Child Labor and Economic Development

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Abstract

The paper develops an overlapping generations model where the issue of child labor can be addressed in the short as well as in the long run. It also captures the transitional dynamics from the short to the long run. In this model parents are the decision-making unit and are altruistic towards their children. Since child labor is present only in developing countries, we use this model to show how the major features of underdevelopment, namely, backward technology, inefficiency of the education system, parental apathy etc. bind an economy in a child labor trap in the long run. The paper also seeks to derive the short run and long run implications of a minimum wage law, which applies to both adult and child workers. We find that, if the minimum wage rate is set above the long run free market steady state wage rate and the parents perceive the impact of the law on employment, the law eliminates child labor altogether in the long run. If, however, the wage rate is set below the steady state wage rate, there are multiple equilibria.

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1. Introduction

Child labor is present only in developing nations and it disappears once a nation achieves a certain degree of development. Information presented in Table 1, which shows how incidence of child labor has declined with economic development in different regions of the world, brings it out quite clearly. Hence it is important to examine the relationship between child labor and those aspects of an economy that are regarded as major indicators of underdevelopment. Recent literature on child labor, which has emerged following the controversy created by child labor standards, identifies parents' economic condition as the single most important causal factor responsible for child labor (see, for e.g., Basu and Van(1998) and Basu(1999)). It has not sought to go farther and link the incidence of child labor to the stage of economic development achieved by the economy. It is true that the low level of income of the parents is an important feature of underdevelopment, but it is by no means the only index. More importantly, it should be regarded as an endogenous variable at least in the long run. One important purpose of this paper therefore is to explain the incidence of child labor in the long run in terms of certain important features of development, which are responsible for both low levels of parents' income and child labor. In this sense the paper seeks to generalize one major result of the recent theoretical literature and thereby tries to remove a major gap.

Child labor is obviously undesirable. Every child should get the opportunity to develop all her/his faculties to the fullest possible extent. However, as many

Table 1

Participation Rates for Children, 10-14 Years

	1950	1960	1970	1980	1990	1995	2000	2010
World	25.57	24.81	22.30	19.91	14.65	13.02	11.32	8.44
Africa	36.06	35.88	33.05	30.97	27.87	26.23	24.92	22.52
Asia	36.06	32.26	28.35	23.42	15.19	12.77	10.18	5.60
Europe	6.49	3.52	1.62	0.42	0.10	0.06	0.04	0.02

Source: ILO (1996)

writers have argued, see, for e.g., Ranjan(1999), Basu and Van (1998), among others, a ban on child labor may be counter-productive. Under these circumstances it may be advisable to search for an alternative policy measure. This paper takes such a course and examines the impact on child labor of a minimum wage law that is applicable to both adult and child labor. It finds that, when parents perceive the impact of the minimum wage law on unemployment, the law removes the incidence of child labor altogether in the long run if the minimum wage is set above the long run free market steady state wage rate. If, however, the minimum wage rate is set below this steady state wage rate, there are multiple equilibria.

The present paper develops a simple overlapping generations model where parents are altruistic towards their children. Glomm (1997) has also used an overlapping generations model with altruistic parents, but he has focused only on the relative efficacies of private and public investment in human capital formation. Ranjan (2001) also uses an overlapping generations model with altruistic parents, but his focus is on the relationship between inequality and the incidence of child labor and the evolution of inequality over time. This paper, however, abstracts from the problem of inequality, assumes all individuals to be identical and seeks to relate the problem of child labor to the major features of underdevelopment.

This paper is arranged as follows. Section 2 develops the model and derives the conditions under which an economy gets caught in a child labor trap in the long run. Section 3 examines the implications of the minimum wage law, while the final section contains the concluding remarks.

2.Model

The model consists of a large number of identical households and firms. Firms produce a single good with only one input, labor. Households use it only for purposes of consumption. There is no physical capital in the model. Markets for both this consumption good and labor are assumed to be perfectly competitive. The only qualification is that here the number of firms existing in the economy is assumed to be fixed. This implies that there may exist positive profit or loss even in the long run. This assumption is made just for simplicity and without any loss of generality. It allows us to examine the implications of the minimum wage law in the simplest possible framework. Thus firms and households are price takers in both the markets.

Household

As we have already mentioned, there are a large number of identical households. Each household consists only of two members, one parent and one child. Each member lives for two periods. In the first period of an individual's life, he is a child. In the second period, he is a parent. An individual spends a part of the first period of his life in schools and works in the remaining part. He spends the whole of the second period of his life working. In any given period in a representative household, the parent is the decision-making unit. He is assumed to be altruistic. He supplies inelasticity the whole of his labor endowment and decides on how much time or labor the child will devote to current production and how much to schooling. In this model, it is assumed for simplicity and without any loss of generality that there is no child labor if the child is allowed to spend the whole of the first period of his life in schools. Accordingly, we measure the incidence of child labor in terms of how much time or labor endowment the child devotes to schooling. The greater the proportion of time or labor endowment the child devotes to schooling, the less is the incidence of child labor. In this model the household does not save.

Here we also assume for simplicity that there is no cost of schooling other than the amount of current production foregone. There is no population growth. Households do not save and the economy produces a single consumption good, which is treated as the numeraire. We also postulate that both the parent and the child supply labor of the same quality.

In any period, t, the parent in the representative household maximizes the following utility function, which for simplicity is assumed to be separable and additive.

$$\log C_t + \phi \log h_{t+1}; \quad \phi > 0 \tag{1}$$

where $C_t \equiv$ consumption of the household in period t, $h_{t+1} \equiv$ human capital of the child of period t in period t+1,and $\phi \equiv$ a shift parameter, which measures the parent's attitude or the degree of altruism towards the child.

$$C_t = W_t L_t + \Pi_t \tag{2}$$

where $W_t \equiv$ wage rate in period t, $L_t \equiv$ amount of labor supplied by the household in period t and $\Pi_t \equiv$ profit income of the household in period t. Value of h_{t+1} is given by the following human capital formation function:

$$h_{t+1} = (1+\delta)\alpha_t + 1;\ 0 \le \alpha_t \le 1 \text{ and } \delta > 0 \qquad (3)$$

Let us explain eq. (3). Labor endowment of the child is assumed to be unity. α_t denotes the proportion of labor endowment devoted by the child in period t to schooling and δ, which measures the efficiency of schooling is a constant. For simplicity we have not introduced either the parent's human capital or the aggregate stock of human capital in period t as an argument in the human capital formation function. Equation (3) does not contain any mechanism to generate externality or endogenous growth. From eq. (3) it follows

$$L_t = LF_t + (1-\alpha_t) \qquad (4)$$

where $LF_t \equiv$ labor endowment of the parent in period t and $(1-\alpha_t)$ gives the proportion of labor endowment or amount of labor devoted by the child to current production in period t.

