CHILDREN, EDUCATION, LABOR, AND LAND: IN THE LONG RUN AND SHORT RUN

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Abstract
The paper uses an overlapping generations model to examine the effects of an increase in a household's land ownership on child labor. Consistent with previous studies, it found that small increases in land lead to increased child labor. However, as land continues to increase child labor declines. Further, even when an increase in land ownership causes an immediate rise in child labor, there are contexts where long-run child labor (that is aggregated over progenies) declines. (JEL: O10, D13, E20)

1. Introduction

It has been noted in empirical studies that, in poor countries, a greater ownership of land by a household or the fact of a household having a larger business enterprise tends to result in greater child labor supplied by the household (Bhalotra and Heady 2003; Edmonds and Turk 2004; Menon 2005). As Bhalotra and Heady note, "In Pakistan, where 33% of households own land, the probability of working at all or working on the farm is substantially higher among landowners than among the landless" (p. 206). "In Ghana the probability of both working at all and working on a farm increases steadily with land size for boys and girls" (p. 207). Some of this leads to skepticism regarding the view that child labor is caused by poverty, because the poor typically have little land or businesses opportunities. Moreover, these findings suggest that, if we want to control child labor, we ought not to enhance the land wealth of laboring households. This has huge implications for the land-reform initiatives that so many poor countries, emerging from the shadows of colonialism, have toyed with. However, before we settle for such far-reaching conclusions it is important to try to understand analytically what underlies these empirical findings.

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First of all, a closer look at the empirical evidence suggests that while for the poorest agricultural households, a rise in land wealth does result in higher child labor, this relationship is non-monotonic. Using a new data set from northern India that gives information on the hours of work done by children, Basu, Das, and Dutta (2008) show that the relation between child labor and land wealth, at the level of each household, is an inverted-U. Beyond a point (empirically estimated to be three acres), as the land owned by a household continues to rise, the incidence of labor provided by the children of the household declines. The aim of the present paper is to better understand the short-run and long-run effects of changes in a household's land holdings (or other durable capital) on child labor. A novelty of the model is its explicit recognition of the dynamics of child labor.

First we demonstrate how a standard overlapping generations macroeconomic model with imperfect capital markets can explain the inverted-U relationship. Second, the popular discussion and the empirical literature on the impact of land wealth on the extent of child labor are focused entirely on the short-term effect. Our dynamic model gives rise to the following natural question. Is it possible that even when a rise in the household's land ownership causes an immediate increase in child labor, its impact on child labor aggregated over all future descendent generations of the household goes down? This paper answers this question in the affirmative. Our analysis is based on an adaptation of the overlapping generations model of Galor and Zeira (1993). For related work see Banerjee and Newman (1993), Galor and Weil (1996), Hazan and Berdugo (2002), and Doepke and Zilibotti (2005, 2008). We adapt the Galor–Zeira model to introduce land as a factor of production and analyze the effect changes in land ownership has on child labor. In our model, and in several of the cited papers, capital market imperfections play a critical role. We find that an exogenous rise in the household's land can cause child labor to rise in the short run. If the rise in land wealth is small, child labor could be high even in the long run. But as soon as the increase in land goes above a critical level, child labor goes down in the long run, even though its immediate consequence is that of enhanced child labor.

2. Benchmark Model

As in the standard overlapping generations model, each person is supposed to live for two periods—one as a child and a second as an adult. As a child the person can choose to get educated (at cost h) or not. If he gets educated, as an adult he earns w_s (wage for skilled workers); otherwise he earns $w_n < w_s$.

If a household has land $\ell \geq 0$ and uses L units of labor on it, it can produce output q given by the production function

$$q = A\ell L - \frac{DL^2}{2},$$

where $A, D > 0$. Hence,

$$\frac{\partial q}{\partial L} = A\ell - DL.$$

We use this special production function purely for mathematical convenience. All we need is a production function with the reasonable property that, as land rises, the marginal productivity of labor goes up.[1]

It will be assumed that children, if they work, work on the family farm (that is, there is no market as such for child labor). We shall also assume, though only temporarily, that adult workers work only on the labor market (at wages of w_s or w_n, depending whether they are skilled or unskilled).

