouse p

$$\begin{aligned} \frac{\partial U_p}{\partial e_p} &= \frac{-n}{w_p + nw_c l_c^{p*} - ne_p^*} + \frac{n\delta_p\alpha\gamma}{e_p^* + e_{-p}^*} \leq 0 \\ \frac{\partial U_p}{\partial l_c^p} &= \frac{nw_c}{w_p + nw_c l_c^{p*} - ne_p^*} - \frac{n\delta_p\alpha(1 - \gamma)}{1 - l_c^{f*} - l_c^{m*}} \leq 0 \end{aligned}$$

Assuming there exists an interior optimum level of both variables for each parent, the partial derivatives hold with equality¹⁴. Solving this system of 4 equations, we get the following values for E^* and t_c^*

$$E^* = \frac{\delta_f \delta_m \alpha \gamma}{\delta_f + \delta_m + n\delta_f \delta_m \alpha} [w_f + w_m + w_c] \quad (9)$$

$$t_c^* = \frac{\delta_f \delta_m \alpha (1 - \gamma)}{\delta_f + \delta_m + n\delta_f \delta_m \alpha} \left[\frac{w_f + w_m + w_c}{w_c} \right] \quad (10)$$

While it is not possible to recover the individual contributions of each parent, the fact that the expression for E^* includes both w_f and w_m shows that both parents contribute to schooling expenditures. As in Section II, we see in this result that intra-household transfers of income do not affect the optimal total amount of expenditures, since all individual incomes (w_c included) have the same positive marginal impact on expenses. The same conclusions can therefore be drawn.

14. As this seems like a strong assumption we can show that only two scenarios are mathematically consistent : either they both contribute to the financing and they both make their children work ; or one specializes in the financing, while the other is in charge of sending the kids to work. We choose to concentrate on the first scenario as the second one does not seem particularly plausibly to us. Without appropriate transfers, it is hardly conceivable to have the one spouse that receives no income from child labor, financing education alone.

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The expression for t_c^* , while similar to E^* in that it increases in both δ 's, is very different to the extent that, unlike expenditures that directly depend on net wages, the time spent in school is only affected by relative wages. This particularity is explained by the fact that t_c is not inherently costly for parents, as nothing entering into the LHS of their constraint is relative to the time spent in school. Instead of a pure cost we talk about an opportunity cost. Sending their children to school instead of sending them off to work deprives parents from an additional income, and therefore is directly reflected in the amount of money they have. In contrary to E^* that depends positively on all wages, t_c^* positively depends only on parents' wages, and has a negative relation with the wage from child labor. Intuitively, if adult wages increase, making your child work becomes relatively less interesting and parents might therefore want to send them to school instead. Important then to check the effect of an increase in w_c on t_c^* . The elasticity of the time spent in school to the wage of child labor is

$$\varepsilon_{t_c, w_c} = \frac{\partial t_c / t_c}{\partial w_c / w_c} = -\frac{w_f + w_m}{w_f + w_m + w_c} > -1$$

which means that t_c decreases less than proportionally to an increase in w_c . Similarly, the elasticity of the time spent in school to the adult wages is given by

$$\varepsilon_{t_c, w_p} = \frac{\partial t_c / t_c}{\partial w_p / w_p} = \frac{w_p}{w_f + w_m + w_c} < 1$$

In view of these two results we check by how much w_f , for instance, has to increase to keep t_c constant, in case of an increase in child labor wages. In order to keep a constant time spent in school, we need the sum of the two elasticities to be equal to 0. That is

$$\omega \varepsilon_{t_c, w_p} + \varepsilon_{t_c, w_c} = 0$$

Solving this equation for ω we find

$$\omega = \frac{w_f + w_m}{w_f}$$

which means that in order to keep t_c constant w_f has to respond more than proportionally to any increase of w_c . Any raise in children wages has a potentially huge impact on education. Moreover, the impact is increasing as wages are already high.

