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CHILD LABOUR, SKILL FORMATION AND CAPITAL ACCUMULATION: A THEORETICAL ANALYSIS*

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Abstract: In this paper, we consider a two sector dynamic model of a small open economy with a child labour market. This model analyses the simultaneous accumulation of human capital and physical capital; and shows the possibility of multiple long-run equilibria with a low level equilibrium trap (child labour trap). The effect of trade sanctions imposed on the child labour using products are analysed on the long run equilibrium of the system.

1. INTRODUCTION

The problem of child labour is wide spread in the third world countries. Even the developed countries of today had to suffer from this problem at the early stage of their development. The rate of decline of the participation rates for children, aged between 10 to 14 years, during the late 20th Century is not at all high in African and Asian countries.[1] In India and China, these rates were 35.43% and 47.85% in 1950; and, in 1990, we find a decline to 16.68% and 15.24% only. In Ethiopia, the participation rate was 52.95% in 1950 and has declined to only 43.47% in 1990.

The awareness of and concern for child labourers have increased through out the world; and there is a strong feeling that steps should be taken so that the institution of child labour can be abolished. One simple way is to ban it; and across the world, there is a strong opinion in favour of a ban on child labour. For example, there is a view to impose trade sanctions on the import of those goods from less developed countries which are produced using child labour; and the so called Harkin's Bill in the U.S. is a classic example of this. International Labour Organizations also favour at least partial ban on child labour and the various restrictions on their employers. Suggestions for labelling "child labour free" bands on the products have also come from various corners so that the consumers can confine their consumption to such goods. In U.K., many

* Interesting and helpful comments of a referee of this journal on an earlier version of this paper are gratefully acknowledged. Remaining errors are of mine alone.

[1] An empirical picture is available in Basu (1999).

N.G.Os. are involved in the naming and shaming of stores selling products produced with the use of child labour.

There exists a small set of theoretical works on the economics of child labour market. Basu and Van (1998) investigate the implication of a ban on child labour in a static general equilibrium model. The model shows the possibility of multiple equilibria with at least one stable equilibrium with child labour. Swinnerton and Rogers (1999) show that child labour can not exist in equilibrium in Basu-Van (1998) model if the non-labour income is equally distributed. Ranjan (1999) explains the existence of child labour in terms of credit market imperfection and shows how banning child labour reduces the welfare of the households supplying child labour. Jafarey and Lahiri (1999) analyse the effects of trade sanctions in reducing the child labour and show how the nature of the credit market is related to these effects. Gupta (2000) also analyses the effect of trade sanctions on the unemployment in the adult labour market and on the size of the child labour market. However, none of these papers deal with capital accumulation (growth) and its interaction with the size of the child labour market.

In the present paper, we do a dynamic analysis of capital accumulation and skill formation in a less developed economy suffering from the existence of a child labour market. Child workers of today become the unskilled workers of tomorrow; and thus the existence of the child labour market lowers the rate of human capital accumulation. This, along with the investment of capitalists' income to physical capital formation,[2] describes the intertemporal growth path of the economy. We investigate the properties of the long run equilibrium of the system. The system may be caught into a low level equilibrium trap characterized by the existence of child labour and low level of capital stock. The trade sanctions imposed on the exportables produced using child labour lowers the steady state value of capital stock and may even raise the size of the child labour market. This may also lower the long run equilibrium value of national income.

2. THE STATIC MODEL

We consider a small open economy with two sectors (producing two commodities) and three factors-Capital, adult labour and child labour. Capital is perfectly mobile between the two sectors which leads to the equalisation of the rates of return in the two sectors. Adult labour is specific to one sector and the child labour is specific to the other sector.[3] The country is open with respect to goods only. Factors of production are internationally immobile.

At any particular point of time, the stock of capital and the number of adult workers are exogenously given. Adult workers can be classified as skilled and unskilled; and this distribution is also exogenous at a given point of time. One unskilled worker is β-times efficient as compared to a skilled worker with $\beta < 1$. Stock of adult labour endowment is expressed in efficiency unit. Skilled labour and unskilled labour are perfect

[2] This is an assumption made in this paper borrowing from the literature on old growth theory.

[3] This assumption is a simplifying one.

substitutes; and hence are additive.[4] Wage rate of an unskilled adult worker is β-times of that of a skilled worker.

Supply of child labour varies positively with the wage rate in the child labour market, negatively with the wage rate in the adult labour market; and positively with the number of unskilled adult workers. This supply function of child labour can be derived from the utility maximizing behaviour of the representative household who controls the supply of children to work.[5] The representative households' skilled adult and unskilled adult members are in the same proportion as is given in the economy as a whole.

Factor prices—the wage rates in the two labour markets and the rate of return on capital—are perfectly flexible; and this ensures automatic attainment of full employment equilibrium in all the factor markets.

Production function in each of the two sectors satisfies all the standard neo-classical properties including constant returns to scale. All the product and factor markets are perfectly competitive; and the representative firm in either sector maximises profit. Both the goods are traded and the economy exports the child labour using product and imports the adult labour using product.