As in the Galor–Zeira model a person consumes only when she becomes an adult. Her life-time utility, which is also the utility as an adult, is given by

$$U(c, b) = c^{\alpha} b^{1-\alpha}, \tag{1}$$

where c is consumption and b bequest.

The present model makes critical use of the realistic assumption of an imperfect capital market, as assumed in, for instance, Baland and Robinson (2000). By investing money in a bank a person earns an interest of r, but to borrow money he or she has to pay an interest of i where $i > r$. It is easy to see that if a person has y dollars as an adult her utility will be $u = ey$, where $e = \alpha^{\alpha}(1-\alpha)^{1-\alpha}$, and her bequest will be $b = (1-\alpha)y$.

If a person inherits x, has ℓ units of land (this is indestructible and is passed down from one generation to another), decides not to go to school and works L amount when a child, her income as an adult is

$$\left[x + A\ell L - \frac{DL^2}{2}\right](1+r) + w_n.$$

Hence, her life-time utility is

$$v(x, L) = e\left\{\left[x + A\ell L - \frac{DL^2}{2}\right](1+r) + w_n\right\}. \tag{2}$$

The optimal value of L is easily derived from the first-order condition and is given by

$$L = \frac{A\ell}{D}. \tag{3}$$

Hence, as land increases, child labor increases. Note that inheritance (x) does not affect L once the child has decided not to go to school. This changes, however, once we endogenize the decision to go to school.

1. In this production function there is complementarity between land and labor and there are increasing returns to scale. The latter, fortunately, is incidental. As will be obvious from the subsequent generalized model, our result does not hinge on it in any way.

2.1. Education and Bequests

For now, a child born into a household with ℓ units of land and an inheritance of x units of financial wealth will, if she decides not to get education, provide L units of labor as given by equation (3). The question that we have to now answer is whether or not she will get education. It will be assumed that education is incompatible with child labor. This is a useful simplifying assumption and no more than a polar case of what is empirically valid, namely, that greater education implies less child labor (see, for example, Kruger 2007; Edmonds, Pavcnik, and Topalova 2008).

A person who inherits x, has land ℓ, chooses not to get education, and works optimally as a child, will get the utility level given by

$$u_n(x) = e\left[\left(x + \frac{(A\ell)^2}{2D}\right)(1+r) + w_n\right], \tag{4}$$

and will leave a bequest given by

$$b_n(x) = (1-\alpha)\left[\left(x + \frac{(A\ell)^2}{2D}\right)(1+r) + w_n\right]. \tag{5}$$

The subscript n represents "no schooling."

A person who inherits x, has land ℓ and chooses to go to school has the following utility,

$$u_s(x) = \begin{cases} e[(x-h)(1+r) + w_s] & \text{if } x \geq h, \\ e[(x-h)(1+i) + w_s] & \text{if } x < h, \end{cases} \tag{6}$$

and leaves the following bequest,

$$b_s(x) = \begin{cases} (1-\alpha)[(x-h)(1+r) + w_s] & \text{if } x \geq h, \\ (1-\alpha)[(x-h)(1+i) + w_s] & \text{if } x < h. \end{cases} \tag{7}$$

To understand the choice between education and child labor, assume ℓ is fixed and draw two lines, for equations (4) and (6). This is done in Figure 1.

The two graphs do not have to intersect but the interesting case occurs when they do. In the case illustrated in Figure 1, if $x < \hat{x}$ no education is acquired and if $x \geq \hat{x}$ the child becomes educated.[2] Because we know what the bequest function is with and without education, we can now write an equation for how

2. A similar result though viewed from the point of view of labor instead of education occurs in Basu and Van (1998) and Swinnerton and Rogers (1999).