In Section II we have discussed about the trade-off that parents face when it comes to fertility. In this version of the model, the trade-off is still present, yet a bit different and, it seems, a little more complex. Indeed, in addition to the "consumption-education" trade-off we had in the previous Section, making your children work can now directly improve your income. Therefore, the more children parents choose to have, the more their total potential income becomes high. The shortfall is of course that a child who works is not at school and cannot improve his level of human capital. The problem we face is that, because we know neither e_p^* nor l_c^{p*} , we cannot retrieve the optimal value for c_p^* , and therefore the way

it varies with n . Nevertheless as utility is increasing and concave in c_p , we can assume that U_p reacts to n in a similar way as in the basic model.

The effects of γ will be investigated more in depth in the next Section, as the results we have here are not so propitious to a deeper analysis. For now, let us just say that whether γ is high or low will have an impact on the effect of w_c on the utility function. Indeed, since $\partial E^*/\partial w_c > 0$ and $\partial t_c^*/\partial w_c < 0$, γ has the key role to determine which effect dominates. When, compared to money, the time spent in school becomes relatively less important in the production of human capital ($\gamma \uparrow$), it becomes more and more likely to have $\partial h_c^*/\partial w_c < 0$.

IV Child-specific altruism factors

It has been shown that in many developing countries it is common for parents to treat their children differently. Whether it is according to their sex, according to the order of birth, or according to some other characteristics, it is clear that children in a household are seldom seen as equal. In order to implement this idea into our model, we now consider the δ 's as child-specific. In our model, this is translated into the fact that parents consider education as more important for some of their children than for others. Although the process would be exactly the same for every thinkable ways for parents to rank their children, we concentrate our interpretations on gender-specific δ 's. Assume therefore that the household is composed of two children : one boy and one girl. Suppose also that the mother has altruism factors δ_f^b and δ_f^g for her son and her daughter, respectively, and that the father has altruism factors δ_m^b and δ_m^g . The utility function of spouse p becomes

$$U_p(c_p, h_g, h_b) = \log c_p + \delta_p^g \alpha (\gamma \log E^g + (1 - \gamma) \log t_g) + \delta_p^b \alpha (\gamma \log E^b + (1 - \gamma) \log t_b) \quad (11)$$

where E^g is the total expenses in education made for the girl, t_g the amount of time the girl spends in school, E^b the total expenditures in education made for the boy, and t_b , the amount of time the boy spends in school. Assuming both boys and girls earn the same salary, w_c , the budget constraint of spouse p becomes

$$c_p + e_p^g + e_p^b = w_p + w_c(l_p^g + l_p^b) \quad (12)$$

where e_p^g and e_p^b are the amounts spent by spouse p in the education of his daughter and son, respectively, and l_p^g and l_p^b are to amount of time that spouse p chooses to send his daughter and son to work. Each spouse maximize (11) subject to (12) with respect to e_p^g , e_p^b , l_p^g and l_p^b and find the following First Order Conditions

$$\begin{aligned} \frac{\partial U_p}{\partial e_p^g} &= \frac{-1}{w_p + w_c(l_g^{p*} + l_b^{p*}) - e_p^{g*} + e_p^{b*}} + \frac{\delta_p^g \alpha \gamma}{e_f^{g*} + e_m^{g*}} < 0 \text{ and } e_p^{g*} = 0 \\ \frac{\partial U_p}{\partial e_p^b} &= \frac{-1}{w_p + w_c(l_g^{p*} + l_b^{p*}) - e_p^{g*} + e_p^{b*}} + \frac{\delta_p^b \alpha \gamma}{e_f^{g*} + e_m^{g*}} = 0 \text{ and } e_p^{b*} > 0 \end{aligned} \quad (13)$$