Again, from eq. (3) and eq. (4) it follows that

$$LF_t = \alpha_{t-1}(1+\delta) + 1 + B;\ B > 0 \text{ and } 0 \le \alpha_{t-1} \le 1 \qquad (5)$$

where α_{t-1} gives the amount of labor devoted by the child in period (t - 1) to schooling and B gives the amount of labor that an unskilled parent can supply over and above the unit amount of labor that an unskilled child can supply in one period if they work over the whole period. However, for simplicity and without any loss of generality we shall henceforth assume B to be equal to zero. Using equations

(2), (3), (4) and (5), the parent's maximization exercise in period t may be rewritten as

$$\max_{\alpha_t}[\log(W_t.\{\alpha_{t-1}(1+\delta)+1+(1-\alpha_t)\}+\Pi_t)+\phi\log(1+\alpha_t(1+\delta))]$$

s.t.

$$0 \le \alpha_t \le 1, 0 \le \alpha_{t-1} \le 1$$

First order condition for maximization, when there is an interior solution, is given by

$$(W_t.\{\alpha_{t-1}(1+\delta)+1+(1-\alpha_t)\}+\Pi_t)^{-1}.W_t = \phi(\alpha_t(1+\delta)+1)^{-1}.(1+\delta) \tag{6}$$

If, however, the solution of α_t as yielded by eq.(6) for the given value of α_{t-1} exceeds 1 (falls short of 0), we have a corner solution and the solution is 1(the solution is 0). Given (1), the second order condition for maximization is satisfied. When there is an interior solution, we can solve eq. (6) for the optimum value of α_t as a function of α_{t-1}, δ, ϕ and Π_t.

$$\alpha_t = \tilde{\alpha}(\Pi_t, \alpha_{t-1}, \delta, \phi) \tag{7}$$

From equations (4), (5), and (7) we get the labor supply function of the household in period t. Thus

$$L_t = [1+\alpha_{t-1}(1+\delta)]+\{1-\tilde{\alpha}(.)\} \tag{8}$$

Firm

There are a large number of identical firms. Each firm produces the same good with only labor. The production function of the representative firm is given by

$$Q = L^{\beta}; \beta \in (0,1) \tag{9}$$

where $Q \equiv$ amount of the good produced and $L \equiv$ amount of labor employed by the firm. The firm maximizes profit as shown below:

$$\max_{L_t} \Pi_t = L_t^{\beta} - W_t L_t \tag{10}$$

First order condition for profit maximization is given by

$$\beta L_t^{\beta-1} = W_t \tag{11}$$

From eq. (11) we get the labor demand function. Denoting labor demand in period t by L_{dt}, we get

$$L_{dt} = g(W_t, \beta) \equiv \left[\frac{1}{W_t}\beta\right]^{\frac{1}{1-\beta}} \;;\; g_1 < 0 \text{ and } g_2 > 0 \quad \text{(see eq.(9))} \tag{12}$$

Substituting eqs. (10) and (12) into eq. (8) and using eqs. (12), (4) and (5), we can write the labor market equilibrium condition as

$$1 + \alpha_{t-1}.(1+\delta) + \{1 - \widetilde{\alpha}([g(W_t, \beta)]^{\beta} - W_t.g(W_t, \beta), \alpha_{t-1}, \delta, \phi)\} = g(W_t, \theta)$$

Walras' law holds in our model. Substituting eq.(10) into eq. (2), we get

$$C_t = W_t L_t + Q_t - L_{dt} W_t \Rightarrow (C_t - Q_t) + W_t(L_{dt} - L_t) = 0$$

The above equation gives the Walras' law. Hence labor market equilibrium implies goods market equilibrium. Therefore the labor market equilibrium condition gives the short run equilibrium condition, i.e., equilibrium condition in any given period, in our model. Alternatively, the short run equilibrium condition may be derived as follows. Substituting into eq. (6) equilibrium values of W_t and Π_t as given respectively by equations (11) and (10) and the value of L_t as given by equations (4) and (5), we get

$$[\{1+(1+\delta)\alpha_{t-1}+(1-\alpha_t)\}^{\beta}]^{-1}\beta\{1+(1+\delta)\alpha_{t-1}+(1-\alpha_t)\}^{\beta-1}$$
$$=\{1+(1+\delta)\alpha_t\}^{-1}(1+\delta)\phi \Rightarrow$$

Determination of the Equilibrium Value of α_t, given α_{t-1}

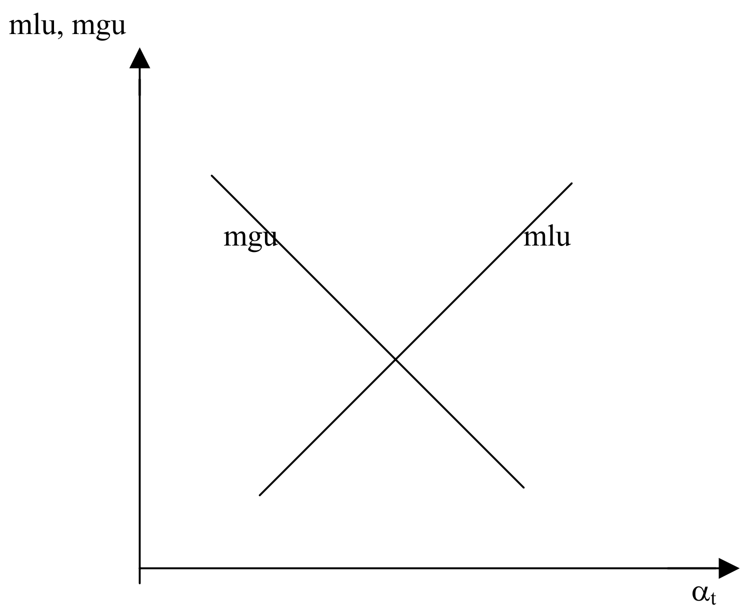

Figure 1

$$\beta\{1+(1+\delta)\alpha_{t-1}+(1-\alpha_t)\}^{-1} \equiv \left\lfloor \beta\{LF_t+(1-\alpha_t)\}^{-1} \right\rfloor \\ = \{1+(1+\delta)\alpha_t\}^{-1}(1+\delta)\phi \tag{13}$$

