Child labour in the presence of agricultural dualism: possible cures

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Abstract: The paper using a three-sector general equilibrium model with agricultural dualism and child labour shows that any fiscal measures designed to benefit backward agriculture cannot cure the problem of child labour in a developing economy although they raise the non-child labour income of the poor households. A policy of capital led growth through inflows of foreign capital, on the contrary, will be able to alleviate the problem by encouraging advanced agriculture and lowering the demand for child labour. The analysis questions the desirability of assisting backward agriculture and advocates in favour of a liberalized investment policy for controlling the menace of child labour in the society.

Keywords: Child labour, general equilibrium, agricultural dualism, subsidy policy, capital led growth.

JEL classification: D15, J10, J13, O 12, O17.

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1. Introduction

The incidence of child labour is one of the most disconcerting problems in the transitional societies of developing economies. According to ILO (2002), one in every six children aged between 5 and 17 - or 246 million children are involved in child labour.[1] If the "invisible" workers who perform unpaid and household jobs are included, it is likely that the estimates would shoot up significantly further.

Available empirical evidences suggest that the concentration of child labour is the highest in the rural sector of a developing economy and that child labour is used intensively directly or indirectly in the agricultural sector[2]. In backward agriculture, the production techniques are primitive, use of capital is very low and child labour can almost do whatever adult labour does. Farming in backward agriculture is mostly done by using bullocks and ploughs and the cattle-feeding is entirely done by child labour. Besides, at the time of sowing of seeds and harvest children are often used in the family farms for helping adult members of the family. The advanced agricultural sector on the other hand uses mechanised techniques of production and uses agricultural machineries like tractors, seeders/planters, sprayers and harvesters etc. and therefore does not require child labour in its production process. This type of agricultural dualism is a very common feature of the developing countries. The distinction between advanced and backward agriculture can be made on the basis of inputs used, economies of scale, efficiency and elasticity of substitution between different factors of production.

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[1] Out of 246 million about 170 million child workers were found in different hazardous works. Some 8.4 million children were caught in the worst forms of child labour including slavery, trafficking, debt bondage and other forms of forced labour, forced recruitment for armed conflict, prostitution, pornography and other illicit activities (ILO, June 2002).

[2] According to the ILO (2002) report (figure 4, pp. 36), more than 70 per cent of economically active children in the developing countries are engaged in agriculture and allied sectors.

The existing theoretical literature on child labour[3], however, has not paid any attention as yet to agricultural dualism and its implications on the problem of child labour. This is important because from the view point of the use of child labour, these two types of agricultural sectors differ and any changes in their output composition will affect the magnitude of child labour use in the agricultural sector. Agriculture in many countries is supported by government's subsidy policies in the form of price support, export subsidy, credit support etc. In a developing country like India, farmers in backward agriculture are given price support with a view to protect themselves from sharp fall in their product prices during the times of over supply in the market. Government's Minimum Support Price mechanism is a very common form of government subsidy policy directed towards backward agriculture. These types of subsidy schemes are designed to benefit the poorer section of the working population who are the potential suppliers of child labour. It is therefore natural to expect that these fiscal measures will raise the earning opportunities of the poor households which in turn will lower the supply of child labour by these families through positive income effect. However, the matter is not as straightforward as it appears to be at the first sight. This is because apart from their impact on adult wages, these policies affect the output composition of different sectors and the earning opportunities of children as well. An expansion of backward agriculture resulting from a price subsidy policy to that sector, for example, will result in a higher demand for child labour and raise the use of child labour in the economy. Even if there is a positive income effect due to increase in adult wages, the net effect on child labour may be perverse. Any policy effect on the child labour incidence should, therefore, be carried out in a multi-sector general equilibrium framework so as to capture various linkages that may exist in the system.

The present paper is designed to examine the consequences of different agricultural subsidy policies on the child labour incidence in a developing economy in terms of a three-sector full-employment general equilibrium model with child labour and agricultural dualism. We consider a three-sector full-employment model with child labour. The economy is divided into two agricultural and one manufacturing sectors. One of the two agricultural sectors is backward agriculture (sector 2) that uses child labour. In this set-up we have examined the consequence of a

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[3] See Basu an Van (1998), Basu (1999), Gupta (2000, 2002), Jaferey and Lahiri (2002), Ranjan (1999, 2001), Baland and Robinson (2000), Chaudhuri (2010), Chaudhuri and Dwibedi (2006, 2007), Dwibedi and Chaudhuri (2010) among others. In the literature the supply of child labour has been attributed to factors such as abject poverty, lack of educational facilities and poor quality of schooling, capital market imperfection, parental attitudes including the objectives to maximize present income etc.

price subsidy policy designed to benefit backward agriculture and the poorer section of the working population on the aggregate supply of child labour in the economy. Our analysis finds that a price subsidy policy to backward agriculture is very likely to produce a perverse effect on the child labour incidence. On the contrary, a policy of growth with foreign capital will be effective in lessening the gravity of the child labour problem. The results obtained in the paper can at least question the desirability of assisting backward agriculture so as to eradicate the problem of child labour in the society.

