Agricultural Subsidy Policies Fail to Deal with Child Labour under Agricultural Dualism: What could be the Alternative Policies?

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Agricultural Subsidy Policies Fail to Deal with Child Labour under Agricultural Dualism: What could be the Alternative Policies?♣

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Abstract: We provide a theoretical explanation why agricultural subsidy policies are likely to fail to ensure simultaneous eradication of the incidence of child labour and improvement in the well-being of the poor working families in terms of a three-sector general equilibrium model with child labour and agricultural dualism. We identify both demand and supply side effects of any policy intervention on child labour. We also suggest two alternative policies, a scheme of direct cash transfer to poor people and economic growth through foreign direct investment (FDI), both of which would be effective in achieving these twin objectives of a welfare government.

Keywords: Child labour, general equilibrium, agricultural dualism, agricultural subsidy policy, direct cash transfer, FDI-led growth.

JEL classification: D15, J10, J13, O12, O17.

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1. Introduction

Abject poverty has been attributed to be the root cause behind the widespread existence of child labour in the developing countries. Therefore, it is a commonly held view that poverty alleviation programs should vigorously be resorted to for mitigating the problem.[1] Empirical studies have revealed that the incidence of child labour has decreased satisfactorily in most of the developing economies although incomes of the poorer section of the population have not changed significantly in absolute terms over the last two decades.[2, 3]

The problem of child labour has two sides: demand and supply. Countries with high incidence of poverty undertake policies which are designed to increase earning opportunities of the poor. Consequently, these policies are expected to produce favourable effect on the incidence of child labour through the supply side. The empirical findings that the incidence of child labour in the developing nations has decreased satisfactorily although poverty has not changed much during the liberalized economic regime suggest that favourable effect on child labour must have come from the demand side. Why the policies designed to eradicate child labour through the supply side of the problem have not been able to mitigate the problem satisfactorily urgently calls for theoretical explanations. The pertinent question is then whether the supply side policies that target the child labour problem through poverty eradication have been designed appropriately.

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[1] See World Development Report (1995), Basu and Van (1998), Basu (2000) and Bonnet (1993) among others.

[2] ILO (2012) has reported that the number of child labour in the 5-17 age group declined sharply by 32% during the period 2000 to 2012. Child labour incidence has declined from 16% in 2000 to 10.6% in 2012. The decline is sharpest for Latin America & Caribbean and Asia and Pacific, whereas Sub-Saharan Africa registered very small decline in activity rates.

[3] See, for example, Wade (2004), Reddy and Minoiu (2005), Wade and Wolf (2002), Khan (1998) and Tendulkar et al. (1996).

According to ILO (2012) the concentration of child labour is the highest in the rural sector of a developing economy and child labour is used intensively directly or indirectly in agriculture.[4] Besides, agricultural dualism is a common symptom 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. In backward agriculture, the production techniques are primitive, use of capital is very low and child labour is used highly intensively because of their ability to substitute adult labour in almost every activities and lower wages relative to adult labour. Farming in backward agriculture is mostly done by using bullocks and ploughs and the cattle-feeding is entirely done by child labour.[5] Besides, during peak season when there is a temporary scarcity of adult labour demand for child labour remains high. Children are often used in the family farms for helping adult members of the family. It would be quite natural to assume that as the system of agriculture adopts more labour-saving technology the demand for child labour would fall. Use of modern machines like tractors replaces traditional ploughing done by bullocks and therefore eliminates children's requirement in cattle feeding. It is now well documented how introduction of good practices in agriculture using more labour-saving technology can reduce and eliminate use of child labour in agriculture. Labour and energy-saving technologies through farm mechanization minimize and eliminate use of labour in all farm operations as well food storage and utilization. FAO's intervention in countries like Mali, Malawi, Cambodia and Tanzania has been very successful in this regard.[6]

Agriculture in many countries is supported by governments' subsidies in the form of price support, export subsidy, credit support, energy support etc. In a developing country like India, subsidy policies are adopted so as 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

[4] According to the ILO (2012) more than 59 per cent of economically active children in the developing countries are engaged in agriculture and allied sectors. In case of India this figure is as high as 68 percent (National Sample Survey Organisation 2004-05).

