Mortality, Fertility and Child Labor

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Abstract

We discuss how child labor problems may persist in developing countries when adult mortality risks are endogenous. Children provide current consumption through child labor and future consumption via an informal social security arrangement. Poorer parents, unable to invest much in their health, face greater mortality risks and are inclined to send their children to work instead of investing in their human capital. Endogenous fertility decisions exacerbate the problem as parents substitute toward quantity investment in children.

Keywords: child labor, fertility, mortality, education
JEL Classification: J2, O1

1 Introduction

The existing literature identifies capital market failure as the principal factor behind the intergenerational persistence of child labor in poorer households (Basu, 1999; Ranjan, 2001). But poorer parents may send their children to work even in a perfect credit world if the return to children's education is lower for these families (Baland and Robinson, 2000). In this paper we identify a distinct mechanism which, operating through endogenous mortality risks, reduces the effective return to children's education for poorer households, thereby contributing to the persistence of child labor.

Following the current theoretical literature, we assume that supply decisions regarding child labor are taken by parents. There is no altruistic motive linking successive generations; instead, children are regarded as a source of current and future consumption by self-interested parents.[1] As children offsprings contribute to the family's income by working and as adults they provide old-age support to parents through an informal social security arrangement determined by social norms.

Since the decision regarding whether or not to send children to work is interrelated with the decision regarding their schooling hours, it essentially involves a trade-off for the parent. Sending a

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[1] Our model can be easily reinterpreted as one with 'warm glow' altruism where such parental altruism stems from being alive and witnessing a child's well-being; see Chakraborty and Das (2003).

child to work implies more current consumption but comes at the cost of lower future consumption since the offspring realizes lower income in adulthood. How parents evaluate this trade-off depends crucially on their rate of time preference. In our model adults face mortality risks which decrease their effective discount rates. We show that endogenous mortality can be instrumental in generating child labor traps by altering the incentive structure poorer parents face vis-à-vis relatively richer ones. Such traps become more pronounced when fertility decisions are also endogenous: poorer parents not only send their children to work, they also have a larger number of them, indicating a quantity-quality trade-off at work.

Child labor here arises from the interaction between parental income and preferences, working through endogenous mortality. Endogenous mortality is captured by postulating a positive relationship between the probability with which a parent survives into old age and health investment. Effectively this implies a positive correlation between income level and the rate of time preference. Lawrence (1991) and Samwick (1998) provide strong empirical evidence in favor of this hypothesis. Studies by Duraisamy (2002) and Beal (2001) similarly show that parental preferences play an important role in children's schooling decisions. Also in so far as parental health and mortality are affected by public health expenditure (e.g., sanitation, nutrition, vaccination and other forms of preventive and curative care), our model predicts a positive response of schooling to public health expenditure, a conclusion that finds empirical support in Cigno and Rosati (2001).

2 The Model

Consider an overlapping-generations economy where individuals potentially live for three periods, "childhood", "youth" (adulthood) and "old-age". While an individual lives for sure during the first two periods of her life, her survival into old-age is uncertain. Specifically, it depends upon her health status through appropriate investments undertaken in youth. A family unit comprises of children, young parents and possibly, grandparents.

Individuals are endowed with a single unit of time in childhood and youth. Each period ($t = 0, 1, 2, \dots \infty$) a unique perishable consumption good is produced using efficiency units of labor supplied by young parents and, in some cases, their children. Output per efficiency unit of labor is $\overline{w}$. At date 0, the initial young generation is born with a given distribution of human capital $\{e_0^i\}$.

Children can work and/or go to school. A young parent decides on the number of offsprings, whether or not to send them to work and concurrently how much to educate them. She also invests in her health which will determine her chance of living until old-age. Children are a form of consumption and investment good: working children supplement their parent's current income and also provide old-age support to their surviving parents on reaching adulthood. We posit a social convention, as exists in many developing societies, whereby each child transfers an α fraction of adulthood labor income to the parent in her old age.

At date t a representative young parent maximizes her expected lifetime utility over youthful (which subsumes children's consumption) and old-age consumption, (c_t^t, c_{t+1}^t),

$$u(c_t^t) + \beta\phi_t u(c_{t+1}^t),$$

$\phi_t \in [0,1]$ being the probability of surviving into old-age and $\beta \in (0,1)$ the subjective discount rate. We assume that utility from death equals zero and that u is concave and twice differentiable. An individual's chance of surviving into old age depends upon her health status h_t via an increasing concave function

$$\phi_t = \phi(h_t),\ \phi(0) = 0\,,\ \phi' > 0,\ \phi'' \leq 0.$$

The effective discount rate, $\beta\phi_t$, is evidently endogenous and plays a key role in explaining the existence and persistence of child labor in our model. Young parents are all alike except for their human capital, e_{t-1}.

