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Children, Education, Labor and Land: In the Long Run and Short

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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 is 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.

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1 Introduction

It is commonly noted in empirical studies that, in poor countries, a greater ownership of land by a household tends to result in a greater amount of labor by the household's children and, further, if a household has its own business, its children are likely to do more work (Bhalotra and Heady, 2003; Edmonds and Turk, 2004; Menon, 2005; Basu, Das and Dutta, 2008). Some of this naturally leads to the suggestion that, if we want to control child labor, it may not be a good idea to enhance the land wealth of laboring households.

There are two possible reasons to object to this policy suggestion. First, child labor should not be treated as equivalent to child welfare. Especially in poor countries, it is possible to conceive of government interventions to deter child labor that lower the incidence of child labor but also lower child welfare (Basu and Van, 1998). Since this is a normative matter a person can counter it by saying that controlling child labor is for him the ultimate aim and he is willing to target this no matter what happens to other variables. This is not a line that we are in sympathy with and it is not the aim of this paper to go into normative issues. However, even if our objective were, solely, to minimize child labor, our next observation clarifies that withholding land from the laboring classes may not be the right policy.

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. Is it possible that a rise in a household's land ownership, even though it immediately raises child labor, lowers child labor in the long run, that is, if we track its consequences down through the future dynastic lineage of this household? This is a question which requires theoretical analysis and that is what the present paper is concerned with. For this purpose we use an adaptation of the overlapping generation's macroeconomic model of Galor and Zeira (1993). The Galor-Zeira model takes the standard idea of an overlapping generations model and adapts it to the context of a developing country to analyze the relation between distribution and development (for related work see Banerjee and Newman, 1993; Galor and Weil, 1996; Hazan and Berdugo, 2002; Doepke and Zilibotti, 2005). We adapt the Galor-Zeira model to introduce land as a factor of production and analyze the effect it has on child labor. We find that an exogenous rise in the household's land may 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 could be that of enhanced child labor.

2 Benchmark Model

Each person lives 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. Of course $w_s > w_n$.

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] We shall throughout be confining our attention to situations where $L \leq A\ell/D$.

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.

By investing money in a bank one earns an interest of r and to borrow money one pays an interest of i and $i > r$. It is easy to see, 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

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

[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 generalized model below, our results does not hinge on it in any way.

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. It is interesting to observe that inheritance (x) does not affect L, once the child has decided not to go to school. But, this changes once we endogenize the decision to go to school.

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 (3) above. 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, Duryea, Lam and Levision, 2007; 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 (4) and will leave a bequest given by (5):

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

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

The subscript 'n' is for 'no schooling.

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

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

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

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

[Insert 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 $x < \widehat{x}$ no education is acquired and if $x \geq \widehat{x}$ the child becomes educated. Since we know what the bequest function is with and without education, we can now write an equation for how 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 function which will be referred to as the 'bequest function'. Hence,

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

In addition, it is worth noting that $\widehat{x}$ itself is a function of ℓ. Holding ℓ constant, ψ is illustrated in Figure 2. $EFGJ^{**}$ describes the graph 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.

[Insert Figure 2]

Diagrammatically, a steady state equilibrium is described by a point of intersection between the 45^o line and the graph 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^*. So each person receives a bequest of x^* and bequeaths to her child x^*. Now let the land owned by this dynasty increase from ℓ to ℓ'. Since 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 is easy to read off Figure 2. Starting from x^* and landholding ℓ, as land rises to $\ell^{''}$ child labor will rise to $L'' = A\ell''/D$. Then with each generation the bequest will keep rising. As soon as 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 the above stylized model. It was assumed above that on the family land only children can work 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 above the short-run and the long-run effects of enhanced land ownership can go in opposite directions. However, the effect on short-run child labor is monotonic as land rises, child labor (weakly) rises. A small injection of additional complexity in the model yields us a more interesting and empirically more plausible result. A rise in land, causes (short-run) child labor to rise; but as land continues to increase, child labor even in the short run declines. The present section establishes this result. We assume that adult workers can be hired to work on the household farm. Moreover, we assume that children need adult help or supervision to be productive.[2] We begin by introducing the new production process. We then generalize the results of the previous section to this more realistic setting.