[5] See Gupta (2000) in this context.

[6] See FAO (2012) and Mwamandi and Seiffert (2012) for details.

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 demand for child labour and therefore earning opportunities by children as well. A subsidy policy in any form designed to benefit backward agriculture will result in a higher demand for child labour and raise the use of child labour in the economy. Despite a positive income effect due to increase in adult wages, the net effect on child labour may be perverse if the child wage rises substantially resulting from increased demand. On the contrary, a subsidy given to advanced agriculture leads to a (an) contraction (expansion) of backward (advanced) agriculture lowers the demand for child labour in the economy and is expected to mitigate the child labour incidence through the demand side effect. However, in both of these cases, the consequence on the welfare of the poor families would be ambiguous. More importantly, these subsidy policies have serious distortionary effects on the economy as a whole and, therefore, should not ideally be recommended for eliminating child labour and improving the welfare of the poor working families.

Alternatively, one can think of policies like non-distortionay direct cash transfer to the poor child labour-supplying families and/or acceleration of economic growth through foreign direct investment (FDI) as means to combat the menace of child labour and to improve welfare of the poor families.[7]

[7] The possible favourable consequences of these two policies on child labour and family welfare have been discussed in Chaudhuri (2010) and Chaudhuri and Mukhopadyay (2014). However, the policy of economic growth through FDI might produce a few undesirable effects on the economy. We are thankful to the anonymous referee for pointing these out. Some of these effects have been discussed in Chaudhuri and Mukhopadhyay (2014) in details. See also footnote 46 in this context.

The existing theoretical literature on child labour[8], however, has not so far paid sufficient attention to identify both the demand and supply side effects of the direct and indirect poverty alleviation programs on the problem of child labour in a developing economy with agricultural dualism. The main objective of the present paper is to examine how different agricultural subsidy policies that are primarily designed to eradicate poverty in agriculture affect the incidence of child labour in the society. We also analyze how these policies impinge on the welfare of the child labour-supplying families. A three-sector full-employment general equilibrium model with child labour and agricultural dualism has been considered for the analytical purpose. 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. However, in advanced agriculture child labour is not used.[9, 10] In this set-up we have examined the consequences of subsidy policies to agriculture, irrespective of whether backward or advanced, designed to benefit the poorer section of the working population on the incidence of child labour and welfare of the child labour-supplying families. Our analysis has found that a price subsidy to backward agriculture is most likely to produce a perverse effect on the child labour incidence even though it raises the non-child labour income and welfare of the child labour-supplying families. On the other hand, the effect of a price or a credit subsidy policy to advanced agriculture on child labour is ambiguous although it affects family welfare adversely. As alternative policies we have also studied the efficacies of a direct cash transfer policy[11] to poor

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8 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.

9 As the advanced agricultural sector uses mechanised techniques of production and uses agricultural machineries like tractors, seeders/planters, sprayers and harvesters etc. one can probably assume away the use of child labour.

10 Using data drawn from a household survey for two Indian states (Uttar Pradesh and Bihar) carried out by the World Bank's Living Standards Measurement Study (LSMS), Self and Grabowskai (2007) reported how use of mechanical technologies which are generally labour-saving in nature significantly reduces the use of child labour in agriculture.

11 We are thankful to an anonymous referee of this journal for his/her suggestion to consider cash transfer as an alternative policy while commenting on an earlier version of the paper.

working household and a policy of economic growth through FDI on the problem of child labour and family welfare. Our results suggest that the direct cash transfer policy, which impinges on the incidence of child labour through the supply side, will be effective not only in mitigating the problem but also in improving family welfare. On the other hand, the policy of economic growth through FDI produces favourable effect on child labour both from the demand and supply sides of the problem. This also improves welfare of the poor families. Therefore, our findings indicate that indirect poverty eradication programs through different agricultural subsidies cannot be the right strategy to combat child labour and improve the conditions of the poor people. The best way to achieve both the targets simultaneously would be to resorting to the direct cash transfer policy to the poor people engaged in agriculture and/or to go for higher economic growth through FDI.