$$\begin{aligned}\frac{\partial U_p}{\partial e_p^b} &= \frac{-1}{w_p + w_c(l_g^{p*} + l_b^{p*}) - e_p^{g*} + e_p^{b*}} + \frac{\delta_p^b \alpha \gamma}{e_f^{b*} + e_m^{b*}} < 0 \text{ and } e_p^{b*} = 0 \\ \frac{\partial U_p}{\partial e_p^b} &= \frac{-1}{w_p + w_c(l_g^{p*} + l_b^{p*}) - e_p^{g*} + e_p^{b*}} + \frac{\delta_p^b \alpha \gamma}{e_f^{b*} + e_m^{b*}} = 0 \text{ and } e_p^{b*} > 0\end{aligned}\quad (14)$$

$$\begin{aligned}\frac{\partial U_p}{\partial l_g^p} &= \frac{w_c}{w_p + w_c(l_g^{p*} + l_b^{p*}) - e_p^{g*} + e_p^{b*}} - \frac{\delta_p^g \alpha (1 - \gamma)}{1 - l_g^{f*} - l_g^{m*}} < 0 \text{ and } l_g^{p*} = 0 \\ \frac{\partial U_p}{\partial l_g^p} &= \frac{w_c}{w_p + w_c(l_g^{p*} + l_b^{p*}) - e_p^{g*} + e_p^{b*}} - \frac{\delta_p^g \alpha (1 - \gamma)}{1 - l_g^{f*} - l_g^{m*}} < 0 \text{ and } l_g^{p*} > 0\end{aligned}\quad (15)$$

$$\begin{aligned}\frac{\partial U_p}{\partial l_b^p} &= \frac{w_c}{w_p + w_c(l_g^{p*} + l_b^{p*}) - e_p^{g*} + e_p^{b*}} - \frac{\delta_p^b \alpha (1 - \gamma)}{1 - l_b^{f*} - l_b^{m*}} < 0 \text{ and } l_b^{p*} = 0 \\ \frac{\partial U_p}{\partial l_b^p} &= \frac{w_c}{w_p + w_c(l_g^{p*} + l_b^{p*}) - e_p^{g*} + e_p^{b*}} - \frac{\delta_p^b \alpha (1 - \gamma)}{1 - l_b^{f*} - l_b^{m*}} < 0 \text{ and } l_b^{p*} > 0\end{aligned}\quad (16)$$

In the previous two sections, we assumed that there existed an interior solution for all variables. This assumption cannot be made here. Considering the equations labeled (13), (14), (15), and (16) as the First Order Conditions for the wife and those below-mentioned (13'), (14'), (15'), and (16') as their correspondings for the husband, we show why this is so. Consider two cases :

Case 1 : In order to have no corner solution, we need ¹⁵

$$\frac{\delta_f^g}{\delta_f^b} = \frac{\delta_m^g}{\delta_m^b}$$

But, because we consider the δ 's as being continuous and independent from one another, the probability for this equality to hold is equal to 0. Let us therefore assume that

15. Combining (13) and (14), we get $\frac{\delta_f^g}{\delta_f^b} = \frac{e_f^{g*} + e_m^{g*}}{e_f^{b*} + e_m^{b*}}$, and using (13') and (14'), we get $\frac{\delta_m^g}{\delta_m^b} = \frac{e_f^{g*} + e_m^{g*}}{e_f^{b*} + e_m^{b*}}$

$$\frac{\delta_f^g}{\delta_f^b} > \frac{\delta_m^g}{\delta_m^b} \quad (\text{a})$$

This hypothesis means that the girl has a comparative advantage in her mother, without necessarily having a absolute one. In other words, we assume that relative to her brother, her mom finds her education more important than her dad. Condition (a) is fulfilled in 3 different situations :

$$-\frac{\delta_f^g}{\delta_f^b} > \frac{e_f^{g*} + e_m^{g*}}{e_f^{b*} + e_m^{b*}} \text{ and } \frac{\delta_m^g}{\delta_m^b} = \frac{e_f^{g*} + e_m^{g*}}{e_f^{b*} + e_m^{b*}}$$