We assume that the adult labour using sector, which is the import competing sector, is more capital intensive than the child labour using sector producing exportables.[6]

The notations consist of the folowings:

$r =$ Rate of return on capital.
$W_A =$ Wage rate in the adult labour market.
$W_c =$ Wage rate in the child labour market.
$k_A =$ Capital labour ratio in the adult labour market.
$k_c =$ Capital labour ratio in the child labour market.
$L_A =$ Level of employment of adult labour in efficiency unit.
$L_c =$ Level of employment of child labour (workers).
$N =$ Number of adult workers.
$S =$ Number of skilled adult workers.
$U =$ Number of unskilled adult workers.
$K =$ Capital endowment of the economy.
$\beta =$ Efficiency parameter converting the unskilled labour into the skilled labour.
$L_c^s =$ Supply of child labour.
$P =$ Producers' effective (relative) price of the child labour using product.
$Y =$ Level of national income.
$X_A =$ Level of output of the adult labour using sector.
$X_c =$ Level of output of the child labour using sector.
$F_A =$ Intensive production function in the adult labour using sector.
$F_c =$ Intensive production function in the child labour using sector.
$\hat{x} = (dx/x)$.

[4] In reality, child-labour and unskilled adult labour are highly substitutes; and we ignore this here for the sake of simplicity.

[5] The behaviour of the parents is described in the Appendix (A).

[6] If the production functions in the two sectors are Cobb-Douglas, comparison can be made in terms of the two capital-elasticity parameters.

The equational structure of the model is the following:

$$X_A = F_A(k_A)L_A \tag{1}$$

and

$$X_c = F_c(k_c)L_c \tag{2}$$

are the two production functions. We assume $F_j'(\cdot) > 0$ and $F_j''(\cdot) < 0$ for $j = A, C$.

The competitive equilibrium conditions in the two product markets are given by the following:

$$1 = C_A(r, W_A) \tag{3}$$

and

$$P = C_c(r, W_c) \tag{4}$$

Capital market equilibrium implies that

$$k_A L_A + k_c L_C = K \tag{5}$$

Also we have,

$$S + U = \bar{N}$$

and

$$S + \beta U = L_A \tag{6}$$

The supply function of the child labour is given by

$$L_c^s = L_c^s(W_A L_A / W_c) \text{ with } L_C^{s'}(\cdot) < 0 \tag{7}$$

This means that L_c^s is homogenous of degree zero in terms of $W_A L_A$ and W_c. Here $W_A L_A$ is the total adult income of the household; and the supply of child labour varies inversely with the total adult income relative to the child wage rate. So, from equation (6), it is clear that supply of child-labour varies inversely (directly) with the proportion of skilled (unskilled) adult workers. Derivation of this labour supply function is made from the utility maximizing behaviour of the representative household with S skilled adult members and $(\bar{N} - S)$ unskilled adult members. The representative household derives utility from total household income and disutility from child labour. The formal derivation is described in Appendix (A).

It should be noted that the derived supply function of child labour is the function of relative adult income only. The income effect exists in a restricted sense; and this is the result of the restrictions imposed on the household's utility function. If the elasticity of marginal utility of income is unity and if the marginal disutility of child labour is independent of household income then a separate absolute income effect does not appear in the child labour supply function.[7]

In the equilibrium of the child labour market,

$$L_c = L_c^s \tag{8}$$

Optimum capital intensities in the two sectors are functions of the factor price ratios. Hence we have

[7] See Appendix (A).

$$k_A = k_A(W_A/r) \text{ with } k'_A(\cdot) > 0 \tag{9}$$

and

$$k_c = k_c(W_c/r) \text{ with } k'_c(\cdot) > 0 \,. \tag{10}$$

The working of the static model is described as follows. In a small open economy, P is given. So equations (3) and (4) solve for the equilibrium values of W_A and W_c as function of r. Hence equations (7), (8), (9) and (10) show that L_c, k_A and k_c become functions of r. At a particular point of time, K, U and S are given. So L_A is known; and then the entire L.H.S. of the equation (5) becomes a function of r. Now equation (5) solves for the equilibrium value of r. Then we find out the equilibrium values of all other variables—W_c, W_A, k_A, k_c, L_c etc. Then equations (1) and (2) solve for the values of X_A and X_c.

The working of the static model is similar to that of the 2×3 specific factor model of Jones (1971). Here capital is mobile between the two sectors; and two types of labour are sector specific. Supply of one type of labour is the function of relative wage and of the endowment of other type of labour. In Jones (1971). Labour is perfectly mobile but two types of capital are sector specific; and the endowments of all the factors are exogenous to the system.

We can easily derive the following comparative static results from the working of the static model.

PROPOSITION 1. *Equilibrium value of the rate of return on capital, r, varies* (i) *inversely with the size of the capital stock, K,* (ii) *directly* (*inversely*) *with the skilled* (*unskilled*) *adult labour endowment*; *and* (iii) *directly with the relative price of the exportables.*

The derivation of the results summarized in the Proposition 1 easily follows from the works in Jones (1971). We now turn to analyse the comparative static effect on the equilibrium value of the supply of child labour. Here

$$\hat{L}_c^s = \sigma_c(\hat{W}_A - \hat{W}_c + \hat{L}_A)$$

where $\sigma_c = (\partial L_c^s / \partial((W_A L_A)/W_c))((L_A W_A/W_c)/L_c^s) < 0$ is the elasticity of labour supply in the child labour market with respect to the relative adult income defined as $(W_A L_A / W_c)$.

Now once again following the derivations in Jones (1971) it can be shown that

$$((\hat{W}_A - \hat{W}_c)/\hat{P}) < 0$$

and

$$((\hat{W}_A - \hat{W}_c)/\hat{K}) > 0$$

if the adult labour using sector is more capital intensive than the child labour using sector. Change in K and/or change in P affect the child labour supply, L_c^s, indirectly through the effect on (W_A/W_c). They have neither any direct effect on L_c^s nor any effect on L_A.