Parents allocate their children's time between work and school. A parent who sends her children a fraction $e_t \in [0,1]$ of their time to school effectively chooses the remainder, $\ell_t = 1 - e_t$, that they work in the labor market. Children are, however, only $\gamma < 1$ times as productive as adult workers. The basic efficiency of an adult is 1, which may be augmented to $1+e$ through schooling investment e received as a child.

Giving birth to and rearing children is time intensive, requiring the parent to devote τ units of time on each child. She works for the remaining $1 - \tau n_t$ units of time, given her fertility choice n_t. A young parent faces the budget constraints

$$\begin{aligned} c_t^t &= \gamma\overline{w}(1-e_t)n_t + (1-\alpha)\overline{w}(1+e_{t-1})(1-\tau n_t) - h_t, \\ c_{t+1}^t &= \alpha\overline{w}(1+e_t)n_t, \end{aligned}$$

and inequality constraints requiring that[2]

$$0 \leq e_t \leq 1 \text{ and } n_t \geq 1.$$

The budget constraint in youth is written under the assumption that the grandparent is alive at t; we focus on this case without any loss of generality.

The Kuhn-Tucker necessary and sufficient first order conditions for (h_t, e_t, n_t) are

$$\begin{aligned} u'(c_t^t) &= \beta\phi'(h_t)u(c_{t+1}^t), & (1) \\ \gamma u'(c_t^t) &\geq \alpha\beta\phi(h_t)u'(c_{t+1}^t), & (2) \\ \left[(1-\alpha)\tau(1+e_{t-1}) - \gamma(1-e_t)\right]u'(c_t^t) &\geq \alpha\beta\phi(h_t)(1+e_t)u'(c_{t+1}^t), & (3) \end{aligned}$$

respectively. Inequality (2) implies that the marginal rate of intertemporal substitution has to be as large as the implicit return to educating children (R^e) if parents are to invest in their children's human capital,

$$\frac{u'(c_t^t)}{\beta\phi_t u'(c_{t+1}^t)} \geq \frac{\alpha}{\gamma} \equiv R^e.$$

[2] Children being the sole source of old-age consumption, parents desire a minimum of one child.

Likewise, from (3), we must satisfy

$$\frac{u'(c_t^t)}{\beta\phi_t u'(c_{t+1}^t)} \geq \frac{\alpha(1+e_t)}{\tau(1-\alpha)(1+e_{t-1})-\gamma(1-e_t)} \equiv R_t^n$$

at an interior fertility optimum, R_t^n being the return on the quantity of children. The numerator on the right hand side denotes the increase in old-age consumption that an additional child brings, while the denominator is the marginal cost of raising that child net of the incremental labor income he/she provides to the parent.

Optimal fertility and child-labor decisions clearly depend on returns to the quantity and quality of children. When $R^e > R_t^n$, quality investment dominates: parents educate their children but minimize on their number. Hence, $n_t = 1$ and $e_t > 0$.

When $R_t^n > R^e$, on the other hand, parents have more than one child but do not educate them at all, $e_t = 0$, or equivalently, their children work full-time, $\ell_t = 1$. Comparing the two returns, we note that this happens when parents are relatively poor, that is, *iff*

$$e_{t-1} \leq \underline{e} \equiv \frac{2\gamma}{(1-\alpha)\tau} - 1, \tag{4}$$

where we assume $2\gamma > (1-\alpha)\tau > \gamma$. Depending upon her human capital a parent thus invests in either quality or quantity.

To examine the intergenerational dynamics of child labor and education, we parameterize preferences by the CES utility function

$$u(c) = c^{1-\sigma},\ \sigma \in (0,1).$$

When returns to quality dominate ($R^e > R_t^n$), setting $n_t = 1$ in (1) and (2) and simplifying gives us

$$h_t = \frac{\gamma\varepsilon\overline{w}}{1-\sigma}(1+e_t) \equiv \overline{w}h(e_t), \tag{5}$$

where $\varepsilon \equiv h\phi'/\phi$ is the elasticity of the survival function.

