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Child Labor and Household Wealth: Theory and Empirical Evidence of an Inverted-U

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Abstract: Some studies on child labor have shown that greater land wealth leads to higher child labor, thereby casting doubt on the hypothesis that child labor is caused by poverty. This paper argues that the missing ingredient is an explicit modeling of the labor market. We develop a simple model which suggests an inverted-U relationship between land holdings and child labor. A unique data set from India that has child labor hours information confirms this hypothesis. It is shown that the turning point beyond which more land leads to a decline in child labor occurs at 3.6 acres of land per household, which is well below the observed maximum value of land-holding.

Key words: child labor, land-holding, education, labor markets

JEL Classification numbers: D13, J20, O12

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1 Introduction

There is now a substantial body of literature that argues that the principal cause of child labor is poverty. This is not to deny that there can be other causes as well. The availability of good schools, and simple incentives, like a meal for children at school or a subsidy to parents who send their children to school, can make a difference to child labor. But the fact remains, this literature would argue, that the primary cause of child labor is poverty. Barring rare cases of abusive parents, parents do not like to send their children to work if they can afford not to. This has been called the 'luxury axiom' in this literature and there is a lot of evidence that supports this view (for discussion see Basu and Van, 1998; Basu 1999; Ray, 2000; Basu and Tzanntos, 2003; Emerson and Souza, 2003; Edmonds and Pavcnik, 2005; Edmonds, 2005).

However, some recent evidence has cast doubt on this view of child labor. Bhalotra and Heady (2003) have shown that in some developing countries - Peru and Pakistan in their study - the amount that the children of a household works increases with the amount of land possessed by the household (see also Menon, 2005). Since land is usually strongly correlated with a household's income, this finding seems to challenge the hypothesis that child labor is caused by poverty.

Given the growing global concern about and the urgent need to end child labor, it is important for us to get the details of the causes of child labor right. Hence, the above dispute deserves serious scrutiny.

The view that we take in this paper is that the challenge to the luxury axiom does not stand up to closer examination. We argue that in developing countries labor markets are usually quite imperfect. This means that there may be poor households that want to send their children to work (in order to escape extreme poverty) but are unable to do so simply because they have no access to labor markets close to their home. If in this situation the household comes to acquire some wealth, say land, its children will get to work more because they *can* now do what they earlier *wished* to do. Hence, we argue that this seemingly perverse response to greater wealth is a consequence of the luxury axiom in conjunction with labor market imperfection. This possibility is also suggested by the evidence discussed by Edmonds and Turk (2004) that in Vietnam households that have their own businesses are more likely to have their children do labor.

But this in turn has another interesting implication. If the household's land-ownership continues to rise then surely beyond a point the household will be so well-off that it will not want to make its children work, even though it has all the land to work with. This intuitive claim is theoretically established in the paper and it means that we have a clear empirically-testable proposition: As a household's land ownership rises, child labor will first rise and then decline, in the manner of an inverted-U.

The underlying theoretical model is described in section 2. Then in section 3 we use a unique data set from Himachal Pradesh and Uttaranchal states of India that has information on the hours of work done by children, unlike data sets from most countries including the nationally representative Indian datasets such as those of the National Sample Survey and the National Family Health Survey. The detailed data on hours worked in various activities has two major advantages relative to the existing literature on child labor. First, the detailed activity information we have allows us to include domestic work done by children in their own homes as child labor, which we find to be the largest component. Second, since our measure of child labor is not a censored or binary variable we can estimate the effects of various factors on child labor by regression. In this case reliable estimates of the effects only require the error term of the regression equation to be uncorrelated with the regressors whereas censored or binary data require maximum liklihood or semiparametric/nonparametric approaches that assume the knowledge of the form of the error distribution (e.g. normal or logistic) or assume independent and identical distribution of the error term conditional on the regressors. In our case, good quality data allows us to use simpler and more robust estimation approaches. We test the inverted-U hypothesis and find strong empirical corroboration for land.

2 The Theory

2.1 Basic Structure

Let us consider an economy in which households treat non-work on the part of children to be a luxury good. That is, they would not think of indulging in this if the household's income happened to be very low. This is the so-called 'luxury axiom'. Now suppose that this household has k units of wealth - let us assume land. It will be shown that if the economy has a perfectly functioning labor market, then, as k rises, child labor has to fall. But once we allow labor markets to be imperfect, as k rises, child labor can rise. However, under some plausible conditions, child labor will eventually begin to fall as k continues to rise.