2. The model

We consider a small open economy with three sectors: two agricultural and one manufacturing. Sector 1 is the advanced agricultural sector that produces its output, X_1, by means of adult labour (L), land (N) and capital (K). Capital used in this sector includes both physical capital like tractors and harvesters and working capital required for purchasing material inputs like fertilizers, pesticides, weedicides etc. The other agricultural sector, we call it backward agriculture (sector 2), produces its output, X_2, using adult and child labour (L_C) and land. Sector 2 does not require capital for its production. The land-output ratios in sectors 1, and 2 (a_{N1} and a_{N2}) are assumed to be technologically given. This assumption can be defended as follows. In one hectare of land the number of saplings that can be sown is given. There should be a minimum gap between two saplings and land cannot be substituted by other factors of production. Besides, empirical evidence from developing countries, like India, suggests that the productivity per hectare of land has remained more or less unchanged over a long period of time.[4]

It is sensible to assume that the backward agricultural sector is more adult labour-intensive vis-à-vis the advanced agricultural sector with respect to land. This implies that $\frac{a_{L2}}{a_{N2}} > \frac{a_{L1}}{a_{N1}}$, where a_{ji}s are input-output ratios. Available empirical evidence suggests that the concentration of

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[4] In case of India, per hectare wheat production was 2708 kg in 2000-01 and it remained at 2708 kg per hectare even for the year 2006-07. Besides, per hectare food grains production was 1734 kg in 2001-02 and the corresponding figure for the year 2006-07 was 1756 kg indicating fairly constant land-output ratio.

child labour is the highest in the rural sector of a developing economy and that child labour is used intensively directly or indirectly in backward agriculture that uses primitive production techniques. The advanced agricultural sector, on the other hand, uses mechanised techniques of production and does not require child labour in production. Child labour is therefore specific to backward agriculture. The two agricultural sectors are the two informal sectors in the sense that the adult workers receive competitive wage, W, and these are the two export sectors of the economy. The formal sector (sector 3) is the import-competing sector that produces a manufacturing commodity, X_3 using adult labour and capital. The formal sector faces a unionised labour market where workers receive a contractual wage $\overline{W}$ with $\overline{W} > W$. The adult labour allocation mechanism is as follows. Adult workers first try to get employment in the formal sector that offers the higher wage and those who are unable to find employment in the said sector are automatically absorbed in the two agricultural sectors, as the wage rate there is perfectly flexible. Capital is completely mobile between sectors 1 and 3. Owing to the small open economy assumption all the three commodity prices, P_is, are given internationally. Competitive markets, excepting the formal sector labour market, constant returns to scale (CRS) technologies with positive and diminishing marginal productivities of inputs[5] and full-employment of resources are assumed. Commodity 1 is chosen as the numeraire.

The following three equations present the zero-profit conditions relating to the three sectors of the economy.

$$Wa_{L1} + Ra_{N1} + ra_{K1} = 1 \tag{1}$$

$$Wa_{L2} + W_C a_{C2} + Ra_{N2} = P_2(1 + S_P) \tag{2}$$

$$\overline{W}a_{L3} + ra_{K3} = P_3 \tag{3}$$

where R, r and W_C stand for return to land, return to capital and child wage rate, respectively. S_P stands for the rate of ad-valorem price subsidy given to backward agriculture.

Complete utilization of adult labour, capital, land and child labour imply the following four equations, respectively.

$$a_{L1}X_1 + a_{L2}X_2 + a_{L3}X_3 = L \tag{4}$$

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[5] The land-output ratios in the two agricultural sectors (a_{N1} and a_{N2}) have been assumed to be technologically given. However, the other inputs exhibit CRS between themselves.

$$a_{K1}X_1 + a_{K3}X_3 = K \quad (5)$$

$$a_{N1}X_1 + a_{N2}X_2 = N \quad (6)$$

$$a_{C2}X_2 = L_C \quad (7)$$

While endowments of adult labour, land and capital[6] are fixed in the economy, the aggregate supply of child labour, L_C, is endogenously determined from the utility maximizing behavior of the households.

2.1. Household behaviour

We derive the supply function of child labour from the utility maximizing behaviour of the representative altruistic poor household. There are L numbers of working families, which are classified into two groups with respect to the earnings of their adult members. The adult workers who work in the higher paid formal manufacturing sector comprise the richer section of the working population. On the contrary, labourers who are engaged in the informal agricultural sectors constitute the poorer section. There is now considerable evidence and theoretical reason for believing that, in developing countries, parents send their children to work out of sheer poverty. Following the '*Luxury Axiom*'[7] of Basu and Van (1998), we assume that there exists a critical level of family (or adult labour) income, W^*, such that the parents will send their children out to work if and only if the actual adult wage rate is less than this critical level. We assume that each worker in the formal manufacturing sector earns a wage income, $\bar{W}$, sufficiently higher than this critical level[8]. So, the workers of the formal sector do not send their children to

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[6] The capital endowment of the economy may, however, increase in the presence of foreign direct investment (FDI).

[7] Basu and Van (1998) have shown that if child labour and adult labour are substitutes (Substitution Axiom) and if child leisure is a luxury commodity to the poor households (Luxury Axiom), unfavourable adult labour market, responsible for low adult wage rate, is the driving force behind the incidence of child labour. According to the Luxury Axiom, there exists a critical level of adult wage rate, and any adult worker earning below this wage rate, considers himself as poor and does not have the luxury to send his offspring to schools. He is forced to send his children to the job market to supplement low family income out of sheer poverty.