which holds if and only if

$$\begin{cases} (13) = 0 \implies e_f^{g*} > 0 \\ (14) < 0 \implies e_f^{b*} = 0 \end{cases}$$

$$-\frac{\delta_f^g}{\delta_f^b} = \frac{e_f^{g*} + e_m^{g*}}{e_f^{b*} + e_m^{b*}} \text{ and } \frac{\delta_m^g}{\delta_m^b} < \frac{e_f^{g*} + e_m^{g*}}{e_f^{b*} + e_m^{b*}}$$

which holds if and only if

$$\begin{cases} (13') < 0 \implies e_m^{g*} = 0 \\ (14') = 0 \implies e_m^{b*} > 0 \end{cases}$$

$$-\frac{\delta_f^g}{\delta_f^b} > \frac{e_f^{g*} + e_m^{g*}}{e_f^{b*} + e_m^{b*}} \text{ and } \frac{\delta_m^g}{\delta_m^b} < \frac{e_f^{g*} + e_m^{g*}}{e_f^{b*} + e_m^{b*}}$$

which holds if and only if

$$\begin{cases} (13) = 0 \implies e_f^{g*} > 0 \\ (14) < 0 \implies e_f^{b*} = 0 \\ (13') < 0 \implies e_m^{g*} = 0 \\ (14') = 0 \implies e_m^{b*} > 0 \end{cases}$$

Case 2 : In a similar way, but treating the First Order Conditions a bit differently, we find the following condition for having no corner solution¹⁶

16. Combining (13) and (13'), we get $\frac{\delta_f^g}{\delta_m^g} = \frac{w_m + w_c(l_g^{m*} + l_b^{m*}) - e_m^{g*} + e_m^{b*}}{w_f + w_c(l_g^{f*} + l_b^{f*}) - e_f^{g*} + e_f^{b*}}$, and using (14) and (14'), we get $\frac{\delta_f^b}{\delta_m^b} = \frac{w_m + w_c(l_g^{m*} + l_b^{m*}) - e_m^{g*} + e_m^{b*}}{w_f + w_c(l_g^{f*} + l_b^{f*}) - e_f^{g*} + e_f^{b*}}$

$$\frac{\delta_f^g}{\delta_m^g} = \frac{\delta_f^b}{\delta_m^b}$$

Once again, because we consider the δ 's as continuous and independent, this equality cannot hold. Therefore, we need to make the following hypothesis

$$\frac{\delta_f^g}{\delta_m^g} > \frac{\delta_f^b}{\delta_m^b} \quad (\text{b})$$

which is interpreted as the mother having a greater comparative interest in her daughter's education, without necessarily having an greater absolute interest. Again, condition (b) is fulfilled in 3 different situations :

$$-\frac{\delta_f^g}{\delta_m^g} > \frac{w_m + w_c(l_g^{m*} + l_b^{m*}) - e_m^{g*} + e_m^{b*}}{w_f + w_c(l_g^{f*} + l_b^{f*}) - e_f^{g*} + e_f^{b*}} \quad \text{and} \quad \frac{\delta_f^b}{\delta_m^b} = \frac{w_m + w_c(l_g^{m*} + l_b^{m*}) - e_m^{g*} + e_m^{b*}}{w_f + w_c(l_g^{f*} + l_b^{f*}) - e_f^{g*} + e_f^{b*}}$$

which holds if and only if

$$\begin{cases} (13) = 0 \implies e_f^{g*} > 0 \\ (13') < 0 \implies e_m^{g*} = 0 \end{cases}$$

$$-\frac{\delta_f^g}{\delta_m^g} = \frac{w_m + w_c(l_g^{m*} + l_b^{m*}) - e_m^{g*} + e_m^{b*}}{w_f + w_c(l_g^{f*} + l_b^{f*}) - e_f^{g*} + e_f^{b*}} \quad \text{and} \quad \frac{\delta_f^b}{\delta_m^b} < \frac{w_m + w_c(l_g^{m*} + l_b^{m*}) - e_m^{g*} + e_m^{b*}}{w_f + w_c(l_g^{f*} + l_b^{f*}) - e_f^{g*} + e_f^{b*}}$$