To model this as simply as possible let us assume each household is endowed with the utility function

$$u = u(x, e) \tag{1}$$

where x is the total consumption of the household and $e \,\epsilon\, [0, 1]$ is the amount of work the children of the household do. We will assume that each household has 1 adult and the adult finds labor costless or, equivalently, leisure of no worth and so always prefers to work.

To keep the subsequent algebra simple let us build the luxury axiom into (1) Gby taking it to be quasi-linear as follows:

$$u = \phi(x) - c \cdot e \tag{2}$$

where $\phi(x) \geq 0$ and $\phi''(x) \leq 0$, for all x, and both these inequalities are strict up to some $X > 0$. And c is a positive real number.

It is easy to verify that if this household's income doubles, child leisure or non-work, $1 - e$, will more than double, thereby showing that it is a luxury good.

2.2 The Perfect Labor Market Case

Perfect labor market means that each household faces a market wage, w, and it can buy or sell as much labor as it wishes. We are assuming that adults and children earn the same wage. Introducing an adult equivalence correction, as is standard in this literature, does not really make a difference here, and is therefore ignored.

Given that the household owns k units of land and there is a perfect labor market, it can earn a profit of $\pi(k, w)$ from this land. Of course $\pi_k(k, w) > 0$. If this household supplies e units of child labor to the labor market we have

$$x = \pi(k, w) + w + ew. \tag{3}$$

Recall that the household has 1 adult who always works.

From (2) and (3) we can write the household's problem to be:

$$\max_e \phi(\pi(k, w) + w + ew) - ce.$$

This gives us the first-order condition

$$\phi'(\pi(k, w) + w + ew) = \frac{c}{w}.$$

Differentiating implicitly with respect to k and rearranging terms we get

$$\frac{de}{dk} = -\frac{\pi_k(k, w)}{w}.$$

Hence, since $\pi_k > 0$, as k rises, child labor has to fall.

If we are to understand the Bhalotra and Heady (2003) empirical finding, clearly the perfect labor market assumption has to go. This is what we proceed to do in the next section and derive further implications of such a model before subjecting it to empirical test.

2.3 The No Labor Market Case

For reasons of simplicity we shall deal with the polar case of labor market imperfection - an economy where each household has to fend entirely for itself.

We therefore need to be a bit more explicit about where the profit, π, came from in Section 2.2. Suppose each household has a production function, f, such that

$$q = f(k,\, e + 1) \tag{4}$$

where q is output produced, k is land owned and $e+1$ is the amount of labor used - e from the children and 1 from the adult. We make usual assumptions on f, namely, $f_k,\ f_e > 0$; $f_{kk},\ f_{ee} \leq 0$; and $f_{ek} > 0$.

Since there is no labor market in this economy, the household consumes what it produces. Hence $x = q$.

Therefore, the household's optimization problem using (2) and (4) is as follows:

$$\max_{e} \phi(f(k,\, e + 1)) - ce. \tag{5}$$

Hence, we have the first-order condition:

$$\phi_x \cdot f_e = c. \tag{6}$$

Taking total differentials with respect to k and e and re-arranging terms we get:

$$\frac{de}{dk} = -\frac{f_e \phi_{xx} f_k + \phi_x f_{ek}}{f_e^2 \phi_{xx} + \phi_x f_{ee}} \tag{7}$$

It is easy to verify that the denominator is always negative. Hence, the sign of $\frac{de}{dk}$ is the sign of $[f_e f_k \phi_{xx} + f_{ek}\phi_x]$. Since this can have different signs, all we know now is that with imperfect labor market, a rise in the household's wealth *can* lead to a rise or fall in child labor.

In fact, equations 6 and 7 enable us to say a little bit more. From equation 6, we know that, given a level of k, say k^0, the household chooses e so that $\phi_x = \frac{c}{f_e}$. Let the optimum be e^0. Now suppose the household's wealth increases. Since $f_k > 0$, the increase in wealth results in an increase in output (and hence x) if $e = e^0$. The increased level of x lowers ϕ_x, the extent of the reduction depending upon the degree of concavity of ϕ. However, since $f_{ek} > 0$, the higher level of k also increases f_e, and so lowers $\frac{c}{f_e}$. Of course, the extent of the increase in f_e depends upon the value of f_{ek}.