[8] We can also quantify this critical value in our model. From equation (10) we can say that $l_C = 0$ if $W \geq \dfrac{n(1-\gamma)W_C}{\gamma}$.

work. On the other hand, adult workers employed in the two agricultural sectors earn W amount of wage income (we assume that this is their only source of income excluding income from child labour), which is less than the critical wage , W^*, and therefore send some of their children to the job market to supplement low family income. For the sake of simplicity, we assume that capital-owners and land-owners are separate classes and they do not supply any child labour.[9]

The supply function of child labour by each poor working family (all assumed to be identical) is determined from the utility maximizing behaviour of the representative altruistic household who works as wage labour in any of the agricultural sectors. We assume that each working family consists of one adult member and 'n' number of children. The altruistic adult member of the family (guardian) decides the number of children to be sent to the workplace (l_C). The utility function of the household is given by

$$U = U(C_1, C_2, C_3, (n - l_C))$$

The household derives utility from the consumption of the three commodities, C_i s and from the children's leisure. For analytical simplicity let us consider the following Cobb-Douglas type of the utility function.

$$U = A(C_1)^{\alpha}(C_2)^{\beta}(C_3)^{\rho}(n - l_C)^{\gamma} \tag{8}$$

with $A > 0$, $1 > \alpha, \beta, \rho, \gamma > 0$; and, $(\alpha + \beta + \rho + \gamma) = 1$.

It satisfies all the standard properties and it is homogeneous of degree 1.

The household maximizes its utility subject to the following budget constraint.

$$P_1C_1 + P_2C_2 + P_3C_3 = (W_C l_C + W) \tag{9}$$

where, W is the income of the adult worker and $W_C l_C$ measures the income from child labour.

Maximizing the utility function with respect to its arguments and subject to the above budget constraint and solving for l_C the following family child labour supply function can be derived.[10]

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[9] Alternatively, one can assume that rental incomes are equally divided among the L number of working families. Consequently, share of rental incomes enters into the household maximization exercise.

[10] See Appendix I for mathematical derivation.

$$l_C = \{(1-\gamma)n - \gamma(W / W_C)\} \tag{10}$$

From (10) it is easy to check that l_C varies negatively with the adult wage rate, W. A rise in W produces a positive income effect so that the adult worker chooses more leisure for his children and therefore decides to send a fewer number of children to the workplace. An increase in W_C , on the other hand, implies increased opportunity cost of leisure and therefore produces a negative substitution effect, which increases the supply of child labour from each family.[11]

In our model there are $L_I (= L - a_{L3}X_3)$ number of adult workers engaged in the two informal sectors and each of them sends l_C number of children to the workplace. Thus, the aggregate supply function of child labour in the economy is given by

$$L_C = [(1-\gamma)n - \gamma(W / W_C)](L - a_{L3}X_3) \tag{11}$$

2.2. The General Equilibrium Analysis

Using (11), equation (7) can be rewritten as

$$a_{C2}X_2 = [(1-\gamma)n - \gamma(W / W_C)](L - a_{L3}X_3) \tag{7.1}$$

The general equilibrium structure of the economy is represented by equations (1) – (6), (7.1) and (11). There are eight endogenous variables in the system: $W, W_C, R, r, X_1, X_2, X_3$ and L_C and the same number of independent equations (namely equations (1) – (6), (7.1) and (11). The parameters in the system are: $P_2, P_3, L, K, N, \overline{W}, \alpha, \beta, \rho, \gamma, n$ and S_P. Equations (1) – (3) constitute the price system. This is an indecomposable system with three price equations and four factor prices, W, W_C, r and R. So factor prices depend on both commodity prices and factor endowments. Given the child wage rate, sectors 1 and 2 together effectively form a modified Heckscher-Ohlin system as they use both adult unskilled labour and land in their production. Given the world prices and the unionised wage $\overline{W}$, r is determined from equation (3). Now

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[11] It may be checked that the results of this paper hold for any utility function generating a supply function of child labour that satisfies these two properties.

W, W_C, R, X_1, X_2 and X_3 are simultaneously obtained from equation (1), (2), (4) – (6) and (7.1). Finally, L_C is determined from (11).

3. Comparative Statics

As discussed earlier agriculture in many countries, especially backward agriculture in developing countries is supported by different subsidies of the government. The primary objective of such a fiscal support is poverty alleviation. As these policies are designed to benefit the poorer section of the working population, conventional wisdom suggests that these measures will raise the adult income of the poor households which in turn will put a brake on the problem of child labour in the society. This section is aimed at examining the efficacy of a price subsidy policy in mitigating the child labour problem in the economy.

For determining the consequences of the price subsidy policy to backward agriculture on factor prices and output composition after totally differentiating equations (1), (2), (4) –(6) and (7.1) and solving by Cramer's rule we can establish the following proposition[12].

Proposition 1: A price subsidy policy to backward agriculture leads to (i) increases in both adult wage, W, and child wage, W_C; (ii) a fall in the (W/W_C) ratio and an expansion (a contraction) of the backward (advanced) agricultural sector. The formal manufacturing sector contracts if $\{S_{KL}^1 |\lambda|_{NL}^{12} + \lambda_{N2}\lambda_{L1}S_{LL}^1\} \geq 0$ □[13].

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[12] See Appendix II for detailed derivations.

[13] Here S_{ji}^k is the degree of substitution between factors j and i in the kth sector with $S_{ji}^k > 0$ for $j \neq i$; and, $S_{jj}^k < 0$ while λ_{ji} is the allocative share of jth input in ith sector. Besides, $|\lambda|_{NL}^{12} = (\lambda_{N1}\lambda_{L2} - \lambda_{L1}\lambda_{N2}) > 0$ as the backward agriculture (sector 2) is more adult labour-intensive vis-à-vis the advanced agriculture (sector 1) with respect to land.