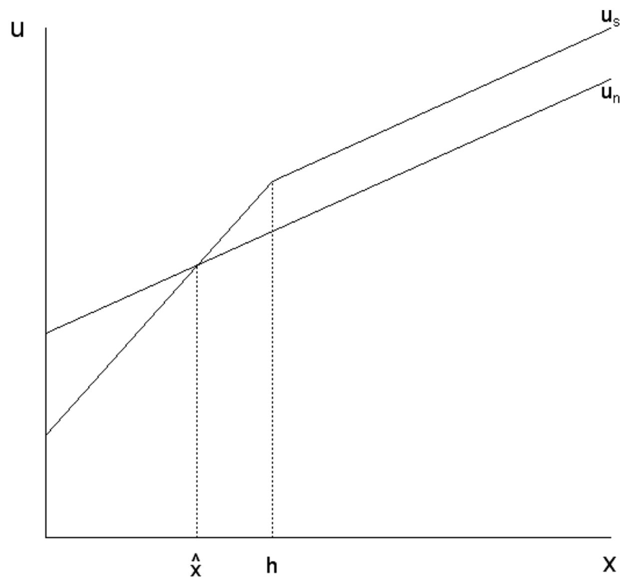

FIGURE 1. Educated (u_s) and non-educated (u_n) utility as a function of bequest.

much a person will bequeath x_{t+1} as a function of the bequest he received x_t. Let us use ψ to denote this 'bequest function'. Hence,

$$x_{t+1} = \psi(x_t) = \begin{cases} b_n(x) & \text{if } x < \hat{x}, \\ b_s(x) & \text{if } x \geq \hat{x}. \end{cases} \tag{8}$$

In addition, it is worth noting that $\hat{x}$ itself is a function of ℓ. Holding ℓ constant, ψ is illustrated in Figure 2. *EFGJ*** describes the line of the bequest function. A steady state equilibrium is a fixed point of this function. Once a household gets into a steady state, the behavior of all its progenies remains unchanged.

Diagrammatically, a steady-state equilibrium is described by a point of intersection between the 45° line and the line of the bequest function. Hence, in Figure 2 there are three steady-state equilibria of which x^* and x^{**} and are stable. As in Galor and Zeira, to assure that the process of bequest is stable, and that the two stable steady states can occur, we assume $r < \alpha/(1-\alpha) < i$. In Figure 2 this assumption implies that the slope of the bequest function is less than 1 at x^* and x^{**}, and steeper than 1 in the intermediate region.

2.2. The Effect of Land Increase

Suppose a dynasty is in the equilibrium x^*. Therefore each person receives a bequest of x^* and bequeaths to her child x^*. Now let the land owned by this

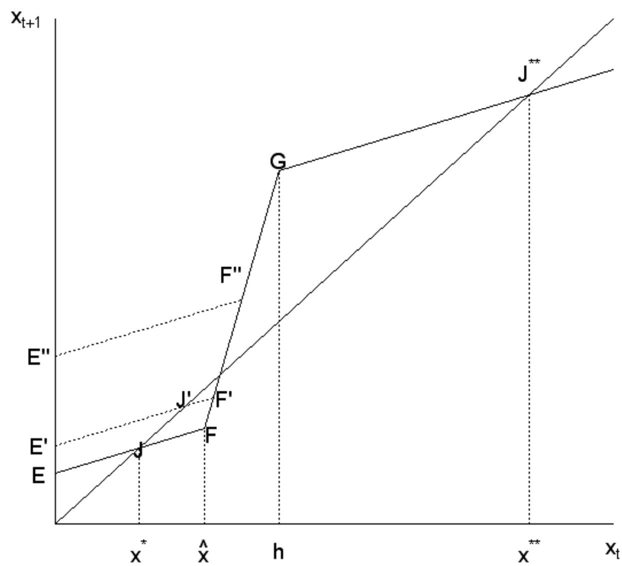

FIGURE 2. The dynamics of bequests and steady states equilibria.

dynasty increase from ℓ to ℓ'. Because b_s is unaffected by this and b_n rises, the only change in Figure 2 is that in the graph of the bequest function, the segment EF will rise to, say, $E'F'$. Hence, the new steady state will move to point J'. The equilibrium bequest will be higher and child labor will be higher, at $L' = A\ell'/D$.