2. The model

We consider a small open economy with three sectors: two agricultural and one manufacturing. The two agricultural sectors produce two exportable agricultural commodities.[12] 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, by using adult labour, child labour (L_C) and land. As the backward agriculture uses primitive production techniques, we make the simplifying assumption that sector 2 does not require capital in its production. The land-output ratios in sector 1 and sector 2 (a_{N1} and a_{N2}) are assumed to be technologically given. This assumption not only simplifies the algebra but also 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.

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[12] These two may be different commodities or the same product with different quality and quite naturally their prices at the international markets are different.

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 in developing economies 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.[13] Both the agricultural sectors produce exportable commodities.[14] In the two agricultural sectors adult workers receive a competitive wage, W. Sector 3 is the import-competing sector that produces a manufacturing commodity, X_3 by means of adult labour and capital. As it is the formal sector of the economy it does not use child labour due to legal reasons.[15] It 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 manufacturing 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.[16] Capital is

[13] See footnote 15 in this context.

[14] See footnote 12.

[15] According to ILO (2012) more than 59 per cent of economically active children in the developing countries are engaged in agriculture and allied sectors and less than 8 per cent are involved in manufacturing and nerly 32 percent in services. Apart from agriculture, child workers are mainly used in informal manufacturing sector which constitutes unregistered units that mainly produce intermediate goods for the formal manufacturing sector. Child labour is also often used in non-traded services like domestic help and prostitution which are consumed primarily by the richer section of the population. Chaudhuri and Dwibedi (2007) deals with this type of child labour. As our objective is to focus on child labour in dualistic agriculture we have not separately considered an informal manufacturing sector with child labour. However, even if one introduces an informal manufacturing sector where child labour, adult labour and capital are used to produce a non-traded input for the formal sector the basic results of this paper still hold under different sufficient conditions containing terms of relative intensities in which child labour and other two inputs are used in the two child labour-using sectors.

[16] A pertinent question in this context is what mechanism stops the entire labour force being employed in the higher paid formal sector (sector 3), especially when we are considering a small open economy that is a price-taker at the international market. If we look at the price system of the model we find that capital is

completely mobile between sector 1 and sector 3. Owing to the small open economy assumption prices of all commodities (e.g. P_2 and P_3) are given internationally. Competitive markets, except the formal sector labour market, constant returns to scale (CRS) technologies with positive and diminishing marginal productivities of inputs[17] and full-employment of resources are assumed. Finally, commodity 1, the price of which is also given internationally, is chosen as the numeraire.

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

$$Wa_{L1} + Ra_{N1} + ra_{K1} = 1 \quad (1)$$

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

$$\bar{W}a_{L3} + ra_{K3} = P_3 \quad (3)$$

where R, r and W_C stand for return to land, return to capital and child wage rate, respectively. The other symbols have already been defined.

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

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used by sector 1 and sector 3. The return to capital, r, is determined from equation (3) as $\bar{W}$ and P_3 are exogenously given. Once r is determined the factor coefficients in sector 3 i.e. a_{L3} and a_{K3} are also determined. Sector 1 uses $a_{K1}X_1$ units of capital. All other factor prices and factor-coefficients are determined from the remaining two price equations and the factor endowments equations. As commodity prices and factor endowments are given all other factor prices and factor coefficients are also given. Now sector 3 actually gets $(K - a_{K1}X_1)$ amount of capital which in turn can produce $(\frac{K - a_{K1}X_1}{a_{K3}})$ units of good 3 and can at best employ $(\frac{K - a_{K1}X_1}{a_{K3}})a_{L3}$ number of workers. For a wide range of parameter values the labour endowment, L, is greater than $(\frac{K - a_{K1}X_1}{a_{K3}})a_{L3}$. This is the case which we are considering. Therefore, owing to scarcity of capital all workers are not employed in sector 3. However, the employment level in this sector rises if the capital stock of the economy goes up.