Proposition 1 can be explained in economic terms in the following fashion. As r is determined from the zero-profit condition for sector 3 (equation (3)) and remains unchanged despite a change in S_P, sectors 1 and 2 together can effectively be regarded as a *Modified Hechscher-Ohlin subsystem (MHOSS)* because they use two common inputs: adults labour and land. The modification is due to the fact that apart from adult labour and land sector 2 uses child labour and sector 1 uses capital as inputs. An increase in S_P that raises the effective producer price of commodity 2 lowers the rate of return to land, R and raises the adult wage, W following a *Stolper-Samuelson type effect,* as sector 2 is more adult labour-intensive than sector 1 with respect to land. As adult wage rate increases producers in sector 1 substitute adult labour by capital while their counterparts in sector 2 substitute adult labour by child labour. As the adult labour-output ratios (a_{L1} and a_{L2}) in the two agricultural sectors fall the availability of adult labour to the *MHOSS* rises that in turn produces an expansionary (a contractionary) effect on sector 2 (sector 1) following a *Rybczynski type effect*. As backward agriculture expands the demand for child labour increases as child labour is specific to that sector. This raises the child wage rate (W_C). As both W and W_C increase there would be two opposite effects on the supply of child labour by each poor working families. It is easy to check that the proportionate increase in child wage rate is greater than that in adult wage so that (W / W_C) falls[14]. What happens to sector 3 will be determined by movement of capital between sector 1 and sector 3. As adult wage rate increases, with given rate of interest and constant land coefficient, wage-rental ratio in the advanced agricultural sector increases and producers in sector 1 substitute adult labour by capital resulting in an increase in a_{K1}. But as sector 1 has contracted the net effect on the use of capital in this sector is ambiguous. However, it can be proved that use of capital increases (decreases) in sector 1 (sector 3) under the sufficient condition that $\{S_{KL}^1 \left|\lambda\right|_{NL}^{12} + \lambda_{N2}\lambda_{L1}S_{LL}^1\} \geq 0$. Consequently, sector 3 contracts.[15]

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[14] This result is consistent with specific factor models. For an understanding of how return to inter sectoral mobile factor and specific factors reacts to change in relative commodity prices, one can go through Jones (1971). See Appendix II for mathematical proof.

[15] Note that the capital-output ratio in sector 3 (a_{K3}) is given as r does not change.

3.1 Price subsidy to backward agriculture and incidence of child labour

For examining the implications of the subsidy policies on the incidence of child labour in the economy we use the aggregate child labour supply function, which is given by equation (11). We note that any policy affects the supply of child labour in two ways: (i) through a change in the size of the informal sector adult labour force, $(L_I = L - a_{L3}X_3)$, as these families are considered to be the suppliers of child labour; and, (ii) through a change in l_C (the number of child workers supplied by each poor family), which results from a change in the (W / W_C) ratio. Differentiating equation (11) the following proposition can be proved.[16]

Proposition 2: A price subsidy policy directed towards backward agricultural sector will worsen the problem of child labour in the economy either if $\{S_{KL}^1 \left|\lambda\right|_{NL}^{12} + \lambda_{N2}\lambda_{L1}S_{LL}^1\} \geq 0$; or if, $S_{LC}^2 S_{KL}^1 \geq S_{CC}^2 S_{LL}^1$.

As explained previously, a price subsidy policy to backward agriculture lowers the (W / W_C) ratio, which in turn increases the supply of child labour from each poor working family. On the other hand, as the formal sector contracts in terms of output and employment (under the sufficient condition mentioned earlier) the number of poor working families, which are considered to be the suppliers of child labour, $(L - a_{L3}X_3)$, increases. So, we have a situation where there are more poor families each supplying an increased number on child worker. Therefore, a price subsidy to backward agriculture aggravates the problem of child labour in the society.

4. Quest for alternative policies

What alternative policies this theoretical analysis recommends in combating the problem of child labour is the crucial question the answer to which the present section attempts to provide. We have already demonstrated that a policy which only targets the supply side of the child labour

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[16] This has been derived in Appendix IV.

problem may not be effective in mitigating the prevalence of the evil in the system. This is because a policy that encourages backward agriculture to grow does not only increase the non-child labour income (adult income) but also boosts up the demand for child labour. A policy that addresses the demand side of the problem is likely to be effective under the given circumstances. Mechanized farming should be encouraged that lowers the demand for child labour. One such alternative policy could be growth with foreign capital. To capture the effects of foreign direct investment (FDI) flows[17] totally differentiating equations (1), (2), (4) – (6) and (7.1) and solving by Cramer's rule we get the following result[18].

Proposition 3: An inflow of foreign capital leads to (i) an increase in adult wage, W; (ii) a fall in child wage, W_C; (iii) an increase in the (W/W_C) ratio; and, (iv) and an expansion (a contraction) of the advanced (backward) agricultural sector. The formal manufacturing sector also expands owing to capital inflows.

An FDI inflow raises the capital stock of the economy. But the rate of return to capital does not change as it is determined from equation (3). Both the capital using sectors i.e. sector 1 and sector 3 expand.[19] This raises the demand for adult labour. Consequently, the adult informal wage, W, rises. This lowers the return to land, R (see equation (1)). For supplying additional land required for expansion of sector 1, sector 2 has to contract. The contracting backward agriculture (sector 2) also supplies the extra adult labour to the expanding other two sectors. The demand for child labour goes down that lowers the child wage rate, W_C. As W rises and W_C falls the relative adult wage (W/W_C) increases unambiguously[20] which in turn lowers the supply of child labour by each poor working household. On the other hand, as the formal sector (sector 3) has expanded both in terms of output and employment the number of poor working families engaged in the two agricultural sectors falls. So, we have a situation where there are fewer potential child labour supplying families with each of them sending a fewer number of children to workplace. Thus,

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[17] Here foreign capital and domestic capital have been assumed to be perfect substitutes.