Eq.(13) gives the short run equilibrium condition of our model, i.e., the equilibrium condition in any given period. We can solve eq. (13) for the short run equilibrium value of α_t as a function of $[1+\alpha_{t-1}(1+\delta)]$ $(\equiv LF_t), \delta, \beta$ and ϕ. The solution of eq. (13) is shown graphically in Figure 1 where mlu and mgu schedules represent the LHS and RHS of eq. (13) respectively. In Figure 1 mlu schedule or the LHS of eq. (13) gives the amount of loss in utility due to the fall in C_t following a unit increase in α_t. We call this marginal loss in utility or mlu due to a unit increase in α_t. The slope of the mlu schedule is quite self-evident. Again, the RHS of eq. (13) or the mgu schedule gives the amount of increase in household's utility due to the rise in h_{t+1} brought about by a unit increase in α_t. We refer to this as the marginal gain in utility or mgu of a unit increase in α_t. Obviously, the short run equilibrium value of α_t corresponds to the point of intersection of mgu and mlu schedules. Let us now solve eq.(13) mathematically for the equilibrium value of α_t. From eq.(13) we get

$$\frac{1+(1+\delta)\alpha_t}{1+(1+\delta)\alpha_{t-1}+(1-\alpha_t)} = \frac{(1+\delta)\phi}{\beta}$$

or,

$$\alpha_t = \frac{\phi}{\phi+\beta}(1+\delta)\alpha_{t-1} + \frac{\phi}{\phi+\beta}\left[2-\frac{\beta}{(1+\delta)\phi}\right] \equiv \alpha(\alpha_{t-1}) \tag{14}$$

Eq.(14) is a linear first-order difference equation. Let us therefore derive the conditions under which it will have a unique and stable steady state. Now, $\alpha(.)$ is continuous and differentiable over the domain $\alpha_{t-1} \in [0,1]$. Therefore it will have a unique and stable interior fixed point if $0 < \alpha(0) < 1$, $0 < \alpha' < 1$ and $\alpha(1) < 1$. From eq.(14) we get

$$\alpha(0) = \frac{\phi}{\phi+\beta}\left[2-\frac{\beta}{(1+\delta)\phi}\right]$$

Therfore

$$\alpha(0) > 0 \Leftrightarrow 2 > \frac{\beta}{(1+\delta)\phi} \Leftrightarrow \phi > \frac{\beta}{2(1+\delta)} \tag{15}$$

Again,

$$\alpha(0) < 1 \Leftrightarrow \frac{\phi}{\phi+\beta}\left[2-\frac{\beta}{(1+\delta)\phi}\right] < 1 \Leftrightarrow \phi < \beta\left(\frac{1}{1+\delta}+1\right) \tag{16}$$

From (15) and (16) it follows that

$$0 < \alpha(0) < 1 \text{ if and only if } \frac{\beta}{2(1+\delta)} < \phi < \beta\left(\frac{1}{1+\delta}+1\right) \tag{17}$$

Now,

$$0 < \alpha' < 1 \Leftrightarrow \frac{\phi}{\beta+\phi}(1+\delta) < 1 \Leftrightarrow \phi < \frac{\beta}{\delta} \tag{18}$$

$$\alpha(1) < 1 \Leftrightarrow \frac{\phi}{\beta+\phi}\left[\left(2-\frac{\beta}{(1+\delta)\phi}\right)+(1+\delta)\right] < 1 \Leftrightarrow \phi < \beta\left(\frac{1}{1+\delta}\right) \tag{19}$$

If ϕ satisfies (19), it automatically satisfies (18) $(\because (1+\delta) > \delta)$ and (16) $(\because [(1/1+\delta)+1] > (1/1+\delta))$. Therefore if $[\beta/2(1+\delta)] < \phi < [\beta/(1+\delta)]$, then $0 < \alpha(0) < 1$, $0 < \alpha' < 1$ and $\alpha(1) < 1$. From the above it follows

Derivation of the Steady State Value of α

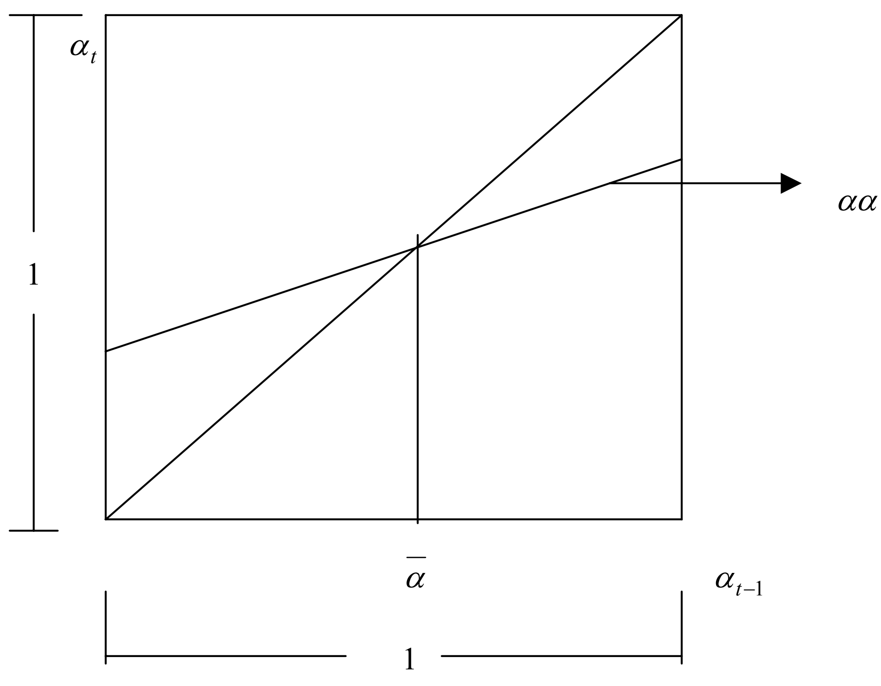

Figure 2

Remark 1: If $[\beta/2(1+\delta)] < \phi < [\beta/(1+\delta)]$, $\alpha(.)$ will have a unique and stable interior fixed point.