[17] 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.

$$a_{L1}X_1 + a_{L2}X_2 + a_{L3}X_3 = L \quad (4)$$

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

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

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

While the economy is endowed with given levels of adult labour, land and capital[18], the aggregate supply of child labour, L_C, is endogenously determined from the utility maximizing behavior of the households.

2.1. Household behaviour

Supply function of child labour is derived from the utility maximizing behaviour of the representative altruistic household. We assume that all working families are identical in every respect and each household consists of only one adult member and n number of children. Adult workers who work in the higher paid manufacturing sector earn sufficiently higher wage such that they do not send their children to work[19]. On the contrary, labourers who are engaged in the two agricultural sectors earn a low competitive wage which is less than the critical wage[20] (Basu and Van (1998)) and therefore send many of their children to the job market to supplement

[18] The capital endowment of the economy may, however, increase in the presence of either foreign direct investment (FDI) or domestic capital accumulation.

[19] 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.

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

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.[21]

The supply function of child labour by each poor working family is determined from the utility-maximizing behaviour of the representative altruistic household who works as wage labour in either of the two agricultural sectors. The altruistic adult member of the family (guardian) decides the number of children to be sent to the work place (l_C). The utility function of the representative 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 for $i = 1,2,3$; and from the children's leisure. For analytical simplicity let us consider the following Cobb-Douglas type utility function for each household.

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

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.

$$C_1 + P_2C_2 + P_3C_3 = (W_C l_C + W) \quad (9)$$

where, W is the income of the adult worker and $W_C l_C$ measures the income from child labour. Note that commodity 1 has been considered to be the numeraire so that $P_1 = 1$.

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.[22]

$$l_C = [(1 - \gamma)n - \gamma(W / W_C)] \quad (10)$$

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[21] 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.

[22] See Appendix I for mathematical derivations.

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 place of work. An increase in W_C, on the other hand, implies increased opportunity cost of leisure and hence produces a negative price effect. This leads to a decrease in children's leisure and hence raises the supply of child labour by each family.[23]

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

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

2.2. The General Equilibrium Analysis

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

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

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. The parameters in the system are: $P_2, P_3, L, K, N, \bar{W}, \alpha, \beta, \rho, \gamma$ and n. 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, except r, depend on both commodity prices and factor endowments. Given the unionized wage, $\bar{W}$, r is determined from equation (3). Now 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).

[23] 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.

3. Comparative Statics

As discussed earlier agriculture in many countries including the developing ones agriculture, irrespective of whether backward or advanced, is supported by different government subsidies. The primary objective of such a fiscal support in a developing economy 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 either to backward or to advanced agriculture in mitigating the child labour problem and in improving welfare of the child labour-supplying families.

For determining the consequences of a price subsidy policy to backward agriculture, captured through an increase in P_2, on factor prices and output composition of the economy after totally differentiating equations (1), (2), (4) – (6) and (7.1) and solving we can establish the following proposition.[24]

Proposition 1: A price subsidy 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 backward (advanced) agriculture. The manufacturing sector contracts if $\{S^1_{KL}\left|\lambda\right|^{12}_{NL} + \lambda_{N2}\lambda_{L1}S^1_{LL}\} \geq 0$.[25]

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 an increase in P_2, sector 1 and sector 2 together can effectively be regarded as a *Modified*

[24] See Appendix II for detailed derivations.

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

Hechscher-Ohlin subsystem (MHOSS) because they use two common inputs: adult 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 P_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 the 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 which 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 family. 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.[26] 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 producer 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 the use of capital increases (decreases) in sector 1 (sector 3) under the sufficient condition that $\{S^1_{KL}|\lambda|^{12}_{NL} + \lambda_{N2}\lambda_{L1}S^1_{LL}\} \geq 0$. Consequently, sector 3 contracts.[27]

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

[27] Note that the capital-output ratio in sector 3 (a_{K3}) remains unchanged as *r* does not change.