[18] For mathematical derivations see Appendices II and III.

[19] See Appendix III.

[20] See Appendix II.

both the forces work together and result in an unambiguous fall in the aggregate supply of child labour in the society.

It is worthwhile in this connection to point out that a policy of subsidizing/encouraging advanced agriculture in the form of a price and/or a credit subsidy will also be effective in lessening the child labour incidence but that will be at the cost of lowering the adult wage rate. Looking at the price system (equations (1) – (3)) it is easy to find that a price and/or a credit subsidy to advanced agriculture effectively raises the relative price of commodity 1. That produces a *Stolper-Samuelson effect* in the *MHOSS* that results in an increase the return to land, R and a decrease in the adult wage, W as sector 1 is more land-intensive relative to sector 2 with respect to adult labour. This produces an expansionary (a contractionary) effect on sector 1 (sector 2). As sector 2 contracts the demand for child labour goes down as this is specific to this sector. Consequently, the child wage rate falls. It is easy to check that the proportionate fall in child wage rate is greater than that in adult wage so that (W / W_C) rises. This lowers the supply of child labour by each poor working family, l_C. It can be shown[21] that under the sufficient condition that $\{S_{KL}^1 \left|\lambda\right|_{NL}^{12} + \lambda_{N2}\lambda_{L1}S_{LL}^1\} \geq 0$ sector 3 expands. So, we can have a situation where there are fewer families each supplying a lower number of child workers. Therefore, the aggregate supply of child labour falls at the cost of further impoverishment[22] of the child labour supplying families. This establishes the final proposition of the model.

Proposition 4: A price and/or a credit subsidy policy to advanced agriculture succeeds in bringing down the prevalence of child labour in the society under the sufficient condition that $\{S_{KL}^1 \left|\lambda\right|_{NL}^{12} + \lambda_{N2}\lambda_{L1}S_{LL}^1\} \geq 0$. However, each poor family becomes poorer due to this policy.

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[21] Interested readers can easily check this after going through Appendices II and III.

[22] Note that both W and W_C fall due to the policy. Aggregate income of each family unequivocally plummets as l_C falls too.

5. Concluding remarks

In a developing country the government often tinkers with market mechanism using its tax and subsidy policies for different purposes. It is a common belief that the backward agricultural sector should be subsidized as poorer group of the working population are employed in this sector who send their children out to work out of sheer poverty. If the economic conditions of these people can be improved the social menace of child could automatically be mitigated. The analysis of this paper has challenged this populist belief using a three-sector general equilibrium model with child labour and agricultural dualism. The advanced agriculture is distinguished from backward agriculture as follows. The former uses capital in the form of agricultural machineries that prevents child labour to work on these farms. On the contrary, backward agriculture uses primitive techniques of cultivation and employs child labour in a significant number. Apart from this, backward agriculture uses more labour-intensive (adult labour) technique vis-à-vis advanced agriculture with respect to land. In this backdrop we have examined the consequences of a price subsidy policy designed to benefit backward agriculture on the aggregate supply of child labour in the economy. We have found that fiscal policies that encourage backward agriculture sector are likely to aggravate the child labour problem in the economy. We have then proposed a couple of alternative policies to deal with the child labour situation. We have advocated in favour of polices that target the demand side of the problem. Our analysis has shown how an FDI led growth strategy that encourages mechanized farming or incentive policies designed to benefit advanced agriculture will be effective in reducing the gravity of the child labour incidence. However, the analysis has suggested that the FDI led growth strategy is superior to subsidization policy to advanced agriculture because the former policy unlike the latter does not lead to further impoverishment of the child labour supplying families. The paper questions the desirability of assisting backward agriculture from the view point of eradication of child labour and advocates in favour of a more liberalized investment policy.

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Appendix I: Derivation of family supply function of child labour

Maximizing equation (8) with respect to C_1, C_2, C_3 and l_C and subject to the budget constraint (9) the following first-order conditions are obtained.

$$((\alpha U)/(P_1 C_1)) = ((\beta U)/(P_2 C_2)) = ((\rho U)/(P_3 C_3)) = ((\gamma U)/(n - l_C)W_C) \tag{A.1}$$

From (A.1) we get the following expressions.

$$C_1 = \{\alpha(n - l_C)W_C /(\gamma P_1)\} \tag{A.2}$$

$$C_2 = \{\beta(n - l_C)W_C /(\gamma P_2)\} \tag{A.3}$$

$$C_3 = \{\rho(n - l_C)W_C /(\gamma P_3)\} \tag{A.4}$$

Substitution of the values of C_1, C_2 and C_3 into the budget constraint and further simplifications give us the following child labour supply function of each poor working household.

$$l_C = \{(\alpha + \beta + \rho)n - \gamma(W / W_C)\} \tag{10}$$

Appendix II: Changes in factor prices

As r is determined from equation (3), it is independent of any changes in S_P and K. In other words, we have $\hat{r} = 0$.