which holds if and only if

$$\begin{cases} (14) < 0 \implies e_f^{b*} = 0 \\ (14') = 0 \implies e_m^{b*} > 0 \end{cases}$$

$$-\frac{\delta_f^g}{\delta_m^g} > \frac{w_m + w_c(l_g^{m*} + l_b^{m*}) - e_m^{g*} + e_m^{b*}}{w_f + w_c(l_g^{f*} + l_b^{f*}) - e_f^{g*} + e_f^{b*}} \quad \text{and} \quad \frac{\delta_f^b}{\delta_m^b} < \frac{w_m + w_c(l_g^{m*} + l_b^{m*}) - e_m^{g*} + e_m^{b*}}{w_f + w_c(l_g^{f*} + l_b^{f*}) - e_f^{g*} + e_f^{b*}}$$

which holds if and only if

$$\begin{cases} (13) = 0 \implies e_f^{g*} > 0 \\ (13') < 0 \implies e_m^{g*} = 0 \\ (14) < 0 \implies e_f^{b*} = 0 \\ (14') = 0 \implies e_m^{b*} > 0 \end{cases}$$

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Because of these two cases, we know that only the third situations of each case is relevant. Thus we find $e_m^{g*} = 0$ and $e_f^{b*} = 0$, which means that the mother only invests into her daughter's education, while the father only invests into his son's education. This also means that even in the case in which the father as altruism factors strictly lower than his wife's, he will still participate in the funding of the one for which he has a comparative advantage. We therefore come to the conclusion that each spouse will participate only to the education of the child in which they have a greater comparative interest.

Before going further, let us point out the concept of Pareto efficiency in non-cooperative models that was briefly mentioned in the Introduction. We said that non-cooperative models, unlike their cooperative counterpart, had the characteristic to feature multiple equilibria. Because of that, we need to make an additional assumption to the model : repetition. Aside of a *mixed strategies Nash equilibrium*, the model has two *pure strategy Nash equilibria*¹⁷. The first strategy is the one we just found where the mother invests in her daughter, and the father invests in his son only. Nevertheless, if we start by assuming that the parents, at the beginning of their common life, do not exactly know the other's preferences over the kids, then having the father investing in his daughter and the mother investing in her son is also a pure strategy Nash equilibrium. But because we assumed hypotheses (a) and (b), this strategy is not Pareto efficient. Pareto efficiency is therefore attain by the repetition of the decision-making process.

Similarly, therefore, keeping hypotheses (a) and (b), we show that at the optimum we have $l_g^m = 0$ and $l_b^f = 0$. Hence, maximizing (11) after setting $e_m^{g*} = 0$, $e_f^{b*} = 0$, $l_g^m = 0$, and $l_b^f = 0$, we get

$$e_f^{g*} = \frac{\delta_f^g \alpha \gamma}{1 + \delta_f^g \alpha} [w_f + w_c] \quad (17)$$

$$e_m^{b*} = \frac{\delta_m^b \alpha \gamma}{1 + \delta_m^b \alpha} [w_m + w_c] \quad (18)$$

$$h_g^* = \frac{\delta_f^g \alpha (1 - \gamma)}{1 + \delta_f^g \alpha} \left[\frac{w_f + w_c}{w_c} \right] \quad (19)$$

$$h_b^* = \frac{\delta_m^b \alpha (1 - \gamma)}{1 + \delta_m^b \alpha} \left[\frac{w_m + w_c}{w_c} \right] \quad (20)$$

While in Sections II & III, all variables depended on all parent-specific factors, here the variables depend only on the factors characterizing the parent who contributes to them. This happens because, unlike the participation of both spouses that happened in the previous

17. This argument is developed based on the famous *Battle of the Sexes* game.

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Sections, we assist here to a full-specialization of parents in the child for which they have a greater comparative interest.