3.1 Price subsidy to backward agriculture, incidence of child labour and family welfare

For examining the implication of a price subsidy policy to backward agriculture 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 adult labour force employed in the two agricultural sectors, $(L_I = L - a_{L3}X_3)$, 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.[28]

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

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.

We now turn our attention to examine implication of a price subsidy policy to backward agriculture on the welfare of the child labour-supplying families. We capture this in terms of the

[28] This has been mathematically proved in Appendix IV.

family utility function (equation (8)). After substituting the optimum values of consumption of commodities (C_1, C_2 and C_3) and children's leisure $(n - l_C)$ in the family utility function, totally differentiating and rearranging terms the following proposition[29] can be established.

Proposition 3: A price subsidy policy to backward agriculture unambiguously improves the welfare of each child labour-supplying family.

A price subsidy to backward agriculture raises both the adult wage, W and child wage, W_C. This generates income effect which leads to increased consumption of all the physical commodities (C_1, C_2 and C_3). The children's leisure, $(n - l_C)$, also increases due to the positive income effect. But, as the opportunity cost of leisure (W_C) has increased, children's leisure falls due to a negative price effect. As (W / W_C) ratio falls, the price effect dominates over the income effect. The net outcome would be a decrease in children's leisure and hence an increase in the supply of child labour (l_C) by each family. This works negatively on welfare of the family. However, our analysis shows that the increase in family welfare caused due to increases in physical commodities dominates over the decrease in household utility resulting from a fall in children's leisure. Hence, family welfare unambiguously improves.

3.2 Price subsidy to advanced agriculture, incidence of child labour and family welfare

A policy of directly subsidizing advanced agriculture in the form of a price and/or a credit subsidy will be effective in lessening the gravity of the child labour problem but at the cost of lowering the adult wage rate and family welfare. A mere inspection of the price system (equations (1) – (3)) reveals that a price and/or a credit subsidy to advanced agriculture effectively raises the relative price of commodity 1. This produces a *Stolper-Samuelson effect* in the *MHOSS* that results in an increase in 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

[29] For mathematical derivation see Appendix V.

the demand for child labour goes down as it is specific to this sector. Consequently, the child wage rate falls. From the standard trade-theoretic result it follows that the return to the specific factor (child labour) falls at a higher rate relative to that of the intersectorally mobile factor (adult labour). Consequently, the (W/W_C) ratio rises. This lowers the supply of child labour by each poor working family, l_C $\left(\text{equation } (10)\right)$. It can be shown[30] that under a few alternative sufficient conditions sector 3 expands. So, we have a situation where there are a fewer families with each of them supplying a lower number of child workers. Consequently, the aggregate supply of child labour falls. On the other hand, we have found that both W and W_C fall due to this policy. Hence, the aggregate income of each family unequivocally plummets as l_C falls too. As family welfare is a positive function of the aggregate income, the well-being of each child labour-supplying family worsens although children's leisure rises due to price effect.

This establishes the following proposition.

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 $\{S^1_{KL}\,|\lambda|^{12}_{NL} + \lambda_{N2}\lambda_{L1}S^1_{LL}\} \geq 0$. However, this policy lowers family welfare of the child labour-supplying families.

So, our results indicate that a subsidy policy, either to backward agriculture or to advanced agriculture, cannot simultaneously mitigate the incidence of child labour and improve welfare of the poor families.[31]

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[30] Interested readers can easily check this after going through Appendices II and III or can obtain proofs from the authors on request.

[31] Additionally, different subsidies distort relative prices of commodities and consequently lead to misallocation of economic resources between the sectors which would affect social welfare of the economy adversely.