Hence we can prove the following proposition:

PROPOSITION 2. *Size of the child labour market*[8] *varies* (i) *positively with the relative price of exportables*; *and* (ii) *inversely with the size of the capital stock if the adult labour using sector is more capital intensive than the child labour using sector.*

We now turn to analyse the effect of change in U on L_c^s. It can also be shown that

$$(\partial L_A/\partial U) = -(1-\beta) < 0 \quad \text{and} \quad (\partial L_A/\partial S) = (1-\beta) > 0\,;$$

and $((\hat{W}_A - \hat{W}_c)/\hat{L}_A)$ has the opposite sign of $((\hat{W}_A - \hat{W}_c)/\hat{K})$. Moreover, change in L_A has a direct negative effect on L_c^s; and so the indirect effect through change in (W_A/W_c) and the direct effect move in opposite directions. So the size of the child labour market may vary in either way as the number of unskilled workers, U, is increased. Here

$$(\hat{L}_c^s/\hat{U}) = \sigma_c(((\hat{W}_A - \hat{W}_c)/\hat{L}_A)(\hat{L}_A/\hat{U}) + (\hat{L}_A/\hat{U}))$$

Here $\sigma_c < 0$ and $(\hat{L}_A/\hat{U}) < 0$. Hence

$$\text{sign}\{\hat{L}_c^s/\hat{U})\} = \text{sign}\{((\hat{W}_A - \hat{W}_c)/\hat{L}_A) + 1\}\,.$$

Here $((\hat{W}_A - \hat{W}_c)/\hat{L}_A) < 0$ and so $(((\hat{W}_A - \hat{W}_c)/\hat{L}_A) + 1)$ may have any sign$((\hat{W}_A - \hat{W}_c)/\hat{L}_A)$ is the elasticity of relative wage (W_A/W_c) with respect to L_A. However, we can prove the following proposition:

PROPOSITION 3. *Size of the child labour market varies directly* (*inversely*) *with the unskilled workers, U, if and only if the absolute value of the elasticity of relative wage, (W_A/W_c), with respect to adult labour endowment, L_A, is less* (*greater*) *than unity.*[9]

Hence we can derive the following functions from the comparative static exercises:

$$r = \psi(K, U, P) \tag{11}$$

with $\psi K < 0$; $\psi U < 0$; and $\psi P > 0$.

$$L_c^s = g(K, U, P) \tag{12}$$

with $g_K < 0$; $g_p > 0$; and g_u being unrestricted in sign. Here $g_u \gtrless 0$ if and only if $|(\hat{W}_A - \hat{W}_c)/\hat{L}_A| \lesseqgtr 1$.

The intuition behind the comparative static effects on r and on (W_A/W_c) are clearly understood from those available in Jones (1971). Here r is the price of the mobile capital; and (W_A/W_c) is the relative price of one specific factor, adult labour, in terms of the other, child labour. The effects of change in skilled workers and unskilled workers are opposite to each other because the number of adult workers (skilled plus unskilled) is given and the skilled workers are more efficient than the unskilled workers.

[8] Here the size of the child labour market is measured by the equilibrium level of child labour.

[9] We have already assumed that the sector A is more capital intensive than the sector C. This assumption is not unrealistic. In reality, child labourers are employed in backward agriculture and in urban informal sectors. These sectors are far more labour intensive than modern industries.

3. THE DYNAMIC ANALYSIS

We now turn to analyse the dynamics of capital accumulation and skill formation. The child labourers in the current period are the unskilled adult workers in the next period; and the other children who do not join child labour market in the current period are assumed to be educated and become the skilled workers in the next period.[10] However, the model assumes a representative myopic household where adults care only about child's current earnings and leisure, not future earnings. All the workers who are adult in the current period will die in the next period. For the sake of simplicity, we assume that the total number of children (and hence the total number of adult workers) do not change over time. However, the distribution of adult workers between skilled and unskilled becomes endogenous over time because the equilibrium size of the child labour market is determined within the static model.

Capital accumulation takes place over time through investment. Capital stock depreciates at a constant rate; and the income of the capitalists is the only source of investment.[11] Government does not adopt any tax/subsidy programme. Let m be the constant rate of depreciation. Then the equations of motion of the system are

$$\dot{K} = rK - mK$$

and

$$\dot{U} = L_c^s - U .$$

Using equations (11) and (12) we can modify them as follows:

$$\dot{K} = \psi(K, U, P)K - mK \tag{13}$$

and

$$\dot{U} = g(K, U, P) - U . \tag{14}$$

We now want to analyse the properties of the long run equilibrium of the system. In the long run equilibrium, $\dot{K} = 0 = \dot{U}$; and so the $\dot{K} = 0$ stationary locus and $\dot{U} = 0$ stationary locus are given by the following equations:

$$\psi(K, U, P) = m$$

and

$$g(K, U, P) = U .$$

The slope of the $\dot{K} = 0$ locus is given by

$$(dK/dU) = -(\psi U/\psi K) < 0$$

and the slope of the $\dot{U} = 0$ locus given by $(dK/dU) = -((g_U - 1)/g_K)$ is indeterminate in sign because g_U is unrestricted in sign. If $|(\hat{W}_A - \hat{W}_c)/\hat{L}_A| > 1$, then $g_u < 0$; and, in that case, $\dot{U} = 0$ locus slopes negatively. If $|(\hat{W}_A - \hat{W}_c)/\hat{L}_A| < 1$, then $g_U > 0$. However, $\dot{U} = 0$ locus slopes negatively so long $0 < g_U < 1$. $\dot{U} = 0$ locus has a positive slope only when $g_U > 1$.