Now we totally differentiate equations (1), (2), (4) – (6) and (7.1), collecting terms and arranging in a matrix notation we get the following expression.

$$\begin{bmatrix} \theta_{L1} & \theta_{N1} & 0 & 0 & 0 & 0 \\ \theta_{L2} & \theta_{N2} & \theta_{C2} & 0 & 0 & 0 \\ \overline{S}_{LL} & 0 & \lambda_{L2}S_{LC}^2 & \lambda_{L1} & \lambda_{L2} & \lambda_{L3} \\ \lambda_{K1}S_{KL}^1 & 0 & 0 & \lambda_{K1} & 0 & \lambda_{K3} \\ 0 & 0 & 0 & \lambda_{N1} & \lambda_{N2} & 0 \\ (S_{CL}^2 + \dfrac{\gamma W}{l_C W_C}) & 0 & (S_{CC}^2 - \dfrac{\gamma W}{l_C W_C}) & 0 & 1 & \dfrac{\lambda_{L3}}{(1-\lambda_{L3})} \end{bmatrix} \begin{bmatrix} \hat{W} \\ \hat{R} \\ \hat{W}_C \\ \hat{X}_1 \\ \hat{X}_2 \\ \hat{X}_3 \end{bmatrix} = \begin{bmatrix} 0 \\ G.\hat{S}_P \\ 0 \\ \hat{K} \\ 0 \\ 0 \end{bmatrix} \tag{A.5}$$

where,

$$
\left.
\begin{aligned}
&G = \frac{S_P}{(1+S_P)} > 0\,; \\
&\overline{S}_{LL} = (\lambda_{L1}S_{LL}^1 + \lambda_{L2}S_{LL}^2) < 0; \\
&\Delta = [\{\lambda_{L2}S_{LC}^2 A_1 - (S_{CC}^2 - \frac{\gamma W}{l_C W_C})A_2\}(\theta_{L1}\theta_{N2} - \theta_{N1}\theta_{L2}) \\
&\qquad +\theta_{N1}\theta_{C2}\{\overline{S}_{LL}A_1 - \lambda_{K1}S_{KL}^1 A_3 - (S_{CL}^2 + \frac{\gamma W}{l_C W_C})A_2\}] < 0 \\
&A_1 = \lambda_{K1}(\lambda_{N2}\frac{\lambda_{L3}}{1-\lambda_{L3}}) + \lambda_{N1}\lambda_{K3} > 0 \\
&A_2 = \lambda_{K3}(\lambda_{N1}\lambda_{L2} - \lambda_{L1}\lambda_{N2}) + \lambda_{K1}\lambda_{L3}\lambda_{N2} > 0 \\
&A_3 = \frac{1}{1-\lambda_{L3}}(\lambda_{N2}\lambda_{L3}\lambda_{L1} + \lambda_{N1}\lambda_{L3}\lambda_{L1}) = \frac{\lambda_{L3}\lambda_{L1}}{1-\lambda_{L3}} > 0
\end{aligned}
\right\} \tag{A.6}
$$

$\left|\lambda\right|_{NL}^{12} = (\lambda_{N1}\lambda_{L2} - \lambda_{L1}\lambda_{N2}) > 0$ as we have assumed that the backward agricultural sector is more adult labour-intensive vis-à-vis the advanced agricultural sector with respect to land both in physical and value sense. The latter implies that $(\theta_{L1}\theta_{N2} - \theta_{N1}\theta_{L2}) < 0$ which in turn shows that $\Delta < 0$.

Solving (A.5) by Cramer's rule the following expressions are obtained.

$$\hat{W} = -\frac{1}{\Delta}\{\lambda_{L2}S_{LC}^2 A_1 - (S_{CC}^2 - \frac{\gamma W}{l_C W_C})A_2\}\theta_{N1}G\hat{S}_P - \frac{1}{\Delta}\theta_{N1}\theta_{C2}A_3\hat{K} \tag{A.7}$$

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$$\hat{W}_C = \frac{1}{\Delta}\{\overline{S}_{LL}A_1 - \lambda_{K1}S_{KL}^1 A_3 - (S_{CL}^2 + \frac{\gamma W}{l_C W_C})A_2\}\theta_{N1}G\hat{S}_P - \frac{1}{\Delta}(\theta_{L1}\theta_{N2} - \theta_{N1}\theta_{L2})A_3\hat{K} \tag{A.8}$$

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$$\hat{R} = \frac{1}{\Delta}\{\lambda_{L2}S_{LC}^2 A_1 - (S_{CC}^2 - \frac{\gamma W}{l_C W_C})A_2\}\theta_{L1}G\hat{S}_P + \frac{1}{\Delta}\theta_{L1}\theta_{C2}A_3\hat{K} \tag{A.9}$$

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Now subtraction of (A.8) from (A.7) yields

$$(\hat{W}-\hat{W}_C) = -\frac{1}{\Delta}[A_1(\lambda_{L2}S_{LC}^2+\overline{S}_{LL})-A_2(S_{CC}^2+S_{CL}^2)-\lambda_{K1}S_{KL}^1A_3)]\theta_{N1}G\hat{S}_P$$

$$-\frac{1}{\Delta}\{\theta_{N1}\theta_{C2}-(\theta_{L1}\theta_{N2}-\theta_{N1}\theta_{L2})\}A_3\hat{K}$$

Using the expression of $\overline{S}_{LL}$ from (A.6) we can further simplify the expression of $(\hat{W}-\hat{W}_C)$ as follows.

$$(\hat{W}-\hat{W}_C) = -\frac{1}{\Delta}[A_1\lambda_{L1}S_{LL}^1-\lambda_{K1}S_{KL}^1A_3]\theta_{N1}G\hat{S}_P$$

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$$-\frac{1}{\Delta}\{\theta_{N1}\theta_{C2}-(\theta_{L1}\theta_{N2}-\theta_{N1}\theta_{L2})\}A_3\hat{K} \tag{A.10}$$

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[Note that $(S_{CC}^2+S_{CL}^2)=0$ and $(S_{LL}^2+S_{LC}^2)=0$, (note that as a_{N2} is constant $S_{CN}^2=0$ and $S_{LN}^2=0$.]