The situation is shown in Figure 2, where $\alpha\,\alpha$ represents $\alpha(.)$ in the (α_{t-1}, α_t) plane. Let us now derive the steady state value of α. Denoting it by $\overline{\alpha}$ and substituting it in eq. (14), we get

$$\overline{\alpha} = \frac{\phi}{\beta - \phi\delta}\left[2 - \frac{\beta}{(1+\delta)\phi}\right] \tag{20}$$

The steady state value of α is unique and globally stable. From eq. (20) it is clear that parent's economic condition is not a determinant of the incidence of child labor in the long run. Obviously, parent's economic condition is itself an endogenous variable in the long run. From eq. (20) we find that in the long run the determinants of child labor are δ, β and ϕ.

Economic Development and Child Labor

We shall here carry out a few comparative dynamic exercises. More precisely, we shall examine how δ, β and ϕ, which are all important indicators of development affect the incidence of child labor in the short and the long run.

Parent's Economic Condition

Parent's economic condition measured by LF_t in this model may be regarded as exogenous only in the short run, i.e., only in a given period. It is obviously endogenous in the long run. Therefore we can examine the impact of an increase in LF_t in the short run only. It is clear from eq.(13) that an increase in LF_t, given all other variables, leaves its RHS unaffected, but lowers the LHS. This implies that at the initial α_t, marginal reward of sending children to school remains unchanged, but its marginal cost falls. This obviously induces parents to increase α_t. The fall in marginal cost of schooling is due to diminishing marginal utility of the parents from household's income. In terms of Figure 1 following an increase in LF_t mlu schedule shifts downward, while mgu schedule remains unaffected. This leads to the following proposition:

Proposition 1: An improvement in parents' economic condition will reduce the incidence of child labor in the short run. In the long run, however, parent's economic condition is itself an endogenous variable and therefore cannot be regarded as a determinant of the incidence of child labor.

The first part of the above result is perfectly in accord with the results derived by Basu and Van (1998) and Ranjan (1999), among others.

Parental Altruism and Child Labor

Consider now the effect of an increase in ϕ. Focus on the short run first. From eq. (14) it is clear that an increase in ϕ implies an increase in the value of α_t, given the value of α_{t-1}. This result may be explained with the help of Figure 1. An increase in ϕ raises the value of the marginal gain from the child's education as measured by the RHS of eq.(13), given the value of α_t. It, however, leaves the LHS, which measures the marginal cost of sending the child to school unaffected. Therefore the mgu schedule in Figure 1 shifts upward, while the mlu schedule remains unaffected. Thus at the initial equilibrium value of α_t marginal gain of sending children to school exceeds its marginal cost inducing the parent to increase α_t.

From the above it follows that, following an increase in ϕ, $\alpha\,\alpha$ schedule in Figure 1 will shift upward bringing about an increase in $\bar{\alpha}$. This result follows straightway from eq.(20) also. It is clear from Figure 2 that, following an increase in ϕ, α will rise steadily from its initial steady state value to its new steady state value. This leads to the following proposition:

Proposition 2: An increase in ϕ, which measures parental altruism towards children will reduce the incidence of child labor in both the short and the long run.

Efficiency of the Education System and Child Labor

Let us now examine the effect of an improvement in the efficiency of the education system, which in our model implies an increase in δ, on the incidence of child labor in the short and the long run. Let us focus on the short run first, i.e., let us first examine how an increase in δ affects the equilibrium value of α_t, given α_{t-1} in period t. It is quite clear from eq. (14) that an increase in δ leads to an increase in the equilibrium value of α_t, corresponding to any given value of α_{t-1}. This is the short run implication.

The long run implication can easily be derived with the help of Figure 2. In terms of Figure 2, an increase in δ brings about an upward shift in the $\alpha\,\alpha$ schedule. Hence the steady state value of α rises. This is obvious from eq. (20)

also. Therefore following an increase in δ, as must be clear from Figure 2, incidence of child labor as measured by α will rise steadily from its initial steady state value to its new steady state value. Thus we get the following proposition.

Proposition 3: An improvement in the efficiency of schooling will reduce the incidence of child labor both in the short and the long run.

This result may be explained with the help of eq.(13) and Figure 1. An increase in δ, given all other variables, lowers the value of the LHS of eq. (13) due to diminishing marginal utility of the parent from household income. Therefore marginal return from sending the child to school falls and mlu schedule in Figure 2 shifts downward. On the other hand, the value of RHS rises by $\left(1/\widetilde{B}\right)\phi\left[1-\left\{\left(\widetilde{B}-1\right)/\widetilde{B}\right\}\right]d\delta > 0$, where $\widetilde{B} \equiv 1+\left(1+\delta\alpha_t\right)$. This indicates that a rise in δ raises the marginal return from schooling. Accordingly, mgu schedule in Figure 1 shifts upward. Thus mlu becomes less than mgu at the initial equilibrium value of α_t inducing the parent to raise α_t. This explains the result.

Technology and Child Labor

Here we shall examine the impact of an improvement of technology on child labor. This in our model we can capture through an increase in β. It follows straight from eq.(14) that an increase in β lowers the equilibrium value of α_t, given α_{t-1}. Thus in the short run it raises the incidence of child labor.