[10] In reality, a substantial proportion of children neither go to school nor take part in child labour market. So this is a simplifying assumption.

[11] This is a standard assumption made in the old growth theory. We just borrow it.

In the remaining parts of this paper, our focus is on the negatively sloped $\dot{U} = 0$ locus. We assume that $|(\hat{W}_A - \hat{W}_c)/\hat{L}_A| > 1$. Such a case can be justified when (i) share of capital in adult labour sector is very high and (ii) elasticity of substitution between capital and labour is very low in the adult labour sector.

The long run equilibrium point is shown by the point of intersection of the two curves in the $K - U$ space. The necessary condition for stability of equilibrium is given in the Appendix (B). In the Figure 1, K^* is the long run equilibrium level of capital stock; and U^* is the level of unskilled adult workers (supply of child labour) in the long run. This is a case of unique stable equilibrium when $\dot{U} = 0$ locus slopes negatively. However, the long run equilibrium is not necessarily unique; and the possibility of multiple equilibria will be discussed in the next section.[12]

When $\dot{U} = 0$ locus slopes positively, the equilibrium is shown in Figure 2. In this case, the equilibrium point B is a saddle point.[13]

Note that $U \leqslant \bar{N}$; and hence a corner solution where $L_c = U^* = \bar{N}$ is also worth discussing at least theoretically. In a less developed economy, $\bar{N}$ is expected to take a very high value; and no generality is expected to be lost if we assume that $U^* < \bar{N}$, i.e. some skilled workers exist in the longrun equilibrium. If $\bar{N}$ is very low, we may not have a point of intersection at a $U^* \leqslant \bar{N}$.

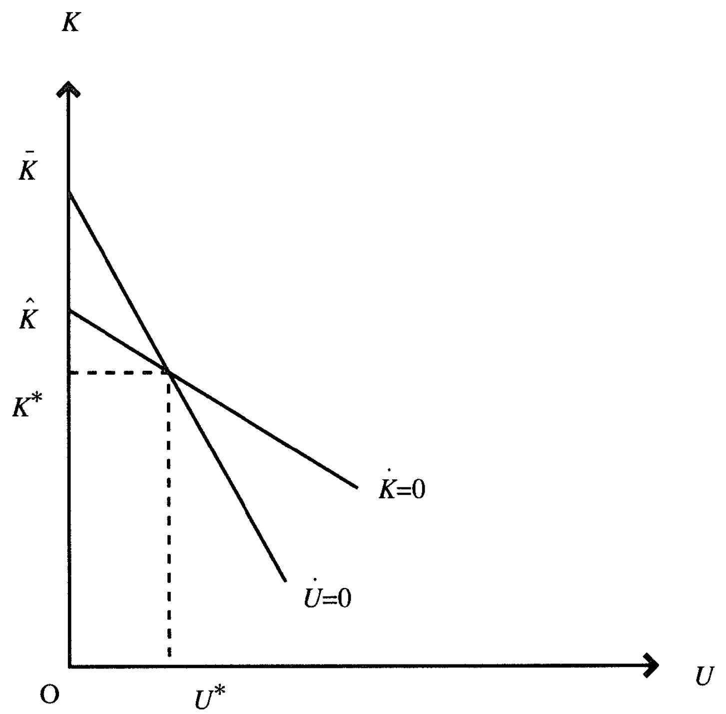

Figure 1.

[12] The equilibrium with positive unskilled labour is basically a low level equilibrium trap. This will be explained in more detail in the next section.

[13] It is shown in the Appendix (B).

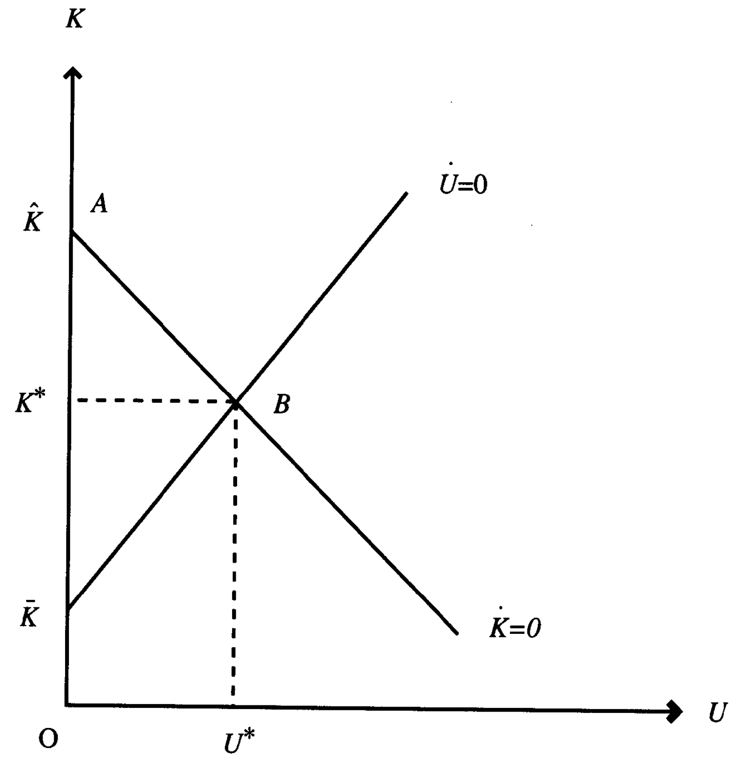

Figure 2.