3.1 Production process

Without loss of generality we shall assume that leisure has zero value. Child labor L_c is therefore free for the household; $L_c \in [0, 1]$ since 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 $\gamma \geq \phi$; otherwise it would never be worth while 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

[2] This seems reasonable in the context of child labor and allows us to depart from the quadratic form assumed earlier. We can alternatively keep a quadratic production function or introduce a small cost to child labor, such as extra nutritional needs or the value of leisure.

supervised. Employing L_c units of child labor and L_a units of adult labor the number of effective labor units is given by

$$L(L_a, L_c) = \begin{cases} L_a - \phi L_c + \gamma L_c & if\ \phi L_c \le L_a \\ \\ \frac{\gamma L_a}{\phi} & if\ \phi L_c > L_a \end{cases} . \tag{9}$$

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. Since 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 ease notation, we denote $F_L(\ell, L) = f(\ell, L)$, and its inverse for determining L given m and ℓ, by $f^{-1}(\ell, m)$, where $m = F_L(\ell, L)$. To ensure that at least some labor is employed, we also assume $f(\ell, 0) > w_n$ for all $\ell > 0$.

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

$$\begin{aligned} & \max_{L_a, L_c \ge 0} F(\ell, L_a - \phi L_c + L_c) - w_n L_a \\ s.t \quad : \quad & L_c \le 1 \ \text{ and } \ L_a \ge \phi L_c. \end{aligned}$$

The profit maximizing input choice could either be interior with $0 < L_c < 1$, or a corner solution $L_c = 1$. Consider first an interior solution, $L_c < 1$. In this case, necessarily the supervision constraint binds $L_a = \phi L_c$. Otherwise, if no constraint binds, profit can be increased by a marginal increase in child labor since $F_L(\ell, L) > 0$. Substituting $L_a = \phi L_c$ we obtain total effective labor hours $L = L_c$. That is, in such interior solution some children work together with just enough adults to supervise them. Our profit maximization problem becomes:

$$\max_{L_c \ge 0} F(\ell, L_c) - w_n \phi L_c \tag{10}$$

Let $\underline{\ell}$ be such that $f(\underline{\ell}, 1) = w_n \phi$ ($\underline{\ell}$ exists given our assumptions on the production process). The profit maximization problem (10) has an interior solution $L_c = f^{-1}(\ell, \phi w_n)$ as long as $\ell \le \underline{\ell}$. If $\ell > \underline{\ell}$, then there is only a corner solution with $L_c = 1$. Effective labor hours are $L = L_a - \phi + 1$. Adult labor must be at least enough to supervise the unit of child labor, $L_a \geq \phi$. Adult labor then solves

$$\begin{aligned} & \max_{L_a \geq 0} F(\ell, L_a - \phi + 1) - w_n L_a \\ s.t \quad : \quad & L_a \geq \phi. \end{aligned} \tag{11}$$

Let $\overline{\ell}$ be such that $f(\overline{\ell}, 1) = w_n$ ($\overline{\ell} > \underline{\ell}$ exists given our assumptions on the production process). The profit maximization problem (11) has an interior solution $L_a > \phi$ when $\ell > \overline{\ell}$. Otherwise, there is a corner solution $L_a = \phi$. Given these optimal input choices, it is easy to derive the household's profit given any land holding ℓ :

$$\Pi_n(\ell) = \begin{cases} F(\ell, f^{-1}(\ell, \phi w_n)) - w_n \phi f^{-1}(\ell, \phi w_n) & if \;\; \ell \leq \underline{\ell} \\ F(\ell, 1) - w_n \phi & if \;\; \underline{\ell} < \; \ell < \overline{\ell} \\ F(\ell, f^{-1}(\ell, w_n)) - w_n f^{-1}(\ell, w_n) + w_n (1 - \phi) & if \;\; \ell > \overline{\ell} \end{cases} . \tag{12}$$