Hence, the effect of an increase in household wealth on child labor depends both upon the specification of the utility function and production function. In particular, an increase in household wealth is likely to increase (decrease) child labor if

(i) f_{ek} is "large" ("small"),
(ii) f_e and f_k are "small"("large"),
(iii) ϕ_x is "large" ("small"),
(iv) the absolute value of ϕ_{xx} is "small" ("large").

To demonstrate this formally, let us specialize the model a bit more. Assume

$$\phi(x) = \begin{cases} Ax - \frac{Z}{2}x^2, & \text{if } x < \frac{A}{Z} \\ \frac{A^2}{2Z}, & \text{if } x \geq \frac{A}{Z} \end{cases} \tag{8}$$

Figure 1 plots $\phi(x)$ as a function of x. Next assume that the production function takes the following Cobb-Douglas form,

$$f(k,\, 1+e) = mk(e+1) \tag{9}$$

Using (2), (7) and (8), we see that the household's aim is to choose e so as to maximize

$$u = \begin{cases} Amk(e+1) - \frac{Z}{2}[mk(e+1)]^2 - ce, & \forall e+1 < \frac{A}{Zmk} \\ \frac{A^2}{2Z} - ce, \ , \forall e+1 \geq \frac{A}{Zmk} \end{cases} \tag{10}$$

Since the household incurs a positive disutility of $c > 0$ from sending a child to work, the household will never choose a level of e if this results in $\phi_x = 0$. That is, the optimum level of e will be such that $\phi(x) < Ax - \frac{Z}{2}x^2$. We record this observation as Lemma 1.

Lemma 1 *The value of e that optimizes (10) is always such that $e + 1 < A/Zmk$.*

In the light of Lemma 1, we can solve the household's problem by using the first line of (9) to represent u and deriving the first-order condition.

$$Amk - Zm^2k^2(e + 1) = c$$

or,

$$e = [A - \frac{C}{mk}]\frac{1}{Zmk} - 1 \tag{11}$$

From (10) it is obvious that as k rises e will first rise and then fall. The turning point occurs where $k = 2C/Am$. This is illustrated in Figure 2.

The aim in the next section is to investigate the relation between e and k and see if it is indeed an inverted-U, in reality.

3 Empirical Test

3.1 Nature of the Data

Most empirical analyses of child labor use data sets that do not have any information on hours worked - the typical information is essentially *binary* since the data only records whether a child works or not. Most studies on child labor treat school and work as mutually exclusive activities. We are fortunate to have a rich dataset which has detailed information on the amount of time spent by children in various activities. It covers 3505 children–1759 boys and 1746 girls – between the ages of 6 and 14 years in 1490 households in the rural areas of Himachal Pradesh and Uttaranchal. These children belong to villages in the mid-Himalayan region with an altitude of 1800-3000 metres and with an average distance to a jeepable road of 3.8 kilometers. Inspite of the remoteness, 92 percent of children between the ages of 6 to 14 years go to school and 93 percent of children between the ages of 10 to 14 years go to school, which is not less than the national average.

In contrast to the usual definition of "child labor" in most child labor statistics, our definition of child labor will include domestic work that consists of chores done inside the house as well as work done for the household but outside the home such as livestock grazing, collection of goods for household use, e.g., firewood, fodder and other forest products. Table 1 shows the distribution of daily hours worked in various activities. "Domestic work"refers to the first two rows of Table 1. In this Table a child is described as "working" if he/she is engaged in any of the four activities listed in the first four rows of Table 1. It shows that 96.8 percent of all children are involved in positive amounts of child labor. Due to this low level of censoring in our data we are able to use estimators that rely on weakest assumptions, such as regression, as compared to those required by discrete or censored data.