The positive relationship between parental health status and children's education in (5) is at the heart of our explanation behind the prevalence and persistence of child labor in developing countries. Children provide means of consumption in adulthood as well as old-age. Healthier parents who expect to live longer behave more patiently, and are more willing to substitute toward old-age consumption. The way they do so is by investing in their children's future productivity. Consequently, parents who are very poor and unable to substantially improve their longevity, prefer their children to work over sending them to school.

Now using (5) in the Euler equation (2), we obtain

$$\alpha(1+e_t) = \left(\frac{\alpha}{\gamma}\right)^{1/\sigma} [\phi(h(e_t))]^{1/\sigma} \left[(1-\alpha)(1+e_{t-1})(1-\tau) + \gamma(1-e_t) - h(e_t)\right],$$

which traces the intergenerational evolution of education and child-labor for families with parental human capital exceeding $\underline{e}$. We rewrite it as

$$e_{t-1} = F(e_t) \tag{6}$$

where

$$\digamma(e) \equiv \frac{1}{(1-\alpha)(1-\tau)}\left\{h(e) + \left(\frac{\gamma}{\alpha}\right)^{1/\sigma}\left[\frac{\alpha(1+e)}{\phi\left(h(e)\right)^{1/\sigma}}\right]\right\} - 1.$$

It is easy to check that a sufficient condition for $\digamma$ to be increasing and concave is $\varepsilon < \sigma$. Under this assumption,[3] Q defined by $e_t = \digamma^{-1}(e_{t-1}) \equiv Q(e_{t-1})$ is a monotonically increasing convex mapping. To study the dynamics in terms of child labor, we rewrite (6) as

$$\ell_t = q(\ell_{t-1}), \tag{7}$$

for $\ell_{t-1} \leq 1 - \underline{e}$ and $q(\ell) \equiv 1 - Q(1-\ell)$, q being an increasing concave function.

Next consider lineages that do not invest in schooling as per (4). For these families, children work full-time. From (1) we now have

$$(c_t^t)^{-\sigma}\left[\tau(1-\alpha)(1+e_{t-1}) - \gamma\right] = \alpha\phi_t(c_{t+1}^t)^{-\sigma},$$

where the marginal cost of rearing children is assumed to exceed their immediate economic returns, that is, $\tau(1-\alpha) > \gamma$. Combining this with (3) above gives us

$$h_t = \varepsilon\overline{w}\mu_{t-1}n_t \equiv h(n_t; e_{t-1})$$

where $\mu_{t-1} \equiv (1-\alpha)(1+e_{t-1})\tau - \gamma$. Finally substituting this relationship into (1) leads to

$$\left[(\gamma - \varepsilon\mu_{t-1}) + (1-\alpha)(1+e_{t-1})\left(\frac{1}{n_t} - \tau\right)\right]\left[\alpha\phi\left(h(n_t; e_{t-1})\right)\right]^{1/\sigma} = \alpha(\mu_{t-1})^{-1/\sigma}.$$

This equation determines the optimal number of children n_t as a function of the parent's human capital e_{t-1}. Since parents with $e_{t-1} < \underline{e}$ do not educate their children at all, future generations of that lineage remain uneducated. Setting $e_{t-1} = 0$ above gives us the (time invariant) optimal fertility rate in these families for $t \geq 1$.

Turn now to the global dynamics of child-labor. The initial distribution $\{e_0^i\}$, in particular how a parent's human capital compares to $\underline{e}$ at $t = 0$, plays a central role. For $e_0^i > \underline{e}$, the dynamics follows equation (7) which can have a single or multiple steady-states. In Figure 1, the unique steady-state ℓ^* is asymptotically stable. In Figure 2, steady-states 0 and ℓ_2^* are stable, ℓ_1^* is not. If fertility were exogenous (that is, all parents had one child irrespective of e_0^i), global dynamics would follow equation (7) alone and we would obtain a high persistence of child-labor in Figure 2 compared to Figure 1. Though the incidence of child-labor does not completely disappear in Figure 1, parental investment in children's human capital is equalized across families. Figure 2, in contrast, points to threshold effects of parental income – some of the poorer households, those with human capital below $1 - \ell_1^*$, are unable to circumvent their initial disadvantage and continue to rely on child-labor in the long-run.