Next note that if a household with land ℓ sends its child to school ($L_c = 0$) it would employ $L_a^s = f^{-1}(\ell, w_n)$ units of adult labor and profit from its own land is given by

$$\Pi_s(\ell) = F(\ell, f^{-1}(\ell, w_n)) - w_n f^{-1}(\ell, w_n) . \tag{13}$$

Profits increase with land holding ℓ, whether or not a child is sent to school. We will assume that $\lim_{\ell \to \infty} \Pi_s(\ell) = \infty$ 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, (4) and (6) have to be rewritten as, respectively (14) and (15)

$$u_n(x, \ell) = e \{ [x + \Pi_n(\ell)] (1 + r) + w_n \} \tag{14}$$

$$u_s(x, \ell) = \begin{cases} e \{ [x + \Pi_s(\ell) - h](1 + r) + w_s \} & \text{if } x + \Pi_s(\ell) \geq h \\ e \{ [x + \Pi_s(\ell) - h](1 + i) + w_s \} & \text{if } x + \Pi_s(\ell) < h \end{cases} . \tag{15}$$

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 $\widehat{x}$ in figure 1 is ambiguous for small increases in ℓ, but when ℓ rises sufficiently, $\widehat{x}$ moves so far to the left that it goes past this original bequest level x^* in figure 2. 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 3 captures the relation between ℓ and the short-run incidence of child labor.

[Insert Figure 3]

This relationship is an inverted-U (admittedly, a cubist's representation of it) and fits in well with the empirical evidence found in Basu Das and Dutta (2008).

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, $x^* > \widehat{x}$ 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 ($x^*(\ell_0) < \widehat{x}(\ell_0) < h - \Pi_s(\ell_0)$), then there exist $\ell_1 > \ell_0$ such that an increase of land to ℓ_1 causes child labor to (1) rise in the short run, and (2) fall in the long run.*

Proof. The steady state level of bequest $x^*(\ell)$, when it exists, is defined implicitly by $b_n(x^*,\ell) = x^*$. As ℓ increases $x^*(\ell)$ increases. Let $\widehat{x}(\ell)$ be the (unique) intersection of $u_n(x,\ell)$ and $u_s(x,\ell)$ when it exists, and let $\widehat{x}(\ell) = 0$ when the graphs do not intersect. For levels of land $\ell > \overline{\ell}$, profits as derived in (12), and (13) differ by a constant $w_n(1-\phi)$. Moreover, we assumed $\lim_{\ell\to\infty} \Pi_s(\ell) = \infty$. Hence, for a sufficient increase in ℓ, $\widehat{x}(\ell)$ will drop to zero. The profit functions are continuous, therefore $\widehat{x}(\ell)$ and $x^*(\ell)$ change continuously with ℓ. We assumed in the initial level of land holdings is such that, $x^*(\ell_0) < \widehat{x}(\ell_0)$. Since $x^*(\ell)$ increases in ℓ and $\widehat{x}(\ell)$ drops to zero for large enough ℓ, there must be a point $\widetilde{\ell}$ were $x^*(\widetilde{\ell}) = \widehat{x}(\widetilde{\ell})$, and for all $\ell > \widetilde{\ell}$, the no education stable steady state ceases to exists. Figure 4 is an aid to understanding this. Since $x^*(\ell_0) < x^*(\widetilde{\ell}) = \widehat{x}(\widetilde{\ell})$, there exists a neighborhood $N_\varepsilon(\widetilde{\ell})$ to the right of $\widetilde{\ell}$ such that for $\ell \in N_\varepsilon(\widetilde{\ell})$, $x^*(\ell_0) < \widehat{x}(\widetilde{\ell})$ which implies in the short run the child is not sent to school and child labor increases. Additionally, since $x^*(\ell)$ is no longer a steady state, in the long run, bequest will converge to the steady state in which the child is sent to school, and child labor drops to zero. ■

[Insert Figure 4]