Table 1 - Daily Hours Worked

Activity	No.	Hrs	Male		Female	
			No.	Hrs	No.	Hrs
Age Group - 6 to 14 Years						
Domestic Chores	3386	1.5	1693	1.4	1693	1.64
Domestic Labour (outside the hh)	2255	1.5	1095	1.3	1160	1.63
Unpaid family business	1649	0.8	792	0.8	857	0.83
Work for wage	4	0	3	0	1	5E-04
Working	3394	3.9	1700	3.6	1694	4.23
Number of Children	**3505**	**3.8**	**1759**	**3.5**	**1746**	**4.11**
Age Group - 10 to 14 Years						
Domestic Chores	2088	1.6	1059	1.4	1029	1.79
Domestic Labour (outside the hh)	1585	1.9	774	1.7	811	2.14
Unpaid family business	1236	1	604	1	632	1.06
Work for wage	4	0	3	0	1	9E-04
Working	2092	4.6	1062	4.2	1030	5.1
Number of Children	**2137**	**4.6**	**1085**	**4.1**	**1052**	**4.99**

Clearly, domestic work is by far the most significant category in all the age as well as gender categories. Hence the usual exclusion of domestic work as part of child labor grossly under estimates its extent. Table 1 also shows that older children and girls tend to work more. For girls of all ages and boys above 10 years of age the daily average hours of work is more than four hours a day!

Table 2 - Participation Rate Based on Cutoff								
	All		Girls		10 to 14 years		Girls 10 to 14 years	
	No.	% participation rate	No.	% participation rate	No.	% participation rate	No.	% participation rate
Hours worked greater than 0	3394	96.83	1694	97.02	2092	97.89	1030	58.99
Hours worked greater than 1	2914	83.14	1485	85.05	1933	90.45	971	92.30
Hours worked greater than 2	2221	63.37	1174	67.24	1673	78.29	868	82.51
Hours worked greater than 3	1678	47.87	910	52.12	1348	63.08	729	69.30
Hours worked greater than 4	1173	33.47	680	38.95	992	46.42	578	54.94
Hours worked greater than 5	822	23.45	502	28.75	697	32.62	431	40.97
Excluding Domestic Work								
Hours worked greater than 0	1649	47.05	857	49.08	1236	57.84	632	36.19
Hours worked greater than 1	778	22.20	394	22.57	625	29.25	315	29.94
Hours worked greater than 2	327	9.33	160	9.16	277	12.96	135	12.83
Hours worked greater than 3	98	2.80	38	2.18	94	4.40	37	3.52
Hours worked greater than 4	12	0.34	5	0.29	10	0.47	4	0.38
Hours worked greater than 5	6	0.17	3	0.17	4	0.19	2	0.19

Table 2 provides detailed evidence on participation rates of child labor based on various cut-offs. The table shows that the participation rate is very sensitive to the cutoffs and falls substantially if the cutoff rises even by an hour. It is also apparent from the table that the incidence of child labor falls dramatically if domestic work is excluded from the definition of child labor.

Table 3 provides a rough idea of the relationship between the incidence of child labor and household land ownership. Here, land is measured in *bighas*, where 5 bighas is equal to an acre. The table shows that the average hours worked increases with land and goes down after the third quartile for all age groups indicating a possible inverted-U relationship.[1]

Table 3 - Land and Child Labor (Land in Bighas)					
		1st quartile (0-1.35)	2nd quartile (1.36-3.9)	3rd quartile (4-6.95)	4th quartile (6.96-47.3)
All 6 to 14 years	Total number	785	872	874	974
	Number worked	731	857	859	947
	Hours worked	2.49	4.24	4.46	4.22
10 to 14 Years	Total number	477	539	529	592
	Number worked	454	535	523	580
	Hours worked	2.88	4.95	5.35	5.11
Girls 6 to 14 years	Total number	375	434	449	488
	Number worked	346	429	444	475
	Hours worked	2.71	4.57	4.88	4.43
Girls 10 to 14 Years	Total number	227	267	271	287
	Number worked	214	266	269	281
	Hours worked	3.17	5.46	5.97	5.4

In a multivariate setting, which controls for other variables that potentially affect child labor, the univariate relationships between asset holding and incidence of child labor can change. Hence, we now turn to the variables that potentially have an effect on child labor. Age and gender are two child characteristics that may be important. With regard to household characteristics, we consider household age and gender composition, assets and adult education. Many empirical studies of child labor use consumption expenditure as a measure of living standards to assess the magnitude of impact of poverty on child labor. This measure is potentially subject to endogeneity bias as a child's income is also a determinant of current consumption. Instead, assets are likely to be more exogenous and free from such bias. For instance, in our data, land holdings of a household are generally inherited and hence largely exogenous. The other asset that is important in our data is livestock. We measure livestock as an aggregate of the large ones (cows, buffaloes and mules) and the small ones (goats and sheep), where the small ones are given a weight of 0.5. The summary statistics of all these variables are given in Table 4.