Next suppose land rises even further, to ℓ'', so that EF rises to $E''F''$. There will now be just one steady state, at J^{**}, where child labor is zero; and intergenerational bequest will be high, x^{**}. The dynamics can be seen in Figure 2. Starting from x^* and landholding ℓ, as land rises to ℓ'' child labor will rise to $L'' = A\ell''/D$. Then with each generation the bequest will keep rising. As soon as the bequest goes beyond F'', child labor drops down to zero and will never rise again. The bequest will eventually settle at the new steady state equilibrium level x^{**}.

More interesting results are possible by adding some more flexibility to this stylized model. It was assumed that children can work on the family land only and that there is no labor market for children. It was assumed in addition that there is no inter-household adult labor market either. The latter assumption is unrealistic. In the next section we allow the possibility that each household can, if that be profitable, hire adult laborers from the open adult labor market.

3. Adult Labor and an Inverted-U

In the simple model described in the previous section only children were employed on a household's land, and land holdings could only affect the income of a non-educated child. In this section we relax these assumptions and suppose, instead, that adult workers can be hired to work on the household farm. Thus, increased land holdings affect a household's income even when the child goes to school. As in the simple version, the short-run and the long-run effects of enhanced land ownership can go in opposite directions. However, in the previous section the effect on short-run child labor was monotonic—as land rises, child labor (weakly) rises. The small injection of additional complexity in the model yields a more interesting and empirically more plausible result. A rise in land owned by a household initially results in the children of the household working more, but as land continues to increase, the labor performed by the household's children decline. A novel feature introduced here is a production function which recognizes that children need adult help or supervision to be productive. We begin by formally describing the new production process.

3.1. A New Production Process

Without loss of generality we shall assume that leisure has zero value. Child labor L_c is therefore free for the household; $L_c \in [0, 1]$ because children only work on their own family land. Adult labor units L_a cost w_n per unit (the wage for non-skilled worker) and can be hired in a labor market. The novel feature that is introduced here is the recognition that children need adult supervision to be productive. This introduces a limited amount of one-way complementarity between adult and child laborers. Hence, we assume every unit of child labor requires φ units of adult labor. Supervised child labor and adult labor are perfect substitutes, with every γ units of supervised child labor being equivalent to one unit of adult labor, $\gamma \in (0, 1]$. We shall also assume $\gamma \geq \varphi$; otherwise it would never be worthwhile employing children. When there are enough adults to supervise child labor, total effective labor hours include adults who are not engaged in supervising and adult equivalent units of supervised child labor. All working children must be supervised. Employing L_c units of child labor and L_a units of adult labor the number of effective labor units is given by

$$L(L_a, L_c) = \begin{cases} L_a - \varphi L_c + \gamma L_c & \text{if } \varphi L_c \leq L_a, \\ \gamma L_a/\varphi & \text{if } \varphi L_c > L_a. \end{cases} \tag{9}$$

What the second line of this equation says is that, in case there are more children than can be supervised by the available adults, then the extra children are left unused. A visual representation of equation (9) is provided in Figure 3. Each each unbroken line such as ABC represents all combinations of L_a and L_c which generates the same total effective labor. It will be evident from the production function introduced subsequently that if land is held constant then each of these lines is an isoquant. As evident from the figure, child and adult labor are substitutes