We can examine the long run implication with the help of figure 2 where, as follows from above, $\alpha\,\alpha$ schedule shifts downward and hence the steady state value of α falls following an increase in β. One can also derive this from eq. (20). From Figure 2 it is clear that the equilibrium value of α will fall steadily from its initial steady state value to its new steady state value. This gives us the following proposition:

Proposition 4: Technological improvement will lead to an increase in the incidence of child labor in both the short and the long run.

This result may be explained with the help of eq.(13) and Figure 2. From eq. (13) it follows that an increase in β, given all other variables, raises the LHS, which measures the marginal cost of sending the child to school. But marginal gain from the child's education as given by the RHS remains unaffected. In terms of Figure 2 the mlu schedule shits upward, but the mgu schedule remains unchanged. Thus at the initial equilibrium value of α_t, mgu falls short of mlu. Accordingly, the parent reduces α_t. This explains our result.

In course of development, parents' attitude towards their children changes. They derive more pleasure from and take greater interest in their children's education. Efficiency of the education system also increases steadily. These changes, as we have seen in our paper tend to reduce the incidence of child labor. However, along with the events noted above, there also takes place steady improvement in technology, which by raising marginal productivity of labor makes it costlier for the parents to send their children to school. However, as experiences of different countries show, the effect of the first two changes dominates over that of the third one and the incidence of child labor falls steadily with economic development.

Propositions 2,3 and 4 yield the final proposition of this section.

Proposition 5: Given the level of technology, if parents' are not sufficiently altruistic towards their children and the education system is not sufficiently

efficient, the economy will be caught in a child labor trap in the long run. If in course of development parental attitude towards children and efficiency of the education system improve at a sufficiently faster rate than technology, incidence of child labor will fall steadily over time.

3. Wage Policies and Child Labor

When a ban on child labor is inadvisable, the government can extend the scope of the minimum wage law to include child labor as well to protect them from exploitation. Here we examine the implications of such a law for child labor. Basu (2000) has explored the relationship between minimum wage law for adult workers and the incidence of child labor in the short run. He has found the impact of the law to be ambiguous. In his model, incidence of child labor is a decreasing function of parents' income. Minimum wage law for adult workers tends to make parents better off by raising the wage rate. At the same time it creates unemployment among adult workers. Therefore parents' income may change either way. This explains the result.

In this paper, however, we seek to examine the impact of a minimum wage law, which applies to adult labor as well as to child labor. Here we consider the case where we assume that parents perceive the impact of the minimum wage law on employment. The assumption may be justified on following grounds. If minimum wage law causes persistent unemployment – which it certainly will, if it is effective- then even if parents fail to identify the cause of unemployment, they will find it difficult to find jobs for their children. It is therefore quite likely that they will incorporate this in their optimizing decision. Not only that, in poor countries poor households operate in unorganized labor markets, which are characterized by the dominance of casual labor and a high degree of labor turnover. In such a scenario if there is unemployment, almost every household will share it. For example, if unemployment rate is ten percent, most of the households will not find work on ten per cent of the days on which they are willing to work. In these circumstances, in the face of persistent unemployment it only seems reasonable that the altruistic parents on the average will take this phenomenon of unemployment into account while deciding on their children's education. Let us therefore examine the implications of the minimum wage law when parents realize that at the stipulated wage rate they are quantity constrained in the labor market. We have modeled the optimization exercise of the parents in this situation following the line suggested by studies belonging to the so-called "disequilibrium" or "fixed price" macroeconomics such as Clower (1967), Barro and Grossman (1976), Malinvoud (1977), Benassy (1982) and others. In the absence of the minimum wage law, i.e., in the free market situation eq.(13) yields the short run equilibrium value of α_t, given α_{t-1}, ϕ, δ and other exogenous variables, when there is an interior solution. This short run equilibrium value of α_t is given by $\alpha(\alpha_{t-1})$- see eq.(14). Accordingly, short run equilibrium values of L_t and W_t that prevail in the absence of the minimum wage law are given by $[1+\alpha_{t-1}(1+\delta)+(1-\alpha(\alpha_{t-1}))](\equiv L(\alpha_{t-1}))$ and $\beta(1+\alpha_{t-1}(1+\delta)+(1-\alpha(\alpha_{t-1})))^{\beta-1}(\equiv W^*)$ respectively (see eq. (11), eq. (4) and eq. (5)). Suppose the minimum wage stipulated by the government is denoted by $\overline{W}$. We assume that for some given t, $\overline{W}$ > W^*

$= \beta(1+\alpha_{t-1}(1+\delta)+(1-\alpha(\alpha_{t-1})))^{\beta-1}$. Under the minimum wage law, given the assumptions, the parent's maximization exercise in the short run, i.e., in any given period reduces to

$$\max_{\alpha_t}[U(W_t.\{\alpha_{t-1}(1+\delta)+1+(1-\alpha_t)\}+\Pi_t)+\overline{U}(1+\alpha_t(1+\delta),\phi)] \tag{21}$$

s.t.

$$[(1+\alpha_{t-1}(1+\delta)+(1-\alpha_t)] \le g(\overline{W},\beta)$$
and (see eq. (12)
$$0 \le \alpha_t \le 1$$

First order condition for the above maximization exercise, in case there is an interior solution, is given by eq. (6). In equilibrium the above first order condition reduces to eq.(13). We know that the value of α_t that satisfies eq. (13) is $\alpha(\alpha_{t-1})$.