In Section II we showed that intra-household transfers of income did not affect the total amount that is spent in schooling. Clearly here this conclusion cannot be made anymore. Indeed, with income transfers from husband to wife $t \geq 0$, we observe an increasing in the spendings in the education of the girl, and a decrease in the spendings for the education of the boy ; the utility of the one therefore comes at the expense of the one of the other. From the parents' point of view, this kind of transfers is almost surely not optimal in term of utility maximization, especially because, for the reasons exposed earlier, one might expect $\delta^g < \delta^b$. Although if the educational gap between boys and girls is big and that this gap is, for some reasons, sub-optimal (in terms of social welfare, for instance), one could imagine public policies aiming at transferring income from the husband to the wife. Working on the pay gap for instance. Transfers work the exact same way : when it comes to time spent in school, they could be use to control gender differences. Similarly, The model suggests that subsidies aiming at increasing the level of human capital of the girls are efficient only as long as they are given to the wife. This is a important contrast with the previous versions of our model which suggested that these kind of targeted transfers had no effect.

We now analyze what we will hereafter refer as the lower bounds for w_c . By that term we mean a level of child wage which does not allow for child labor anymore. That is, a wage low enough for parents to send their children full-time to school. In the case of the girl, it amounts to find $\underline{w_c^g}$ such that $h_g^* = 1$. We get

$$\underline{w_c^g} = \frac{\delta_f^g \alpha (1 - \gamma)}{1 + \delta_f^g \alpha \gamma} w_f$$

Moreover, this lower bound means that as w_c falls lower than a certain fraction of the income of the mother, she finds no interest in sending her daughter to work, because the benefit of sending her to school is simply greater. This result is potentially interesting for public policy purpose, for it means that a government does not necessarily need to pass through legislations in order to forbid child labor. Indeed parents will stop doing so by themselves if the State somehow manages to keep child wages low enough. Note that a similar lower bound exists for child labor among boys as well. However, because under our hypotheses this bound will be strictly greater than the one above, one will need to set w_c at the girls' bound anyways in order to not only stop child labor among boys but also among girls. And as mentioned earlier, we clearly see that child labor is a direct consequence of poverty. If adult wages indeed were high enough, we would find $h_c > 1$ almost surely. Our model finds two ways to stop child labor : decreasing w_c or/and increasing w_p .

For a given w_f , as δ_f^g increases, $\delta_f^g \alpha (1 - \gamma) / 1 + \delta_f^g \alpha \gamma$ increases, and the lower bound of w_c increases as well. This means that as the mother cares more about her daughter and her education, the child wage will need to be lowered by less in order to reach the point where child labor is no more profitable for the household. Similarly, note that $\delta_f^g \alpha (1 - \gamma) / 1 + \delta_f^g \alpha \gamma$

decreases with γ . When the school system is based on expenditures rather than time spent in school (γ is high), the lower bound will be low at a given w_f , and w_c will have to be lower in order to reach the point of full-time schooling. The more education is money-consuming, the more it is hard to eradicate child labor through controlling w_c .

This concept also raises the fact that, in our model, parents are obliged to spend money on education. If they did not, they would face the threat of $\lim_{E \rightarrow 0} U_p = -\infty$. Is it reasonable to assume that all parents need to invest into their children education under the risk of seeing their utilities running down to its lowest value? We think it is not. If we assume then that most of the world has access to a free public school system (whatever its quality), then the education production function could be changed into $h_c = \alpha(\gamma \log(E+s) + (1-\gamma) \log t_c)$, where s is a subsidy that represents the help from the government for sending the kids to school, and whose level accounts for the quality of public school. In this situation, parents could consider not participating in the financing of their children's education and, at the sole condition that it is "good enough", content themselves of the public school system. In this situation, the optimal level for e_f^{g*} and h_g^{*18} would be

$$\hat{e}_f^g = \frac{\delta_f^g \alpha \gamma}{1 + \delta_f^g \alpha} [w_f + w_c] - \frac{1 + \delta_f^g \alpha (1 - \gamma)}{1 + \delta_f^g \alpha} s$$

$$\hat{h}_g = \frac{\delta_f^g \alpha (1 - \gamma)}{1 + \delta_f^g \alpha} \left[\frac{w_f + w_c + s}{w_c} \right]$$