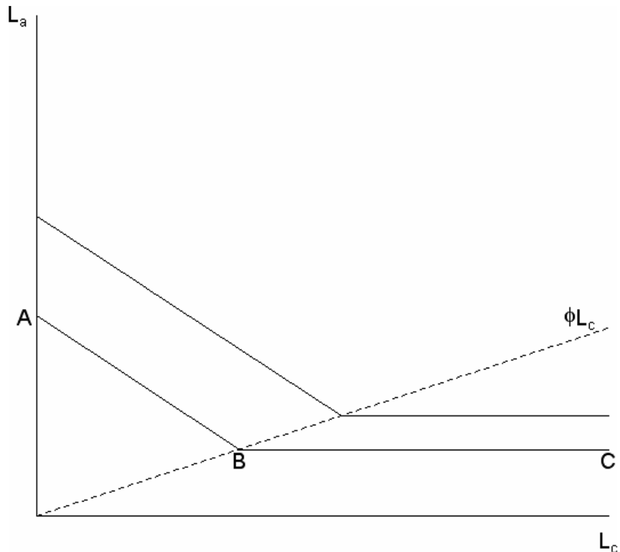

FIGURE 3. Effective labor isoquants given child (L_c) and adult (L_a) labor.

within a bound beyond which they become complements. This is a breakaway from the assumption that is to be found in the existing literature on child labor. We believe this is the more realistic description. Because in the present paper there will be no loss of generality in assuming $\gamma = 1$, we will do so to simplify notation.

Given L units of (effective) labor and ℓ units of land output is $q = F(\ell, L)$. We make standard assumptions on the production function. The production function is twice continuously differentiable; no output can be produced absent one of the inputs $F(0, L) = F(\ell, 0) = 0$; production increases with land $F_\ell(\ell, L) > 0$, for $L > 0$ and with labor $F_L(\ell, L) > 0$ for $\ell > 0$; and is strictly concave in L, $F_{L,L}(\ell, L) < 0$. Moreover, we assume that the marginal productivity of labor increases with land holdings $F_{L,\ell}(\ell, L) > 0$. To ensure that at least some labor is employed, we also assume $F_L(\ell, 0) > w_n$ for all $\ell > 0$.

It is easy to see from equation (9) that there is no loss of generality in assuming that households choose L_c and L_a such that $\varphi L_c \leq L_a$. Hence, the household profit maximization problem is given by

$$\max_{L_a, L_c \geq 0} \quad F(\ell, L_a - \varphi L_c + L_c) - w_n L_a$$

$$\text{subject to:} \quad L_c \leq 1 \text{ and } L_a \geq \varphi L_c.$$

The profit earned by a household owning ℓ units of land that, respectively, does not send its children to school and does send its children to school will be denoted by $\Pi_n(\ell)$ and $\Pi_s(\ell)$. These are easy to derive (the derivation is available from the authors on request) and one can check that both $\Pi_n(\ell)$ and $\Pi_s(\ell)$ increase with ℓ. We will assume $\Pi_s(\ell)$ is unbounded from above, which holds true for commonly used production functions.

3.2. The Effect of an Increase in Land

In this more complex model, where hired adult labor can be used on one's own land, equation (4) has to be rewritten as

$$u_n(x, \ell) = e\{[x + \Pi_n(\ell)](1 + r) + w_n\}, \tag{10}$$

and equation (6) has to be rewritten as

$$u_s(x, \ell) = \begin{cases} e\{[x + \Pi_s(\ell) - h](1 + r) + w_s\} & \text{if } x + \Pi_s(\ell) \geq h, \\ e\{[x + \Pi_s(\ell) - h](1 + i) + w_s\} & \text{if } x + \Pi_s(\ell) < h. \end{cases} \tag{11}$$

Let us denote the corresponding bequest function in this model, defined in the novel way, by $b_n(x, \ell)$ and $b_s(x, \ell)$. Earlier, in equations (4) and (6), $u_n(x)$ rose with ℓ but $u_s(x)$ was unaffected by this change. Now, however, both $u_n(x, \ell)$ and $u_s(x, \ell)$ rise as ℓ increases. The effect on the point of intersection between $u_n(x, \ell)$ and $u_s(x, \ell)$ shown by $\hat{x}$ in Figure 2 is ambiguous for small increases in ℓ, but when ℓ rises sufficiently, $\hat{x}$ moves so far to the left that it goes past this original bequest level x^*. In that case, even in the short run child labor will fall, as household profit is large enough for the child to choose to educate. Figure 4 captures the relation between ℓ and the short-run incidence of child labor.