Since by assumption, in the period under consideration, $\overline{W} >$ W* and $g_1 < 0$ - see eq.(12)- labor supply at W* as given by

$$[1+\alpha_{t-1}(1+\delta)+1+(1-\alpha(\alpha_{t-1}))] > g(\overline{W},\beta) \tag{22}$$

Therefore in equilibrium in the given period the above optimization exercise does not have an interior solution and by Kuhn-Tucker condition the value of α_t that satisfies the parent's optimization exercise in the given period is given by

$$[1+\alpha_{t-1}(1+\delta)+1+(1-\alpha_t)] = g(\overline{W},\beta) \tag{23}$$

From eq.(23) and (22) it follows that

$$\alpha_t = 2+\alpha_{t-1}(1+\delta)-g(\overline{W},\beta) > \alpha(\alpha_{t-1}) \tag{24}$$

Eq.(24) gives the optimum value of α_t as long as the value of α_t that satisfies the above equation is less than or equal to unity. If the value of α_t that satisfies the above equation is greater than unity, then by Kuhn-Tucker condition the optimum value of α_t is unity. From this we get the following proposition:

Proposition 6: **When minimum wage law applies to both adult and child workers and parents perceive its impact on employment, the law induces the parents to step up investment in human capital reducing the incidence of child labor in the short run, i.e., in any given period.**

The intuition behind proposition 6 is quite simple. Since minimum wage law creates unemployment of child labor as well, the cost of sending children to school declines. This induces altruistic parents to do all the work that is available and send the unemployed children to schools. This raises investment in human capital formation and lowers the incidence of child labor in the short run.

Let us now focus on the long run. Suppose the government stipulated minimum wage rate denoted by $\overline{W}$ is greater than the steady state wage rate, which is given by the expression, $\beta(1+\overline{\alpha}(1+\delta)+(1-\alpha(\overline{\alpha})))^{\beta-1}(\equiv W^s)$ (see eq. (11), eq. (4) and eq. (5)). Let us consider the short run equilibrium pair $(\alpha_{t-1}^0, \alpha_t^0)$corresponding to which the short run equilibrium $W = \overline{W}$, i.e., $\beta(1+\alpha_{t-1}^0(1+\delta)+(1-\alpha_t^0))^{\beta-1} = \overline{W}$. Now consider the schedule $\alpha\alpha$ in Figure 3. This is the same $\alpha\alpha$ schedule of Figure 2. Since the slope of $\alpha\alpha$ - see Figure 2 - given by α' is less than unity, see eq.(14), short run equilibrium value of L_t $[= (\alpha_{t-1}(1+\delta)+1+(1-\alpha(\alpha_{t-1})))]$ rises as α_{t-1} and α_t increase along $\alpha\alpha$. Since equilibrium value of W_t is given by $\beta(1+\alpha_{t-1}(1+\delta)+(1-\alpha(\alpha_{t-1})))^{\beta-1}$, there is diminishing marginal productivity of labor. Therefore short run equilibrium value of W_t falls as we move upward along

$\alpha\alpha$. This together with the assumption that $\overline{W} > W^s$ implies that $\left(\alpha_{t-1}^0, \alpha_t^0\right) < \overline{\alpha}$. Thus, as shown in Figure 3, $\left(\alpha_{t-1}^0, \alpha_t^0\right)$ will be to the left and below ($\overline{\alpha}$, $\overline{\alpha}$) on $\alpha\alpha$.

Under minimum wage law the optimization exercise of the parent is given by (21). When the optimization exercise has an interior solution, the first order condition for maximization in equilibrium is given by eq.(13). Given our assumption about $\overline{W}$, we know that, for all $\alpha_{t-1} < \alpha_{t-1}^0$, (21) has an interior solution. Hence for $\alpha_{t-1} < \alpha_{t-1}^0$, short run equilibrium combinations of α_t and α_{t-1} under minimum wage law are given by $\alpha\alpha$ schedule in Figure 3.

However, for $\alpha_{t-1} \geq \alpha_{t-1}^0$, (21) does not have an interior solution. Therefore for $\alpha_{t-1} \geq \alpha_{t-1}^0$, as we have already shown, short run equilibrium combinations of α_t and α_{t-1} under the minimum wage law are given by the equation

$$[1 + \alpha_{t-1}(1+\delta) + 1 + (1-\alpha_t)] = g(\overline{W}, \beta)$$

or by the equation

$$\beta(1 + \alpha_{t-1}(1+\delta) + (1-\alpha_t))^{\beta-1} = \overline{W}$$

$$= \beta(1 + \alpha_{t-1}^0(1+\delta) + (1-\alpha_t^0))^{\beta-1}; \alpha_{t-1}^0, \alpha_t^0 < \overline{\alpha}$$

i.e. by

$$[1 + \alpha_{t-1}(1+\delta) + 1 + (1-\alpha_t)] = (1 + \alpha_{t-1}^0(1+\delta) + (1-\alpha_t^0)) \tag{25}$$