[1]However, this pattern is not true for livestock, the other principal asset in these areas.

Table 4 - Description of Variables					
Variable	Obs	Mean	Std. Dev.	Min	Max
Hours worked	3505	3.792	2.457	0	15
School and studying hours	3505	5.437	1.634	0	8
Land (in bighas)	3505	5.069	5.033	0	47.3
Age (in years)	3505	10.195	2.444	6	14
Female dummy	3505	0.498	0.5001	0	1
Number of children	3505	3.551	1.416	1	12
Number of adult males	3505	1.378	0.844	0	11
Number of adult females	3505	1.53	0.836	0	6
Schooling of adult males (in years)	3505	6.703	4.049	0	17
Schooling of adult females (in years)	3505	3.661	3.461	0	16
Livestock	3505	6.235	11.922	0	215

In the table above, mean land (mean livestock) computation is for all children including those for children from landless (no livestock) homes. Of the 3505 children, 2919 belong to households with positive land holdings with a minimum of 0.2 and a mean of 6.09. Similarly, 2866 children belong to households with mean positive livestock holdings of 7.62 and a minimum of 0.5 (a goat or a sheep only - which is assumed to be half of a big livestock such as a cow).

3.2 Estimable Equation

Let the dependent variable y_{ihv} be the daily hours worked by the ith child in the hth household in the vth village. The vector of characteristics of the ith child is denoted by X_i while that of a household is denoted by X_h. The former represents the supply characteristics of child labor while the latter represents the demand characteristics of child labor. There are also likely to be village characteristics that affect both the supply as well as the demand for child labor. It is important to allow for them to obtain reliable estimates of the effects of X_i and X_h. We denote all the relevant (unobserved) village characteristics by α_v. The estimable equation can now be written as:

$$y_{ihv} = \alpha_v + X_i\beta_i + X_h\beta_h + \epsilon \qquad (12)$$

We estimate two variants of the above equation separately for the four different groups of children when the definition of work includes domestic work. In the first variant we estimate the equation as being nonlinear only in land, the commonly used wealth measure for rural areas. The second variant is the more general model that is nonlinear both in land as well as livestock. Tables 5-9 report the results. Our focus here is to obtain reliable estimates of the effects of the characteristics of children and households on child labor while recognizing that village characteristics may also have an affect on it and may be correlated with household characteristics. Hence we use village fixed -effects regression for all our analysis. The standard errors are robust and account for correlation within clusters.

Table 5 - Village Fixed-Effects Regression: Non-Linear in Land Only

Variable	All	Girls	10 to 14 years	Girls 10 to 14 years
Age	.379***	.564***	.335***	.549***
	(0.0194)	(0.0.021)	(0.045)	(0.049)
Female dummy	-1.161***	0	-1.658**	0
	(0.289)		(0.779)	
Age * female	.179***	0	.22***	0
	(0.027)		(0.065)	
Land	.136***	.133***	.206***	.199***
	(0.017)	(0.025)	(0.026)	(0.042)
Land square	-.004***	-.004***	-.007***	-.007***
	(0.0006)	(0.001)	(.001)	(0.002)
Number of children	-0.046	-0.022	-0.033	-0.009
	(0.028)	(0.041)	(0.039)	(0.057)
Number of adult males	-.101*	-0.074	-0.097	0.008
	(0.053)	(0.079)	(0.074)	(0.109)
Number of adult females	-.125**	-.152*	-.214***	-.254**
	(0.051)	(0.081)	(0.071)	(0.113)
Schooling of adult males	-.058***	-.084***	-.071***	-.107***
	(0.011)	(0.017)	(0.015)	(0.024)
Schooling of adult females	-.112***	-.127***	-.134***	-.148***
	(0.013)	(0.021)	(0.019)	(0.029)
Livestock	0.005	0.005	.009*	0.003
	(0.003)	(0.005)	(0.005)	(0.008)
Constant	0.374	-.719**	0.916	-0.509
	(0.247)	(0.302)	(0.578)	(0.665)
No. of observation	3505	1746	2137	1052
r2 within	0.334	0.362	0.241	0.236

In Table 5, we observe that child labor increases with age, the effect being particularly pronounced for girls. The statistically significant (at 1 percent) negative sign of female dummy suggests the absence of an unconditional female bias. The bias depends on their age. Older girls are made to work more (probably for sibling care). The presence of female adults in a household helps reduce child labor more than the presence of male adults or other children. Similarly educating females is more effective in reducing child labor than educating males. More interestingly, the regression exercise suggests strongly that there is indeed an inverted-U relationship with land for all groups of children. As table 6 show, on average, the turning point occurs at 16.85 bighas or 3.7 acres of land per household.