Our next task is to analyse the comparative steady state effect around a stable equilibrium point with a negatively sloped $U^* = 0$ locus. We consider the effect of trade sanctions imposed on the child labour using product on the long run equilibrium of the system. Such a policy implies lowering the value of P; and both the $\dot{K} = 0$ locus and $\dot{U} = 0$ locus shift downward in this case.

From the Propositions 1 and 2 stated in the previous section, it becomes clear that this policy lowers the rate of return on capital—the mobile factor—given the capital stock and given the skilled-unskilled distribution of adult workers. So, to keep the rate of return equal to the rate of depreciation, we need either a reduction in K given U, or, a reduction U given K, or reductions in both U and K. This implies that the $\dot{K} = 0$ locus should shift downward when P is reduced.

Similarly, supply of child labour, L_c^s, varies directly with P. So if P is reduced then we need reductions in K and/or U to keep the $\dot{U} = 0$ condition unchanged. So the $\dot{U} = 0$ locus should also have a downward shift in this case.

Now, from the Figure 1, it becomes clear that the effects on U^* and K^* are not unambiguous. U^*, which is the long run equilibrium level of unskilled labour force and which also represents the size of the child labour market in the long run, is not necessarily reduced here. The direct effect of the reduction in P on U^* is obtained at the given capital stock. This causes U^* to be reduced. However, in this dynamic model, K^* may fall; and then there is an additional indirect opposite effect on U^* operating through the reduction in K^*. As the equilibrium size of the child labour market varies inversely with the size of the capital stock,[14] the reduction in K^* causes the supply of child labour to rise. So the long run equilibrium value of U^* is increased if the indirect effect dominates the direct effect. The necessary and sufficient conditions for this result to be true is derived in the Appendix (C).

The national income of the economy is given by the following:

$$Y = W_A \cdot L_A + W_C L_C + rK .$$

In the long run equilibrium, $r = m$; and so the equation (3) shows that W_A is also given. Here K^* falls. The steady state value of L_A is also reduced when U^* rises because

$$L_A = \bar{N} - (1 - \beta)U \quad \text{and} \quad \beta < 1 .$$

Equation (4) shows that the reduction in P lowers W_C; and L_C rises because $L_C = U$ in the long run equilibrium. So the long run equilibrium value of national income may also be reduced.

We now summarise the main result in the form of the following proposition:

PROPOSITION 3. *In a dynamic model with capital accumulation and skill formation being endogenous to the system, long run equilibrium size of the child labour market may be enlarged and the long run equilibrium value of national income may be reduced with the imposition of trade sanctions on the child labour using products.*

4. MULTIPLE EQUILIBRIA

Our analysis of the construction of the two stationary loci in the previous section was incomplete because we have not explained how they are related to the vertical axis though that incomplete construction was sufficient to analyse the comparative steady state effect of trade sanctions on the size of the child labour market. In this section, we turn to compare the alternative possible equilibria; and, for this reason, it becomes necessary to explain how the two loci are related to the vertical axis.

Here, $\dot{K} = 0$ locus starts from a point on the K-axis. When $U = 0$, $L_A = S = \bar{N}$; and, in this case, $K = \hat{K}$ can be obtained solving $\psi(K, 0, P) = m$ at a given value of P. So the negatively sloped $\dot{K} = 0$ locus meets the K-axis at $K = \hat{K}$.

We introduce an additional property[15] of the supply function of child labour:

$$L_C^s(W_A/W_c) = 0 \text{ if } (W_A/W_c) \geqslant \alpha \text{ (constant)}.$$

In this case, $\dot{U} = 0$ locus coincides with the axis representing K when $(W_A/W_c) \geqslant \alpha$; and its equation is given by

$$g(K, 0, P) = 0$$

for a given P. Suppose that it is solved at $K = \bar{K}$. Then

$$(W_A/W_c) \geqslant \alpha \Rightarrow K \geqslant \bar{K} .$$

[14] See Proposition 2.

[15] We have not mentioned this property in the analysis made in Section 3. The analysis made in Section 3 using the Figure 1 should not face any disturbances in the presence of this property so far the comparative steady-state effect of imposing trade sanctions on the child labour supply is concerned.

So the $\dot{U} = 0$ locus meets the vertical axis at $K = \bar{K}$; and coincides with the vertical axis for $K \geqslant \bar{K}$.

So we may have two alternative types of long run equilibrium—'Equilibrium With Child Labour' (EWCL) and 'Equilibrium Without Child Labour' (EWOCL). In Figure 1, we have shown a case of unique EWCL which is also stable. No EWOCL exists in this case because the two loci do not have any common point on the vertical axis. However, in Figures 2 and 3, point A shows a stable EWOCL at which $\dot{K} = 0$ locus meets the $\dot{U} = 0$ locus at the vertical axis and point B shows an unstable EWCL because the $\dot{K} = 0$ locus is stiffer than the $\dot{U} = 0$ locus at the point of intersection. In the Figure 4, we present a case of two stable equilibria—one EWCL and one EWOCL. Here point A_1 represents an EWOCL; and points B_1 and C_1 represent EWCL. However, C_1 is stable and B_1 is unstable. Point C_1 may be interpreted as a low level equilibrium trap with low level of capital stock and high level of unskilled labour force. Neither of these possibilities can be ruled out when nothing can be said definitely about the curvature of the two loci. However, we can provide economic interpretations of the necessary conditions for the existence of multiple equilibria as shown in Figure 4.