[3] This assumption is by no means necessary. For example, suppose that $\phi(h) = [h/(1+h)]^\eta$, $\eta \in (0,1)$, so that $\varepsilon = \eta/(1+h)$ is a decreasing function of health investment. Q is convex if $\eta < \sigma$. But even if $\eta > \sigma$, ε will eventually fall below σ for sufficiently high values of h, in which case Q is initially concave and then convex.

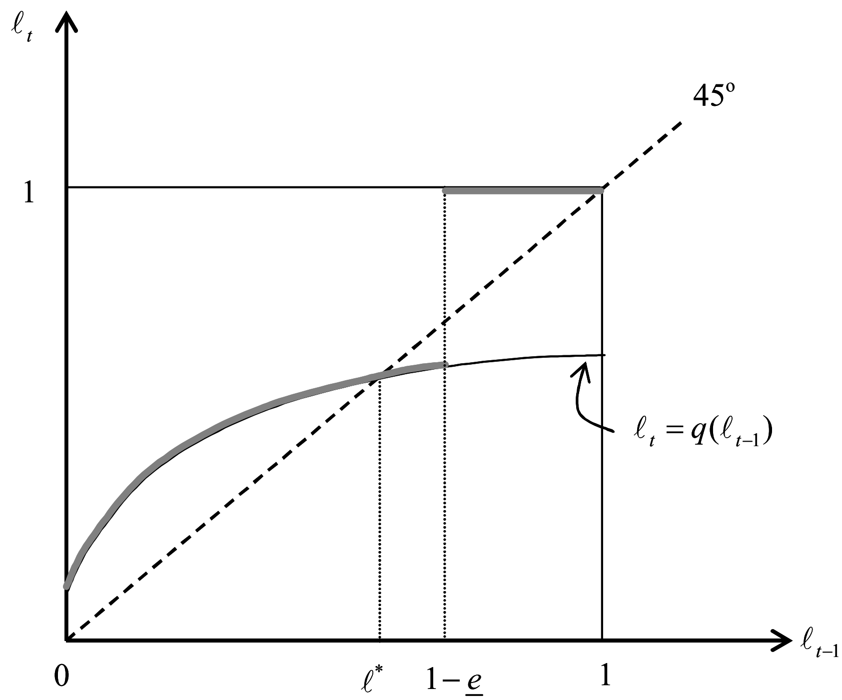

Figure 1: Child labor dynamics – some persistence

With endogenous fertility, the phase-map is portrayed by the discontinuous bold curve in the two figures. Child-labor may, interestingly, persist in both cases. Figure 1 is drawn under the assumption that $\ell^* < 1 - \underline{e}$: a second stable steady-state now appears at 1 to which families with $e_0^i < \underline{e}$ gravitate. In Figure 2, the two stable steady-states are now 0 and 1. Families converging to zero child-labor and full investment in children's quality start out with even higher initial human capital than $\underline{e}$, $e_0^i > 1 - \ell_1^* > \underline{e}$. For others, the long-run dynamics leads to zero quality investment, high fertility rate and full-time child labor. If $1 - \underline{e} > \ell_2^*$, instead, ℓ_2^* would act as yet another threshold. Note how fertility decisions exacerbate the problem as poorer households have a larger number of children who are also more likely to work.

Thus the effect of endogenous mortality, through parental discounting, is to encourage the persistence of child labor and underinvestment in human capital in poorer families. The persistence mechanism at work indicates the kind of interventions that may attenuate the problem. Although mortality here depends only on private health investment, public expenditures are also likely to significantly affect it. Indeed the dramatic global improvement in longevity since World War II may have indirectly led to declines in child labor incidence across the developing world. This mortality decline has occurred due to overall economic growth in some cases, but mostly through the wider availability, knowledge and public implementation of disease-control measures in developing countries. But despite such rapid declines (which have occurred primarily through infant and child mortality declines), adult mortality risks remain substantially high among poorer households in