This relationship is an inverted-U (admittedly, a cubist's representation of it) and fits in well with the empirical picture described in Figure 1.

Consider now the long-run effect of an increase in land. The rise in ℓ and the resulting rise in profit also increase the level of bequest x_{t+1} for any given values of inheritance x_t. Hence, the three segments plotted in Figure 2 shift up. The steady state levels of bequest x^* and x^{**} both rise. For a sufficient rise in ℓ, $x^* > \hat{x}$ and there is only one steady state in which child labor drops to zero. Moreover, we show in the next proposition that, starting from land holdings ℓ low enough, it is always possible that an increase in land holdings would result in a short-run increase in child labor, but a long-run decline in child labor.

PROPOSITION 1. *Suppose $x^*(\ell_0)$ is a stable steady state, given land ℓ_0, such that child labor is less than 1 ($\ell_0 < \underline{\ell}$), and the child is not sent to school ($x^*(\ell_0) < \hat{x}(\ell_0) < h - \Pi_s(\ell_0)$), then there exist $\ell_1 > \ell_0$ such that an increase of land to ℓ_1 causes child labor to (i) rise in the short run, and (ii) fall in the long run.*

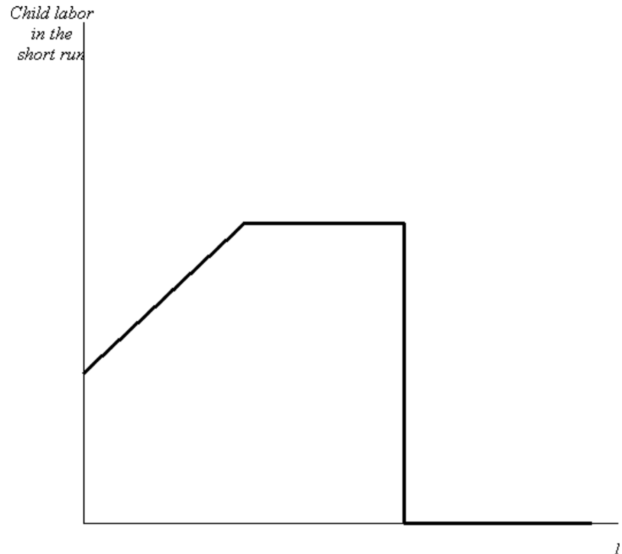

FIGURE 4. Short run child labor as a function of land holdings.

The formal proof of the proposition is omitted here. The intuition is simple. Suppose there is a household with a negligible amount of land. This will be a poor household and the children will be doing little work, because there is no labor market for children. In case the household gets an exogenous increase in land, given the lower cost of using the household's own children, child labor will rise. As land further increases, the productivity of child labor increases, and therefore, child labor will rise. However, beyond a point, this will cause the bequest received by the grandchildren to rise; and the snowballing effect of rising bequests will release the great . . . great-grandchildren of the household from child labor. Hence, while the first-generation children's labor rises, the aggregate child labor of all future generations children declines.

The result is relevant only for those households which, for whatever reason, experience changes in land holding. Expansion in land-holding cannot of course be the experience of all households because, if population rises and arable land remains constant, some households must experience a decline in their land-holding. The analysis gets more complex if we consider migration from rural to urban areas and changes in arable rural land caused by changes in irrigation and other rural infrastructure. This lies beyond the scope of the present paper.

Our model described a mechanism that explains the empirical relationship between land and child labor. For poor households, capital and labor market imperfections and the fact that children's marginal productivity increases with land holdings result in an increase in child labor as land rises. For sufficiently large land holdings, education is preferred and child labor drops. This inverted-U prevails in the short run as well as in the long run, but, the long-run turning point occurs earlier. Hence, long-run child labor can decline even when the immediate impact of an intervention is to raise child labor. In terms of policy, drawing labor away from agriculture into manufacturing and services and enhancing ownership and the productivity of land (through better irrigation and infrastructure, for instance) are likely to be a effective ways of bringing down aggregate child labor in the long run.

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