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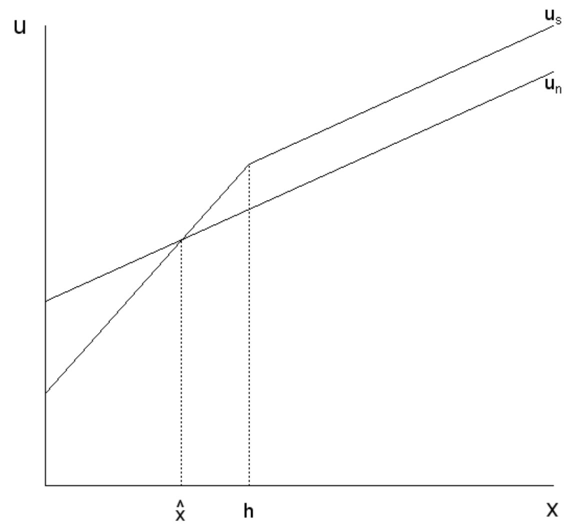

Figure 1

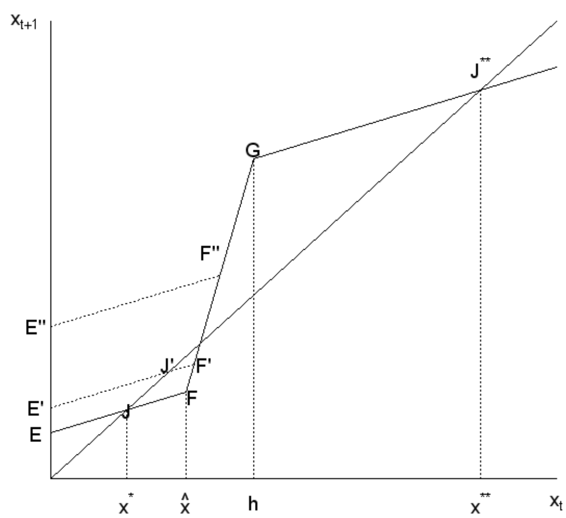

Figure 2

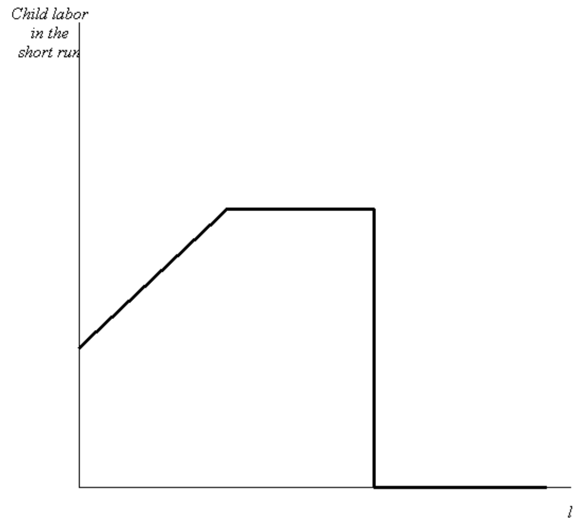

Figure 3

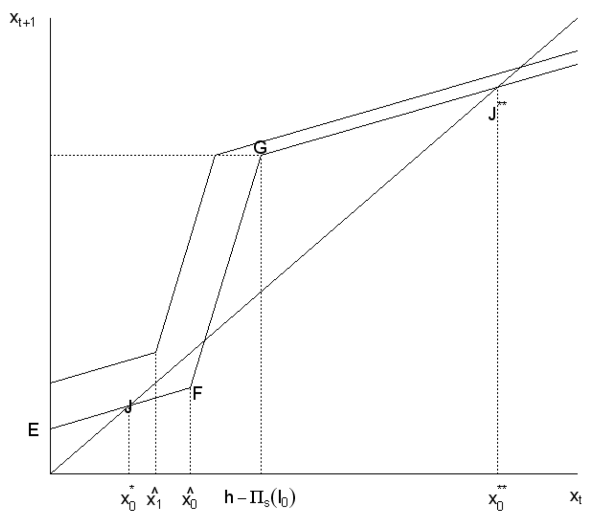

Figure 4