Table 6 - Turning Point and Marginal Effect of Land				
Variable	All	Girls	10 to 14 years	Girls 10 to 14 yrs
Turning Point of land	16.854	17.053	14.582	14.409
Derivative of land (at mean land holding)	0.095	0.094	0.135	0.129

From Table 6, the derivative with respect to land, at mean land holding, implies that child labor increases by approximately 0.1 hours per day for every bigha of land or about 1/2 hour per day for every acre of land. The derivative or the marginal effect of land on child labor increases with age but the turning point after which the marginal effect becomes negative moves to the left with age. The turning point in each case is far below the maximum but well above the mean. The mean and the standard deviation of land holdings imply that for most households the marginal impact of an increase in land holding on child labor is positive. This indicates the importance of the possible labor market imperfections.

As far as household composition is concerned, the number of adult females in a household make the most difference. Each additional adult female reduces the hours worked by a child by 0.12 hours for all children. This effect is more pronounced for girls and older children. Similarly, the education of the adult *females* in the households helps reduce the incidence of child labor by double the magnitude of reduction due to the education of its adult *males*.

Livestock turns out to be an unimportant explanatory variable in the linear specification though in the older age group of all children it has a marginally significant positive effect. In order to check whether a non-linear, specification tells a different story, we now specify the estimated equation to be nonlinear in livestock.

Table 7 - Village Fixed Effects Regression : Non-Linear in Land and Livestock				
Variable	All	Girls	10 to 14 years	Girls 10 to 14 years
Age	.379***	.563***	.336***	.546***
	(0.022)	(0.026)	(0.047)	(0.054)
Female dummy	-1.157***	0	-1.61*	0
	(0.253)		(0.89)	
Age * female	.178***	0	.217***	0
	(0.027)		(0.074)	
Land	.125***	.125***	.189***	.188***
	(0.027)	(0.034)	(0.043)	(0.066)
Land square	-.0034***	-.0032**	-.006***	-.006*
	(0.001)	(0.001)	(0.002)	(0.003)
No. children	-.051	-0.025	-0.039	-0.016
	(0.037)	(0.053)	(0.043)	(0.065)
No. adult male	-0.076	-0.046	-0.089	0.014
	(0.075)	(0.091)	(0.086)	(0.101)
No. adult female	-0.134*	-0.154	-0.230***	-0.261**
	(0.069)	(0.1003)	(0.082)	(0.119)
Average edu adult male	-.059***	-.086***	-.072***	-.108***
	(0.014)	(0.019)	(0.019)	(0.027)
Average edu adult female	-.108***	-.124***	-.131***	-.147***
	(0.019)	(0.024)	(0.023)	(0.033)
Livestock	.019**	.016*	.021**	0.011
	(0.007)	(0.011)	(0.008)	(0.011)
Livestock square	-.000048	-6.00e-06	-.00018	-0.00008
	(0.0001)	(0.00013)	(0.00015)	(0.00019)
Livestock * Land	-0.00049	-0.0008	0.0007	0.00013
	(0.0007)	(0.0008)	(0.001)	(0.0012)
Constant	0.339	-.757**	0.917	-0.467
	(0.301)	(0.361)	(0.665)	(0.706)
No. of observation	3505	1746	2137	1052
r2 within	0.335	0.363	0.242	0.237

Table 8 - Turning Point and Marginal Effects of Land (at mean values)				
Variable	All	Girls	10 to 14 years	Girls 10 to 14 years
Turning Point of land	18.01	18.57	14.87	14.68
Derivative of land	0.087	0.087	0.127	0.123

From tables 7 and 8, we find that the relationship of land and child labor is similar to that in tables 5 and 6, i.e. an inverted-U. However, in Table 7, we do not see strong evidence of livestock having an inverted-U relationship with child labor as indicated by the insignificance of the quadratic term. The negative sign of the quadratic term suggests a downward turning point and statistically significant value of the linear term implies the increase in child labor as livestock increases. The results with respect to the other variables are similar to those in Table 5.[2] The fact that land gives a more definite inverted-U relation than other assets may at first sight seem surprising, since they all constitute wealth. However, as the theoretical model makes clear, assets that have different employment potentials will have different effects on child labor. Land was of particular interest to us here because it is such a critical complement of labor in the rural areas of developing countries and also because much of the prior work on child labor and wealth, focussed on land.