Derivation of the Steady State Value of α Under Minimum Wage Law

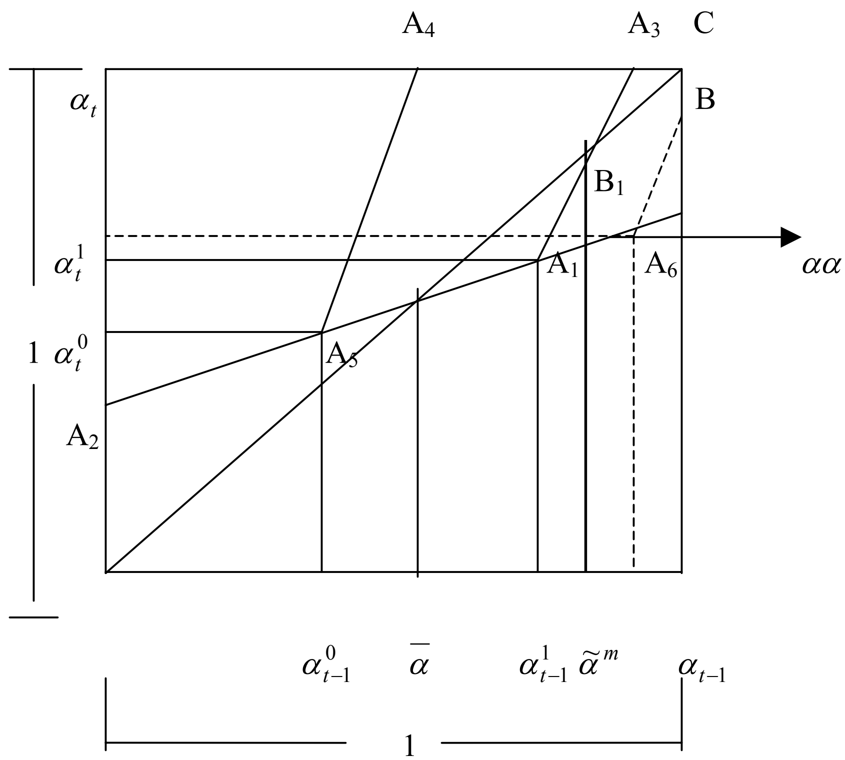

Figure 3

for $0 \le \alpha_{t-1} \le 1$, $0 \le \alpha_t \le 1$. If for any $0 \le \alpha_{t-1} \le 1$, optimum value of α_t, as given by eq. (25), is greater than 1 (less than zero), the optimum α_t is equal to 1 (zero). These optimum combinations of α_{t-1} and α_t are represented by the curve $A_5A_4A_3C$, which starts from the point $(\alpha_{t-1}^0, \alpha_t^0)$ on $\alpha\alpha$ in Figure 3. The curve $A_5A_4A_3C$ shows that the equilibrium value of α_t becomes unity before α_{t-1} becomes unity. This point may be explained as follows. From eq.(25) it follows that $(d\alpha_t / d\alpha_{t-1}) > 1$. Again, $\alpha_t^0 > \alpha_{t-1}^0$. These two facts imply that α_t, according to eq.(25), will be unity at a $\alpha_{t-1} < 1$. Let us denote this α_{t-1} by $\tilde{\alpha}_{t-1}$. For all α_{t-1} such that $\tilde{\alpha}_{t-1} \le \alpha_{t-1} \le 1$, $\alpha_t = 1$. This explains the position of $A_5A_4A_3C$. Thus the locus of all the short run equilibrium combinations of α_{t-1} and α_t in the present case is given by the curve $A_2A_5A_4A_3C$ in Figure 3. Therefore in this case there is only one steady state, C (see Figure 3) and this steady state is stable. Thus we get the following proposition:

Proposition 7: **If the minimum wage rate is set above the long run free market steady state wage rate that prevails in the absence of the minimum wage law, the value of α in the long run will settle down to unity eliminating child labor.**

Let us now consider the case where the minimum wage rate, $\overline{W} < W^s$. Let us consider the short run equilibrium pair $(\alpha_{t-1}^1, \alpha_t^1)$ corresponding to which the equilibrium $W = \overline{W}$, i.e., $\beta(1 + \alpha_{t-1}^1(1+\delta) + (1-\alpha_t^1))^{\beta-1} = \overline{W}$ (see eq. (4), eq. (5) and eq. (11)). We have already shown that, since $\alpha' < 1$ along $\alpha\alpha$ in Figure 2 or 3 (see eq.(14)), short run equilibrium value of L_t rises and therefore that of

W_t falls as α_{t-1} and α_t increase along $\alpha\alpha$. Therefore, since $\overline{W} < W^s$, $\left(\alpha_{t-1}^1, \alpha_t^1\right)$ $> \left(\overline{\alpha}, \overline{\alpha}\right)$. From the above it follows that, for $\alpha_{t-1} < \alpha_{t-1}^1$ optimization exercise, (21), has an interior solution in equilibrium. Therefore for $\alpha_{t-1} < \alpha_{t-1}^1$, short run equilibrium value of α_t continues to be given by $\alpha\alpha$.

However, for $\alpha_{t-1} \geq \alpha_{t-1}^1$, there does not exist any interior solution in equilibrium. Therefore for $\alpha_{t-1} \geq \alpha_{t-1}^1$, short run equilibrium combinations of α_{t-1} and α_t under minimum wage law, by Kuhn-Tucker condition, are given by

$$\beta(1+\alpha_{t-1}(1+\delta)+(1-\alpha_t))^{\beta-1} = \overline{W} \Rightarrow$$

$$\beta(1+\alpha_{t-1}(1+\delta)+(1-\alpha_t))^{\beta-1} = \beta(1+\alpha_{t-1}^1(1+\delta)+(1-\alpha_t^1))^{\beta-1}; \alpha_{t-1}^1, \alpha_t^1 > \overline{\alpha}$$

i.e., by

$$(1+\alpha_{t-1}(1+\delta)+(1-\alpha_t)) = (1+\alpha_{t-1}^1(1+\delta)+(1-\alpha_t^1)); \alpha_{t-1}^1, \alpha_t^1 > \overline{\alpha}$$

From the above equation we get

$$\alpha_t = \left(2-L^1\right)+\left(1+\delta\right)\alpha_{t-1} \equiv \alpha^0\left(\alpha_{t-1}\right); L^1 \equiv 1+\alpha_{t-1}^1(1+\delta)+(1-\alpha_t^1); \alpha_{t-1}^1, \alpha_t^1 > \overline{\alpha} \quad (26)$$

Eq.(26) gives the optimum value of α_t corresponding to any given value of α_{t-1} in the domain $1 \geq \alpha_{t-1} \geq \alpha_{t-1}^1$, if $\alpha^0\left(\alpha_{t-1}\right) \leq 1$. If for any such value of α_{t-1}, value of α_t satisfying eq. (26) is greater than unity, the optimum value of α_t is 1. Now, $\left(\alpha_{t-1}^1, \alpha_t^1\right)$ may be represented in Figure 3 by a point such as A_1 or by a point such as A_6. Therefore, for $1 \geq \alpha_{t-1} \geq \alpha_{t-1}^1$, the short run equilibrium value of α_t corresponding to any given α_{t-1} is given by the curve $A_1B_1A_3C$ or by the curve