The necessary conditions for the existence of multiple equilibria with a child-labour trap are (i) $\hat{K} > \bar{K}$ and (ii) negative slopes of the $\dot{U} = 0$ and $\dot{K} = 0$ loci. We know that

$$\psi(K, 0, P) = m$$

and

$$g(K, 0, P) = 0 .$$

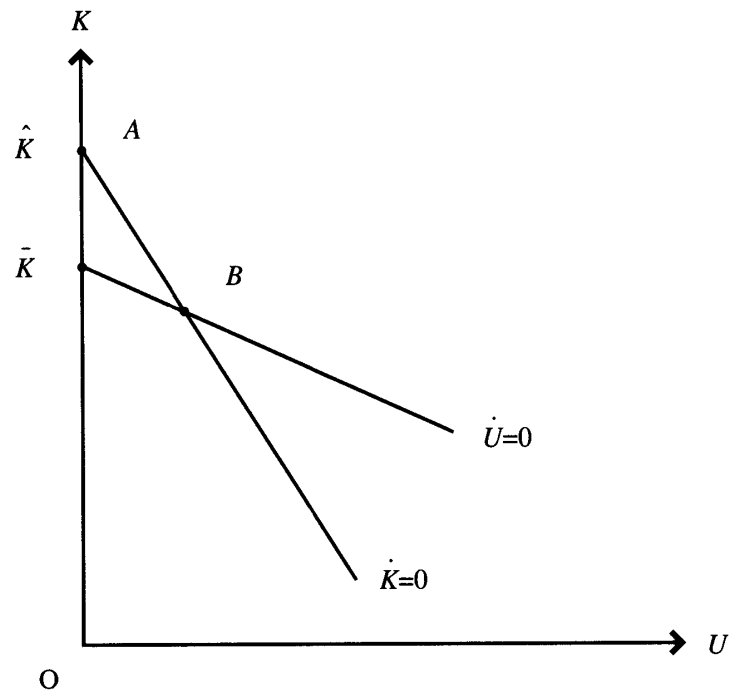

Figure 3.

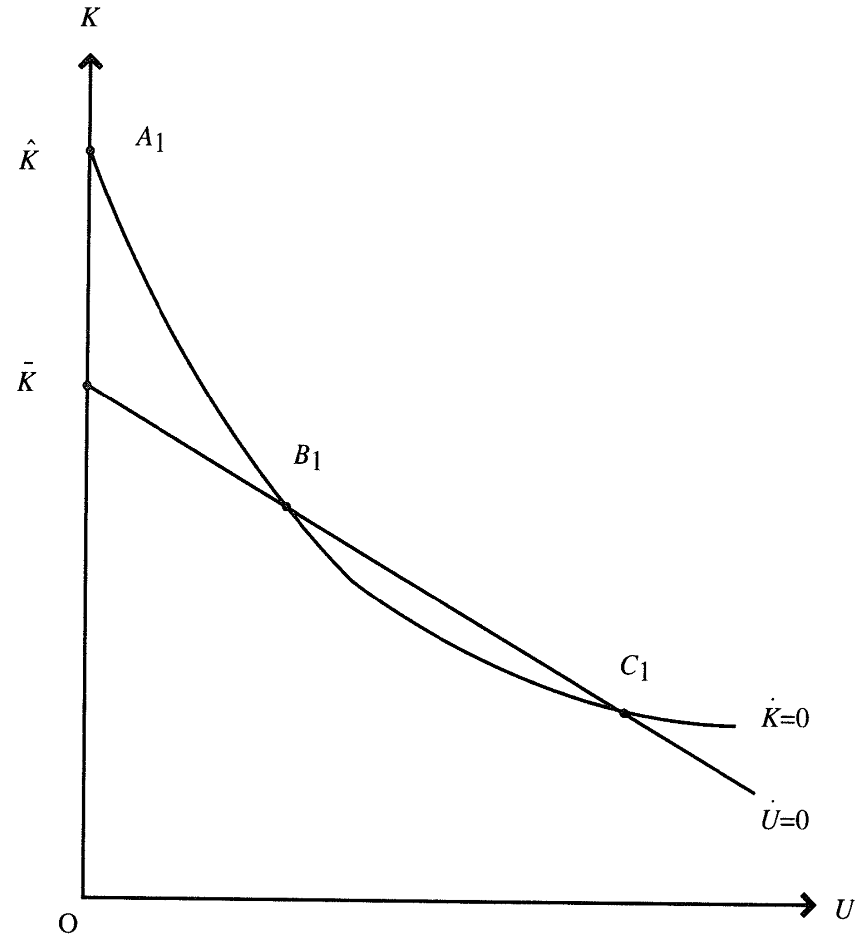

Figure 4.

Here $\psi_K < 0$ and hence $\hat{K}$ varies inversely with m for given P. However, $\bar{K}$ is given for a given P; and is independent of m. Hence $\hat{K} > \bar{K}$ possibility arises with a low rate of depreciation.

$\dot{K} = 0$ locus always slopes negatively. However, $\dot{U} = 0$ locus slopes negatively (i) if the adult-labour using sector is more capital intensive than the child labour using sector and (ii) if the elasticity of relative wage with respect to adult labour employment is greater than unity. Generally, the rate of employment of child labour is high in backward agriculture and in the informal sectors in urban areas; and these sectors are highly labour intensive as compared to modern industries which do not employ child labour. Condition (ii) basically implies that the demand for adult labour is wage-inelastic and this is valid when the elasticity of capital-labour substitution is very low in the adult labour using sector.