There can be other assets which certainly count as wealth but do not have same capacity to employ labor and so may not have the relationship with child labor as predicted by our model. Take, for instance, jewellery. We would expect a rise in a household's jewellery to have a declining effect on child labor throughout, since more jewellery means less poverty without the added complication of greater capacity to employ labor. The same would apply for education of adults since that enhances human capital and therefore wealth without improving the employment prospects of children. Not surprisingly, we do find that higher education leads to lower child labor for all levels of adult education.

In the estimations reported in tables 5 and 7, all the household variables have been assumed to be exogenous. Baland and Robinson (2000) raise the issue of endogeneity of the number of children as households may decide to have more children motivated by the return from child labor. If this is true then our estimates may be biased. One way to check whether they are indeed biased is to estimate the effects of a child's characteristics on his/her labor using household fixed-effects and compare them to those in Table 5 and Table 7. In this set-up we do not have any household variable except a household dummy so that we avoid the problem of potential endogeneity of all the household variables. [3] These results are reported in Table 11.

[2]We also estimated the general specification, which allowed for non-linearity in all assets including education and labor stock (household composition). But we did not find evidence of such effects and hence base our results on the parsimonious specification in table 7.

[3]We are grateful to Jean Marie Baland for suggesting this approach.

Table 9 - Robustness Check: Household Fixed Effects Regression				
Variable	All	Girls	10 to 14 years	Girls 10 to 14 years
Age	.446***	.627***	.391***	.661***
	(0.019)	(0.027)	(0.045)	(0.066)
Female dummy	-.966***	0	-1.985**	0
	(0.266)		(0.853)	
Age female	.161***	0	.248***	0
	(0.026)		(0.072)	
Constant	-1.095***	-2.278***	-0.554	-2.835***
	(0.195)	(0.276)	(0.545)	(0.783)
No. of observation	3505	1746	2137	1052
r2 within	0.496	0.516	0.353	0.331

Comparing these estimates with those in Table 7, we see that the patterns are the same and the values differ marginally as compared to the mean hours worked of 3.9 hours per day. This confirms our confidence in the estimates reported in the earlier table.

Our results have an interesting policy implication. The *channel* through which poverty is reduced is important. If monetary transfers are given to every poor households to reduce poverty, and these transfers are in turn used to increase their levels of agrarian assets such as land or livestock, child labor may in fact increase. On the other hand, policies which improve education levels especially female education or policies which fetch farmers better prices for their products (through, for instance, eliminating middlemen) are more likely to reduce povery *and* the incidence of child labor. Poverty reduction along with institutional reforms that remove adult labor market imperfections will go a long way towards reducing the incidence of child labor.

4 Concluding Remarks

This paper examined the impact of wealth on child labor using a unique data set that provides information on individual hours worked as opposed to a dummy that indicates whether a child works or not. This has two major advantages. First, the detailed activity information allowed us to include domestic work done by children in their own homes as child labor, which we find to be the largest component. Second, since our measure of child labor is not a censored or binary variable we can estimate the effects of various factors on child labor through regression analysis, which only requires the error term of the regression equation to be uncorrelated with the regressors. In contrast, censored or binary data require maximum liklihood or semiparametric/nonparametric approaches that necessitate much stronger assumptions such as knowledge of the form of the error distribution or the assumption of independent and identical distribution of the error term conditional on the regressors. Hence, the availability of detailed data has helped us in using simple and robust estimation approaches than those used in most earlier studies.