4. Quest for alternative policies

A pertinent question at this juncture is what alternative policy (ies) we can recommend that would simultaneously be effective in combating the problem of child labour and in improving welfare of the poor families, especially when the conventional subsidy policies fail to deliver the goods. In this connection, we would like to examine the efficacies of (i) a direct cash transfer to poor families; and, (ii) a policy economic growth through FDI on both child labour and welfare of poor families.[32]

4.1 Direct cash transfer to poor households

The recent trend worldwide has been to move away from the distortionary market invention mechanism by a welfare-state through traditional subsidies towards decoupled income support preferably in the form of direct cash transfer for more egalitarian distribution of income. The preference for a direct cash transfer is implicit in the rules of the WTO agreement as well. The reason for this is that in economic theory market interventions through subsidies distort trade and production whereas such effects are minimal for decoupled income support. India, for example, has started implementing direct cash transfer for some of its subsidy programs to target groups through the "Aadhaar scheme".[33]

We analyze the effect of a direct cash transfer given to poor households by introducing a lump-sum per cash transfer to each poor family of the amount $G > 0$. This per capita cash transfer, G, will be added to family income from non-child labour sources. This will lead to a family child labour supply function as follows.[34]

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[32] We are grateful to the anonymous referee for very useful and constructive comments on these issues.

[33] It is a centralised electronic benefit transfer system to undertake transfer of benefits (like old age pension, social security pension etc.) and subsidies directly to the beneficiaries, by way of crediting to their bank accounts. See http://www.npci.org.in/AEPSOverview.aspx and www.apmaheshbank.com/faq-and-mandate.doc for more details.

[34] From equation (12) it is evident that $l_C = 0$ if $(W + G) \geq \frac{n(1-\gamma)W_C}{\gamma}$.

$$l_C = [(1-\gamma)n - \gamma\{(W+G)/W_C\}] \quad (12)$$

Apart from its usual properties as discussed earlier (equation 10) family child labour is now influenced by the amount of the direct cash transfer, G, by the government. A rise in G 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. This is the direct effect of cash transfer on child labour.

The modified aggregate supply function of child labour would be

$$L_C = [(1-\gamma)n - \gamma\{(W+G)/W_C\}](L - a_{L3}X_3) \quad (11.1)$$

For determining the consequences of the cash transfer policy on factor prices, output composition and aggregate supply of child labour after totally differentiating equations (1), (2), (4) – (7), (8) and (11.1), solving and simplifying we can establish the following proposition.[35]

Proposition 5: An increase in direct cash transfer to poor families leads to (i) a fall in adult wage (W); (ii) an increase in aggregate income from non-child sources $(W+G)$; (iii) a fall in child wage (W_C); (iv) a contraction of the formal manufacturing sector; (v) a lower incidence of child labour (L_C); and, (vi) an improvement in welfare of each child labour-supplying family.

We now interpret these results in economic terms. An increase in direct cash transfer lowers the supply of child labour by each poor family through a direct positive income effect at given W and W_C. This lowers the aggregate supply of child labour given the output composition of the economy. However, W, W_C and the output composition would not change remain unchanged. This is because of the following reasons. Backward agriculture being the only sector that uses child labour contracts and releases adult labour and land which would expand the advanced agricultural sector. As advanced agriculture is less adult labour-intensive relative to backward agriculture both W and W_C would fall. Although W falls, the aggregate income of

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[35] See Appendix VI for mathematical derivations.

every poor family from non-child labour sources including the cash transfer i.e. $(W+G)$ rises.[36] So the supply of child labour by each family, l_C, indeed falls due to both income and price effects.[37] On the other hand, the expanding advanced agriculture draws capital from the formal manufacturing sector (sector 3) causing the latter sector to contract both in terms of output and employment. So, a larger number of adult workers are now absorbed in the two agricultural sectors each of them sending a lower number of children to the job market. The effect on the aggregate child labour supply at this stage remains inconclusive. However, our analysis shows that the net effect will be an unambiguous fall in the aggregate supply of child labour in the society.[38] A recent empirical study by Hoop and Rosati (2014) also supports our theoretical findings. They have found that cash transfers as an anti-poverty strategy seems to be effective to reduce child labor incidence.

The welfare effect of the direct cash transfer policy also works in favour of the child labour-supplying families.[39] As the aggregate non-child income of each family increases it would be able to consume higher amounts of all commodities including children's leisure due to positive income effect. Besides, as W_C has fallen it would enable the family to consume some more children's leisure. Hence, the welfare of the family improves due to both income and price effects.[40]

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[36] See Appendix VI.