Using (A.6), from (A.7) – (A.9) and (A.10) we can obtain the following results.

$$\left.\begin{array}{ll}
\text{(i)} & \hat{W}>0, \hat{R}<0 \text{ and } \hat{W}_C>0 \text{ when } \hat{S}_P>0; \\
\text{(ii)} & (\hat{W}-\hat{W}_C)<0 \text{ when } \hat{S}_P>0 \\
\text{(iii)} & \hat{W}>0, \hat{R}<0 \text{ and } \hat{W}_C<0 \text{ when } \hat{K}>0; \\
\text{(iv)} & (\hat{W}-\hat{W}_C)>0 \text{ when } \hat{K}>0
\end{array}\right\} \tag{A.11}$$

Appendix III: Changes in output composition

Solving (A.5) by Cramer's Rule we can derive the following expressions as well.

$$\hat{X}_1 = -\frac{1}{\Delta}[(S_{CL}^2 + \frac{\gamma W}{l_C W_C})\lambda_{L2} S_{LC}^2 \lambda_{K3} - (S_{CC}^2 - \frac{\gamma W}{l_C W_C})(\bar{S}_{LL}\lambda_{K3} - \lambda_{K1} S_{KL}^1 \lambda_{L3})$$

$$-\frac{\lambda_{L3}}{(1-\lambda_{L3})}\lambda_{L2} S_{LC}^2 \lambda_{K1} S_{KL}^1)]\theta_{N1}\lambda_{N2} G\hat{S}_P$$

$$+\frac{1}{\Delta}[\{\lambda_{L2} S_{LC}^2 \lambda_{N2}\frac{\lambda_{L3}}{(1-\lambda_{L3})} - (S_{CC}^2 - \frac{\gamma W}{l_C W_C})\lambda_{L3}\lambda_{N2}\}(\theta_{L1}\theta_{N2} - \theta_{N1}\theta_{L2})$$

$$+\theta_{N1}\theta_{C2}\{\bar{S}_{LL}\lambda_{N2}\frac{\lambda_{L3}}{(1-\lambda_{L3})} - (S_{CL}^2 + \frac{\gamma W}{l_C W_C})\lambda_{L3}\lambda_{N2}\}]\hat{K}$$

Or,

$$\hat{X}_1 = -\underset{(-)}{\frac{1}{\Delta}}[-\underset{(-)}{(S_{CC}^2 - \frac{\gamma W}{l_C W_C})}\underset{(-)}{(\lambda_{L1} S_{LL}^1 \lambda_{K3} - \lambda_{K1} S_{KL}^1 \lambda_{L3})} - \frac{\lambda_{L3}}{(1-\lambda_{L3})}\lambda_{L2} S_{LC}^2 \underset{(+)}{\lambda_{K1} S_{KL}^1})]\underset{(+)}{\theta_{N1}\lambda_{N2} G\hat{S}_P}$$

$$+\underset{(-)}{\frac{1}{\Delta}}[\{\underset{(+)}{\frac{\lambda_{L2} S_{LC}^2}{(1-\lambda_{L3})}} - \underset{(-)}{(S_{CC}^2 - \frac{\gamma W}{l_C W_C})}\}\lambda_{L3}\lambda_{N2}\underset{(-)}{(\theta_{L1}\theta_{N2} - \theta_{N1}\theta_{L2})}$$

$$+\theta_{N1}\theta_{C2}\lambda_{L3}\lambda_{N2}\{\underset{(-)}{\frac{\bar{S}_{LL}}{(1-\lambda_{L3})}} - \underset{(+)}{(S_{CL}^2 + \frac{\gamma W}{l_C W_C})}\}]\hat{K} \tag{A.12}$$

$$\hat{X}_2 = \underset{(-)}{\frac{1}{\Delta}}[-\underset{(-)}{(S_{CC}^2 - \frac{\gamma W}{l_C W_C})}\underset{(-)}{(\lambda_{L1} S_{LL}^1 \lambda_{K3}} - \underset{(+)}{\lambda_{K1} S_{KL}^1 \lambda_{L3})} - \frac{\lambda_{L3}}{(1-\lambda_{L3})}\lambda_{L2} S_{LC}^2 \underset{(+)}{\lambda_{K1} S_{KL}^1})]\underset{(+)}{\theta_{N1}\lambda_{N1} G\hat{S}_P}$$

$$-\underset{(-)}{\frac{1}{\Delta}}[\{\underset{(+)}{\frac{\lambda_{L2} S_{LC}^2}{(1-\lambda_{L3})}} - \underset{(-)}{(S_{CC}^2 - \frac{\gamma W}{l_C W_C})}\}\lambda_{L3}\lambda_{N1}\underset{(-)}{(\theta_{L1}\theta_{N2} - \theta_{N1}\theta_{L2})}$$

$$+\theta_{N1}\theta_{C2}\lambda_{L3}\lambda_{N1}\{\underset{(-)}{\frac{\bar{S}_{LL}}{(1-\lambda_{L3})}} - \underset{(+)}{(S_{CL}^2 + \frac{\gamma W}{l_C W_C})}\}]\hat{K} \tag{A.13}$$