Hence we can establish the following proposition:

PROPOSITION 4. *The case of a multiple equilibria with a child-labour trap and with a stable EWCL is likely to occur* (i) *when the rate of depreciation of capital is low*; (ii) *when the child labour using sector is more labour intensive than the adult* *labour using sector and* (iii) *when the elasticity of capital-labour substitution in the adult labour using sector is very low.*

If the adult labour sector is more capital intensive than the child labour sector, then capital accumulation raises the relative adult wage, (W_A/W_C), and lowers the supply of child labour. So capital accumulation produces a positive effect on skill formation.

If the elasticity of substitution between capital and labour is very low in the adult labour sector, then the absolute value of elasticity of relative adult wage, (W_A/W_C), with respect to adult labour endowment, L_A, is greater than unity. So the size of the child labour market varies inversely with the number of unskilled workers, U. This means that the skill formation has a negative effect on itself.

The skill formation has a positive effect on the marginal productivity of capital in the adult labour sector; and this, combined with perfect intersectoral mobility of capital, produces a positive effect on the rate of return on capital. So combining these three we find that capital accumulation has an indirect negative effect on itself. If the direct negative effect of capital accumulation on itself and its indirect negative effect on itself through skill formation can not be ranked uniformly at all levels of capital accumulation we find a possibility of multiple equilibria.

If the rate of depreciation of physical capital is very high, then the capital accumulation path may always converge to low levels at which the relative adult wage, (W_A/W_C), fails to exceed the critical value, β. This may rule out the possibility of an 'Equilibrium Without Child Labour' (EWCL).

If the level of capital stock and the percentage of skilled labour force are very low initially, then the system is likely to converge to the low level equilibrium trap. However, convergence takes place to the EWOCL when the initial level of capital stock and the initial proportion of skilled labour force are very high.

A long run equilibrium without child labour and with only adult skilled labour in this model is basically a golden rule steady state equilibrium in a Neo classical one sector growth model.[16] The speciality of the present model lies in showing the possibilities of existence of alternative long run equilibrium points characterized by the existence of a child labour market. Basu and Van (1998) also point out the possibility of multiple equilibria in their model while their analysis does not focus on the dynamics of capital accumulation and skill formation. Basu (1999) presents a theory of child labour trap based on the dynamics of skill formation and the possibility of increasing returns in the efficiency function. However, the role of capital accumulation and its interaction with the skill formation were missing there. In the present model, the possibility of the existence of child labour trap is conditional on the curvature of $\dot{K} = 0$ locus, on the rate of depreciation of capital-stock, on the capital-intensity ranking of the two sectors, and on the elasticity of substitution between capital and adult labour.

A so called 'Big push' investment programme helps the economy to get rid of this trap. If additional investment fund is made available in addition to the capitalists' profit

[16] In the neo classical one sector growth model, golden rule equilibrium is attained when only the entire capitalists' income is invested.

and if this is financed by non-distortionary exogenous sources, then the $\dot{K} = 0$ locus shifts upward without affecting the $\dot{U} = 0$ locus. As a result points B_1 and C_1 in Figure 3 may disappear; and the system converges to the unique stable long run equilibrium shown by the point A_1. So our policy prescriptions are similar to those of Leibenstein (1957), Nelson (1958), etc.

5. CONCLUSION

In this paper, we have developed a two sector growth model of a small open less developed economy in which physical capital and human capital accumulate over time and the human capital accumulation (skill formation) is constrained by the existence of the child labour market. We analyse the properties of the growth path and show that the equilibrium size of the child labour market is reduced as the accumulation of physical capital takes place. There may be multiple long run equilibria in the system; and the growth path may converge to a low level equilibrium trap characterized by the existence of child labour market when the initial levels of physical capital and skilled labour force are very low. Such an equilibrium is likely to occur when the adult labour using sector is more capital intensive than the child labour using sector and when the rate of depreciation of capital stock is very low. Trade sanctions imposed on the child labour using product aggravates the problem lowering the steady-state level of capital stock and raising the supply of child labour and unskilled adult labour. This also lowers the national income in the long run equilibrium.

However, our model is abstract and fails to consider many other important dimensions of the child labour problem. We do not consider the possibility of substitution between child-labour and unskilled adult labour. In reality, there are many sectors in which the unskilled adult labour appears to be a substitute to child labour.

We do not consider any non-tradable goods sector in this model and hence can not analyse how such trade sanctions affect the movement of child labour from the traded goods sector to the non-traded goods sector. In reality, a substantial proportion of child labour is employed in the non-traded goods sector. Perfect capital mobility among all the sectors is also a simplifying assumption. Child labour using sectors are often informal in nature and draw fund from isolated capital markets. Supply of child labour and the demand for child schooling should be analysed simultaneously which is not done here.

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APPENDIX (A)

We consider a representative household with S skilled adult workers, U unskilled adult worker, and with a given number of children (normalized to unity). There is fixed working hour system in the adult labour market and flexible working hour system in the child labour market. The household derives utility from total income (consumption) and disutility from the labour of the children.