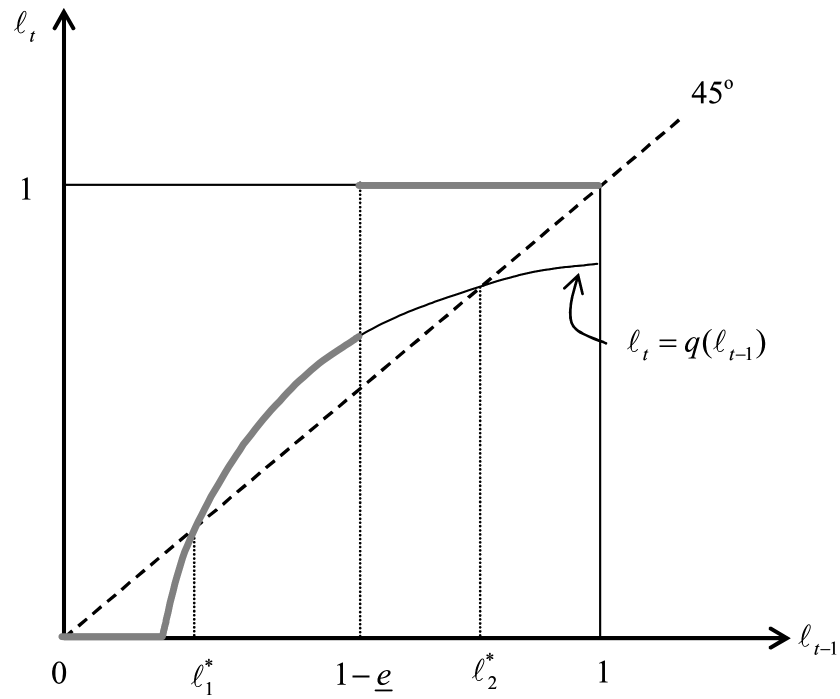

Figure 2: Child labor dynamics – high persistence

developing countries (World Bank, 1993).[4] Hence a suitably designed public health program can be an important policy instrument for the abolition of child labor.

Secondly, in so far as social customs and conventions in less developed societies entrust the male child with the responsibility of supporting parents in their old age, our model can explain why one typically observes gender discrimination in children's education in these societies. Since the return from educating a girl child is much lower (for instance, lower α), for the same level of parental health investment, one would expect more work for girls than for boys. Such work could take the form of labor market participation, or as is perhaps more common, caring for younger siblings and performing other household chores while the mother is at work outside the household.

Finally, our model suggests two reasons why one would expect the incidence of child labor to decline with economic development. First, technological changes associated with the process of development typically enhance the relative efficiency of skilled labor vis-a-vis unskilled labor, thereby increasing the return to children's education. Secondly, technological change associated with increased mechanization which requires longer and more intensive working hours can make child labor less productive relative to adult workers. Both effects can be interpreted as a decline in γ, which lowers the current benefits of working children and causes a substitution toward quality investment in children and a lower incidence of child labor. Concurrently, a lower γ lowers the threshold parental human capital $\underline{e}$ which plays an important role in generating the quality-

[4] Although we have abstracted from child mortality, it is clear that incorporating it would only reinforce the quantity-quality tradeoff and worsen child-labor problems.

quantity trade-off for poorer households. Similar dynamic relationships between the incidence of child labor and economic development has been modelled by Hazan and Berdugo (2002) who allow for endogenous technical progress.

3 Conclusion

Motivated by empirical evidence on the negative correlation between income levels and discount rates on the one hand, and adult mortality risks on the other, we have studied how endogenous parental discounting can explain the persistence of child labor in developing countries. The dynamic analysis presented here complements the works of Hazan and Berdugo (2002) and Emerson and Souza (2003) who provide alternative theoretical explanations for the intergenerational persistence of child labor.

In conclusion we note that our analysis implicitly relies upon a missing credit market, but one distinct from what Baland and Robinson (2000), Ranjan (2001) and Emerson and Souza (2003) point to. In particular, even if parents were able to borrow against their children's future earnings in our model, children's human capital will not necessarily converge across generations in the presence of mortality risks. This is true as long as children cannot credibly commit to repaying the debts of their prematurely deceased parents. Suppose a cohort faces the survival probability ϕ and the lending rate r (taken as given) in borrowing against their children's future labor income. If loans of the prematurely deceased ($1-\phi$ fraction of the cohort) cannot be repaid by their children, the effective lending rate r that each member of the cohort faces is related to the lenders' opportunity cost of funds ρ by: $1+r=(1+\rho)/\phi$ (under perfect competition). For a human capital technology yielding future labor income $\overline{w}\psi(e)$ for schooling investment e ($\psi(e)=1+e$ in the text), we must have $(1+r)\gamma=\alpha\psi'(e)$ in an interior optimum. Since r and ϕ are inversely related, this means that cohorts facing higher mortality risks will underinvest in their children's human capital. This is precisely what generates child-labor traps in our model.

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