A_6B in Figure 3. Thus in the present case the locus of all short run equilibrium combinations of α_{t-1} and α_t are given either by the curve $A_2A_5A_1B_1A_3C$ or by the curve $A_2A_5A_1A_6B$ in Figure 3. Let us now derive the conditions under which we have these two curves. Note first that eq.(26) will definitely have a unique fixed point over the domain $\left(\alpha_{t-1}^1, \infty\right)$ since $\alpha_{t-1}^1 > \alpha_t^1$ and $\alpha^{0'} = (1+\delta) > 1$. Let the value of this fixed point be α_m. We can get the value of α_m by solving eq.(26) after substituting α_m for α_{t-1} and α_t. Obviously, if $\alpha_m < 1$, α_t as given by eq.(26) will equal unity at $\alpha_{t-1} < 1$ since $\alpha^{0'} = (1+\delta) > 1$. Therefore, if $\left(\alpha_{t-1}^1, \alpha_t^1\right)$ is such that $\alpha_m < 1$, we have the situation depicted by $A_2A_5A_1B_1A_3C$ in Figure 3. If on the other hand $\left(\alpha_{t-1}^1, \alpha_t^1\right)$ is such that $\alpha_m \geq 1$, we have the situation as depicted by $A_2A_5A_1A_6B$ in Figure 3. The value of α_m as derived from eq.(26) is given by

$$\alpha_m = \frac{\alpha_{t-1}^1(1+\delta) - \alpha\left(\alpha_{t-1}^1\right)}{\delta} \equiv f\left(\alpha_{t-1}^1\right); f' = 1 + \frac{1}{\delta}(1-\alpha') > 1 \tag{27}$$

Let us now focus on $f\left(\alpha_{t-1}^1\right)$. Since, as follows from eq.(14), $\alpha' < 1$, $f' > 1$. We first derive the conditions under which α_m or $f\left(\alpha_{t-1}^1\right)$ is less than unity. Note that, for $\alpha_{t-1}^1 = \overline{\alpha}$, $f\left(\alpha_{t-1}^1\right) = \overline{\alpha} < 1$. Again, at $\alpha_{t-1} = 1$, $f\left(\alpha_{t-1}^1\right) = 1 + [\{1-\alpha(1)\}/\delta] > 1$ (since $\alpha(1) < 1$ in this model). It is quite clear from eq.(27) that $f\left(\alpha_{t-1}^1\right)$ is continuous and differentiable for every $\alpha_{t-1}^1 \in \left[\overline{\alpha}, 1\right]$. Therefore, if α_{t-1}^1 is sufficiently close to $\overline{\alpha}$, i.e., if $\overline{W}$ is sufficiently close to W^s, $\alpha_m < 1$ and we have the situation depicted by $A_2A_5A_1B_1A_3C$ in Figure 3. If, however, $\overline{W}$ is sufficiently smaller than W^s, we have the situation represented by $A_2A_5A_1A_6B$ in Figure 3.

In the first case, where optimum combinations of α_{t-1} and α_t are given by $A_2A_5A_1B_1A_3C$ in Figure 3 there are multiple equilibria. As shown in Figure 3, there are two other steady states besides A or ($\overline{\alpha}$, $\overline{\alpha}$): one at B_1 and the other at C. Steady states at A and C are stable, but that at B_1 is unstable. Let us denote the steady state value of α_{t-1} and α_t at B_1 by $\tilde{\alpha}_m$. Substituting $\tilde{\alpha}_m$ for α_{t-1} and α_t in eq. (26), we can solve it for the value of $\tilde{\alpha}_m$. However, this steady state is unstable. If initial $\alpha_{t-1} > \tilde{\alpha}_m$, then α_{t-1} and α_t will go on rising and thereby move farther and farther away from $\tilde{\alpha}_m$ and will eventually converge to C, with α_t = α_{t-1} = 1. On the other hand, if $\alpha_{t-1} < \tilde{\alpha}_m$, α_{t-1} and α_t will go on falling over time and converge to the long run steady state value, $\overline{\alpha}$.

In the second case, however, where the short run equilibrium combinations of α_{t-1} and α_t are given by the curve $A_2A_5A_1A_6B$, there is only one steady state, A, which is stable. In this case therefore the law has no impact on the incidence of child labor in the long run. The above discussion leads to the following proposition:

Proposition 8: When $\overline{W} < W^s$, we have two cases. In the first case $\overline{W}$ is not significantly less than W^s. In this case we have multiple equilibria. If in this case in the initial situation the minimum wage law is binding, i.e., if the free market short run equilibrium wage rate is less than $\overline{W}$ in the absence of the law, the law will have two types of effect on child labor. If in the initial

situation the free market short run equilibrium wage rate is less, but not very close to the government stipulated minimum wage rate (so that the initial value of α_{t-1} is greater than $\tilde{\alpha}_m$), the law will eliminate child labor altogether. If, however, in the initial situation the free market equilibrium wage rate is less, but very close to the minimum wage rate, it will have no impact on the incidence of child labor in the long run. If in the initial situation the minimum wage law is not binding, i.e., if in the initial situation the free market short run equilibrium wage rate is greater than the stipulated minimum, the law will have no impact on the child labor in the long run.

In the second case $\overline{W}$ is sufficiently less than W^s. In this case again the law will have no impact on the incidence of child labor in the long run.

4. Conclusion

The paper develops a simple overlapping generations model where parents are altruistic towards their children. The model allows us to address the issue of child labor in the short as well as in the long run and show the dynamics of transition from the short to the long run. The paper uses this model to explain why the problem of child labor persists in poor countries and how economic progress can alleviate the problem. More precisely, it derives the conditions under which the major features of underdevelopment such as backward technology, inefficient education system and parental apathy towards their children's education bind an economy in a child labor trap in the long run. It also identifies the conditions under which improvements in all these fronts reduce the incidence of child labor and eventually eliminate it.

It also examines the impact of a minimum wage law, which applies to both adult and child labor. This exercise is carried out for the case where parents perceive the impact of the law on employment. In this case in the short run the law will unambiguously reduce child labor. Situations in the long run are, however, much more complex. If the minimum wage rate is set above the long run free market steady state wage rate, the law will eliminate child labor altogether. If, however, the minimum wage rate is set below the free market steady state wage rate, there are multiple equilibria. If the minimum wage rate is set substantially below the free market steady state wage rate, it will have no impact on the incidence of child labor in the long run. However, if the minimum wage rate is not that low, there will emerge two different situations. If in the initial situation the free market short run equilibrium wage rate is less than and close, but not very close, to the minimum wage rate, the law will remove child labor altogether. On the other hand, if in the initial situation the free market short run equilibrium wage rate is less than, but very close to or higher than the stipulated minimum, the law will have no impact on child labor in the long run.

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