[We have used the expression of $\bar{S}_{LL}$ and note that $S_{LC}^2 + S_{LL}^2 = 0$ and $S_{CC}^2 + S_{CL}^2 = 0$]

$$\hat{X}_3 = -\frac{1}{\Delta}[\{(S_{CC}^2 - \frac{\gamma W}{l_C W_C})\lambda_{L2}\lambda_{K1}S_{KL}^1 - \lambda_{L2}S_{LC}^2\lambda_{K1}S_{KL}^1\}\lambda_{N1}$$

$$-\{(S_{LC}^2 + \frac{\gamma W}{l_C W_C})\lambda_{L2}S_{LC}^2\lambda_{K1} - (S_{CC}^2 - \frac{\gamma W}{l_C W_C})(\bar{S}_{LL}\lambda_{K1} - \lambda_{L1}\lambda_{K1}S_{KL}^1)\}\lambda_{N2}]\theta_{N1}G\hat{S}_P$$

$$+\frac{1}{\Delta}[\{\lambda_{L2}S_{LC}^2\lambda_{N1} - (S_{CC}^2 - \frac{\gamma W}{l_C W_C})(\lambda_{N1}\lambda_{L2} - \lambda_{L1}\lambda_{N2})\}(\theta_{L1}\theta_{N2} - \theta_{N1}\theta_{L2})$$

$$+\theta_{N1}\theta_{C2}\{\bar{S}_{LL}\lambda_{N1} - (S_{CL}^2 + \frac{\gamma W}{l_C W_C})(\lambda_{N1}\lambda_{L2} - \lambda_{L1}\lambda_{N2})\}]\hat{K}$$

Or,

$$\hat{X}_3 = -\frac{1}{\Delta}[-\lambda_{L2}S_{LC}^2S_{KL}^1\lambda_{N1} + (S_{CC}^2 - \frac{\gamma W}{l_C W_C})\{S_{KL}^1 \left|\lambda\right|_{NL}^{12} + \lambda_{N2}\lambda_{L1}S_{LL}^1\}]\lambda_{K1}\theta_{N1}G\hat{S}_P$$

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$$+\frac{1}{\Delta}[\{\lambda_{L2}S_{LC}^2\lambda_{N1} - (S_{CC}^2 - \frac{\gamma W}{l_C W_C})(\lambda_{N1}\lambda_{L2} - \lambda_{L1}\lambda_{N2})\}(\theta_{L1}\theta_{N2} - \theta_{N1}\theta_{L2})$$

(−) (+) (−) (+) (−)

$$+\theta_{N1}\theta_{C2}\{\bar{S}_{LL}\lambda_{N1} - (S_{CL}^2 + \frac{\gamma W}{l_C W_C})(\lambda_{N1}\lambda_{L2} - \lambda_{L1}\lambda_{N2})\}]\hat{K} \quad \text{(A.14)}$$

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From (A.12) - (A.14) we get the following

$$\left.\begin{array}{ll}
\text{(v)} & \hat{X}_1 < 0, \hat{X}_2 > 0 \text{ when } \hat{S}_P > 0; \\
\text{(vi)} & \hat{X}_3 < 0 \text{ when } \hat{S}_P > 0 \\
\text{(vii)} & \hat{X}_1 > 0, \hat{X}_2 < 0 \text{ when } \hat{K} > 0; \\
 & \text{under the sufficient condition that} \{S_{KL}^1 \left|\lambda\right|_{NL}^{12} + \lambda_{N2}\lambda_{L1}S_{LL}^1\} \geq 0 \\
\text{(viii)} & \hat{X}_3 > 0 \text{ when } \hat{K} > 0.
\end{array}\right\} \quad \text{(A.15)}$$

Also note that $\hat{K}_3 = \hat{X}_3$ where $K_3 = a_{K3}X_3$ (this is because $\hat{a}_{K3} = 0$). So,

$$\left.\begin{array}{l}
\text{(ix) } \hat{K}_3 < 0 \text{ when } \hat{S}_P > 0; \text{ and,} \\
\text{(x) } \hat{K}_3 > 0 \text{ when } \hat{K} > 0.
\end{array}\right\} \quad \text{(A.16)}$$

Appendix IV: Proof of proposition 3

Totally differentiating equation (11) we get the following

$$\hat{L}_C = -\frac{\gamma W}{l_C W_C}(\hat{W} - \hat{W}_C) - \frac{\lambda_{L3}}{(1-\lambda_{L3})}\hat{X}_3$$

We now substitute the expressions of $\hat{X}_3$ and $(\hat{W} - \hat{W}_C)$ from (A.14) and (A.10) respectively to get the following expression.

$$\hat{L}_C = -\frac{1}{\Delta}[-\frac{\gamma W}{l_C W_C}(A_1 \lambda_{L1} S_{LL}^1 - \lambda_{K1} S_{KL}^1 A_3)$$

(−) (−) (+)

$$-\frac{\lambda_{L3}}{(1-\lambda_{L3})}\{-\lambda_{L2} S_{LC}^2 S_{KL}^1 \lambda_{N1} + (S_{CC}^2 - \frac{\gamma W}{l_C W_C})(S_{KL}^1 |\lambda|_{NL}^{12} + \lambda_{N2} \lambda_{L1} S_{LL}^1)\}\lambda_{K1}]\ \theta_{N1} G \hat{S}_P \qquad (12)$$

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From (12) we get the following results.

$\hat{L}_C > 0$ when $\hat{S}_P > 0$ under the sufficient condition $\{S_{KL}^1 |\lambda|_{NL}^{12} + \lambda_{N2} \lambda_{L1} S_{LL}^1\} \geq 0$

Rewriting (12) in a different way it can be checked that the above result also hold under the sufficient condition that $S_{LC}^2 S_{KL}^1 \geq S_{CC}^2 S_{LL}^1$.