Let Y be the level of income of the household; and hence

$$Y = W_A S + \beta W_A \cdot U + W_c L_c$$

or

$$Y = W_A \cdot L_A + W_c L_c \tag{A.1}$$

Here L_c is the proportion of children sent to work. The utility function of the household is

$$u = u(Y, L_c) \tag{A.2}$$

and this satisfies the following properties:

$$u_1 > 0; \quad u_2 < 0; \quad u_{11} < 0; \quad u_{21} = u_{12} \leqslant 0; \quad u_{22} < 0.$$

The problem of the household is to make an allocation of his children between workers and non workers; and he does this maximizing (A.2) subject to (A.1) through the choice of L_c. The first order condition of maximization is

$$u_1 \cdot W_c + u_2 = 0 \tag{A.3}$$

From (A.3), we have

$$\begin{aligned}&[u_{11} \cdot W_C^2 + W_C(u_{12} + u_{21}) + u_{22}]dL_C \\ &\quad +[u_1 + (u_{11} W_C + u_{21})L_C]dW_C + [u_{11} W_C + u_{21}]dW_A L_A = 0.\end{aligned} \tag{A.4}$$

Here,

$$(dL_C/dW_C) = -(N_C/D)$$

and

$$(dL_C/dW_AL_A) = -(N_A/D)$$

where

$$D = [u_{11}W_C^2 + W_C(u_{12} + u_{21}) + u_{22}] < 0$$

and

$$N_C = [u_1 + (u_{11}W_C + u_{21})L_C] > 0$$

if $u_1 > |(u_{11}W_C + u_{21})L_C|$.

$$N_A = [u_{11}W_C + u_{21}] < 0\,.$$

Hence $(dL_C/dW_C) > 0$ and $(dL_C/dW_AL_A) < 0$.

The labour supply function is homogenous of degree Zero in terms of W_AL_A and W_C if

$$(\partial L_C/\partial W_C)W_C + (\partial L_C/\partial W_AL_A)W_AL_A = 0\,;$$

or,

$$N_CW_C + N_AW_AL_A = 0\,;$$

or,

$$u_1W_C + (u_{11}W_C + u_{21})(W_CL_C + W_AL_A) = 0\,;$$

or,

$$u_1W_C + (u_{11}W_C + u_{21}) \cdot Y = 0\,.$$

This condition is satisfied if the utility function is given by

$$u(Y, L_C) = \log eY - H(L_C)\,.$$

Here

$$u_1 = (\partial u/\partial Y) = (1/Y)\,;$$
$$u_{11} = (\partial^2 u/\partial Y^2) = -(1/Y^2)\,;$$

and

$$u_{21} = (\partial^2 u/\partial L_C \partial Y) = 0\,.$$

Hence,

$$\begin{aligned} &u_1W_C + (u_{11}W_C + u_{21})Y \\ &\quad = (W_C/Y) - (W_C/Y) \\ &\quad = 0\,. \end{aligned}$$

Here, $-u_{11} \cdot (Y/u_1) = 1$ and $u_{21} = 0$ are the two sufficient conditions for the child labour supply function to be homogenous of degree Zero in terms of W_AL_A and W_C.

Here $W_AL_A = W_A(S + \beta U)$ is the total adult income of the household; and hence (W_AL_A/W_C) is the relative adult income. So a relative income effect exists in the child labour supply function.

APPENDIX (B)

Here

$$J = \begin{bmatrix} \psi_K & \psi_U \\ g_K & g_U - 1 \end{bmatrix}_{(K^*, U^*)}$$

is the Jacobian matrix. The determinant is evaluated at the long run equilibrium values of K and U. The long run equilibrium point is stable if the trace of the Jacobian matrix is negative and if the Jacobian determinant is positive.

Case 1. $g_u < 1$
The trace of the Jacobian is

$$\psi_K + (g_u - 1) < 0$$

because

$$\psi_K < 0 \quad \text{and} \quad (g_u - 1) < 0 .$$

The Jacobian determinant is

$$|J| = \psi_K \cdot [\psi_K(g_u - 1) - \psi_U g_K];$$

and $|J| > 0$ if

$$\frac{\psi_K}{\psi_U} > \frac{g_K}{g_u - 1};$$

or,

$$\frac{\psi_U}{\psi_K} < \frac{g_u - 1}{g_K}.$$

This implies that the absolute value of the slope of $\dot{K} = 0$ locus is less than the absolute value of the slope of $\dot{U} = 0$ locus. So the long run equilibrium point in Figure 1 is locally stable.

Case 2. $g_u - 1 > 0$
Trace of the Jacobian may have any sign.
$|J| < 0$ because $(g_u - 1) > 0$; $\psi_K < 0$; $\psi_U < 0$; and $g_K < 0$.
So the equilibrium is a saddle point.

APPENDIX (C)

In the long-run equilibrium, $\dot{K} = \dot{U} = 0$; and the comparative steady-state effects with respect to P on K and U are given by the followings:

$$(dK/dP) = |J_K|/|J| \quad \text{and} \quad (dU/dP) = |J_U|/|J| .$$

where,

$$|J_K| = -\psi_P \cdot (g_U - 1) + g_P \psi_U$$

and

$$|J_U| = -\psi_K g_P + g_K \psi_P .$$

$|J| > 0$ for equilibrium to be stable. $|J_U|$ and $|J_K|$ are, in general, unrestricted in sign.

Here $(dK/dP) < 0$ if $|J_K| < 0$ or,

$$\psi_P \cdot (g_U - 1) > g_P \psi_U$$

or,

$$\frac{g_U - 1}{\psi_U} < \frac{g_P}{\psi_P}.$$

Again $(dU/dP) > 0$ if $|J_U| > 0$ or,

$$\psi_K g_P > g_K \cdot \psi_P$$

or,

$$\frac{g_P}{\psi_P} < \frac{g_K}{\psi_K}.$$

So if (g_P/ψ_P) lies in between the absolute values of the slopes of $\dot{K} = 0$ locus and $\dot{U} = 0$ locus, then U rises and K falls in the new long-run equilibrium following a rise in P.