From these we draw several observations. First, introducing free education through subsidies not only raises the time spent in school, but also raises the lower bound for w_c , which, once again, means that child labor is easier to get rid of. Moreover from \hat{e}_f^g we see that the subsidy decreases the expenditures that each parent makes in the child they take care of. Nevertheless, since it only represents a fraction of the subsidy, this decrease does not fully absorb it, and ultimately the overall amount of money spent on a child will increase by $(\delta_f^g \alpha \gamma / 1 + \delta_f^g \alpha) s$. Notice also that $\hat{e}_f^g = 0$ when $w_f + w_c < (1 + \delta_f^g \alpha (1 - \gamma) / \delta_f^g \alpha \gamma) s$. This implies that what is considered by parents as "good enough" depends on their wealth. Of course, high-income household will unlikely be satisfied by what the State proposes for free as a curriculum, and, like it was to be expected, as the household is getting poorer, they rely more and more on public school only. Finally, since we assumed a gender-based pay gap in adult wages, the girl has to satisfy herself with lower quality public school more often than her brother. If we consider future incomes as dependent on the level of human capital, then another important implication of child labor, in a context of wealth inequalities between households, is the rising of these inequality. Our model therefore shows that a consequence of a ban on child labor is a shrinking of the variance in the distribution of income in the economy.

18. The case for e_m^{b*} and h_b^* is essentially the same

V Conclusion

In this thesis we have analyzed several important theoretical implications of the lack of cooperation in an intra-household bargaining process. While they seem to be a trend in recent development economics, we find that gender-based transfers policies are ineffective at increasing the level of human capital of children, in a situation where parents care about all of them equally; this even though the mom, as it is what is usually assumed, cares about their education more than her husband. Nevertheless, we show that when all the children are not seen as equal by parents, a new equilibrium emerges. This equilibrium features a full-specialization of each parent in the child for which he has a comparative greater interest in. In that particular case, gender-based transfers becomes effective in that it would allow to increase the investments made in the education of a targeted sex, and therefore enable a shrinking in the gap that exists between the educational opportunities of boys and girls.

Our analysis also challenges the theoretical and empirical findings that suggest a negative relationship between fertility and incomes. Indeed because parents care about their children's education and do not like seeing working for any reason but financial ones, we find that it is not necessarily rational for them to increase the size of their offspring indefinitely. In particular we show that only high-income families should be interested in having a large amount of children, for they can easily finance a decent level of education for all of them. On the other hand, when the household is in a more precarious situation, the disutility of having uneducated children soon takes precedence over the advantages of increasing its income through child labor. This way, the optimal level of fertility seems rather low in poor households, and possibly even null in very poor ones.

Finally we confirm the theory that child labor would be a consequence of poverty. We show that a ban on child labor is not a necessary condition to get rid of it. Our analysis shows that there exists a level of child wage and incomes such that child labor disappears by itself. Indeed if child wage falls under a certain level it will not be interesting for parents to send their kids to work. Similarly, if the family is rich enough, parents will have no appeal in doing so neither. As we assumed parents could even care about their kids more than they care about themselves, it is therefore clearly not parents' greed that produces child labor. Instead the difficult conditions which they sometimes have to live under, seem to be the cause. An other effective, but rather naive, solution would be to make parents aware of the importance of human capital, that is, working on an increase in the altruism factors. Finally, we show that in a situation of already-existing disparities, child labor, more than being a real curse for children welfare, is also a source of increasing wealth inequalities.

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