It was found that, with respect to the two important rural assets , land and livestock, child labor increases with asset levels way past the average values of the assets. With respect to land we find that child labor declines well before the observed maximum land holding. This suggests that labor market imperfections may be significant enough to hinder the expected monotonically declining relationship of wealth and child labor. In addition, it was found that adult female education is twice as effective in reducing child labor as compared to adult male education. All this is not to deny that there are contexts where simple legal retrictions may be the right invention. But in reality the inventions themselves may be products of the wider political and economic environment (Doepke and Zilibotti, 2005). Moreover, as this paper tried to show, there are unexpected intricacies in the way certain variables impact on child labor and we need to understand these, theoretically and empirically, before we can design effective policies. Overall, policies fostering the smooth functioning of adult labor markets coupled with non-agrarian ways of increasing wealth are likely to be effective tools for reducing child labor. Our future research plans include using structural estimation to evaluate the effectiveness of various policies for reducing child labour.

References

[1] Baland, J.-M., and Robinson, J. (2000). “A Model of Child Labor, ” *Journal of Political Economy*, 108(4), pp. 663-679.

[2] Basu, K., and P. H. Van (1998). “The Economics of Child Labor, ” *American Economic Review*, 88(3), pp. 412-27.

[3] Basu, K. (1999). “Child Labor: Cause, Consequences and Cure, With Remarks on International Labor Standards, ” *Journal of Economic Literature*, 37(3), pp. 1083-1119.

[4] Basu, K., and Z. Tzannatos (2003). “The Global Child Labor Problem: What do we Know and What can we Do?,” *World Bank Economic Review*, 17(2), pp. 147-173.

[5] Bhalotra, S., and C. Heady (2003). “Child Farm Labor: The Wealth Paradox,” *World Bank Economic Review*, 17(2), pp. 197-227.

[6] Doepke M. and Zilibotti, F. (2005). “Macroeconomics of Child Labor Regulation.” *American Economic Review*, 95(5), pp. 1492-1524.

[7] Edmonds, E. (2005). “Does Child Labor Decline with Improvements in Economic Sataus ? ” *Journal of Human Resources*, 40(1), pp. 77-89.

[8] Edmonds, E., and C. Turk (2004). “Child Labor in Transition in Vietnam,” in P. Glewwe, N. Agrawal and D. Dollar (eds), *Economic Growth, Poverty and Household Welfare in Vietnam*, Washington DC: World Bank, pp. 505-550.

[9] Edmonds, E., and N. Pavcnik (2005). “Child Labor in the Global Economy,” *Journal of Economic Perspectives*, 18(1), Winter 2005, pp. 199-220.

[10] Emerson, P. and A.Souza (2003). “Is There a Child Labor Trap? Intergeneration Persistence of Child Labor in Brazil, ” *Economic Development and Cultural Change*, 51(2), pp. 375-398.

[11] Menon, N. (2005). “Why Might Credit Used to Finance Investments Increase Child Labor?,” Brandeis Universtiy, Working Paper.

[12] Ray, R (2000). "Child Labor, Child Schooling and Their Interaction with Adult Labor: Empirical Evidence for Peru and Pakistan," *World Bank Economic Review*, 14(2):347-67.

Figure 1

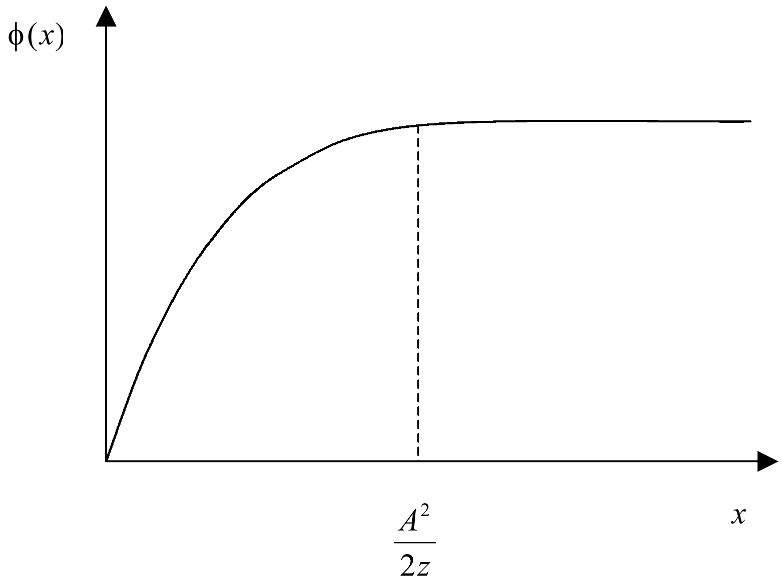

Figure 2