[37] Note that the opportunity cost of children's leisure, W_C, has decreased.

[38] See Appendix VI for mathematical derivations.

[39] See Appendix VI for mathematical proofs of this result.

[40] In this connection, it may be mentioned that Chaudhuri (2010) has also found that the direct cash transfer scheme instead of a mid-day meal program is likely to be effective in eradicating the problem of child labour and in improving welfare of the poor families.

4.2 Capital led growth

Another alternative policy to combat child labour could be fostering economic growth through FDI that attacks the problem from both the demand side and the supply side.[41] Our analyses so far suggest that a policy that works through the supply side as well as the demand side of the problem is likely to be effective under the given circumstances. Economic growth through FDI is such a policy and is likely to expand advanced agriculture and lower the demand for child labour simply because it uses mechanized techniques of cultivation.[42] To capture the effects of FDI totally differentiating equations (1), (2), (4) – (6), (7.1), (8) and (11), solving and simplifying we get the following results.[43, 44]

Proposition 6: 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 manufacturing sector also expands owing to capital inflows. All these lead to an unambiguous fall in the aggregate supply of child labour in the economy. Welfare of each child labour-supplying family also improves as a consequence.

Foreign capital inflows raise 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.[45] This raises the demand for adult labour. Consequently, the adult wage in

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[41] This point would be clear from the subsequent analysis.

[42] In our analysis, the distinction between domestic capital and foreign capital is not important. So the results as summarized in proposition 4 would remain the same if instead of foreign capital one talks about growth due to domestic capital formation. The distinction is only important if we want to investigate the consequence of the policy on national welfare because in the trade literature on FDI and welfare the standard assumption is that earnings by foreign capital are completely repatriated. See, for example, Chaudhuri and Mukhopadhyay (2009, 2014) among others.

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

[44] Here foreign capital and domestic capital are perfect substitutes.

[45] See Appendix III.

the two agricultural sectors, W, rises. This lowers the return to land, R (see equation (1)). Sector 2 must contract so as to release additional land required for expansion of sector 1. The contracting backward agriculture (sector 2) also supplies additional adult labour to the expanding other two sectors. The demand for child labour goes down as backward agriculture contracts that lowers the child wage rate, W_C. As W rises and W_C falls the ratio between adult wage and child wage (W/W_C) increases unambiguously. This in turn lowers the supply of child labour by each poor working household. On the other hand, as 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, both the forces work together and result in an unambiguous fall in the aggregate supply of child labour in the society[46].

The welfare effect of FDI led growth also works in favour of the child labour-supplying families.[47] As mentioned earlier FDI raises the competitive adult wage (W) but lowers child wage rate (W_C). An increase in adult wage income generates a positive income effect that raises consumption of all the commodities including children's leisure, $(n-l_C)$. The latter rises even further as its opportunity cost (W_C) has decreased. Welfare of each family improves unequivocally as consumption levels of all commodities including children's leisure have increased.

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[46] Some researchers may argue that multinational enterprises invest in countries where the extent of child labour is relatively high so that they can exploit lax labour standards prevailing in the developing world. This leads to more decentralization of production process in terms of subcontracting. Empirical investigation by Braun and Busse (2003) that uses cross country information, however, indicates that child labour on the contrary deters foreign direct investment. There are, however, valid arguments how foreign capital can have negative impacts on the economy in terms of land grabbing, exploitation of labour etc. In this paper, we have considered only two issues, namely; the child labour problem and welfare of the poor families. Foreign capital can have many effects (both positive and negative) on the economy and policy makers should analyse those effects more carefully before resorting to this policy. In this context, it is worthwhile to mention that some of these issues have been discussed in Chaudhuri and Mukhopadhyay (2014).

[47] See Appendix V for mathematical proofs of this result.

5. Concluding remarks

The paper has provided a theoretical explanation why subsidy policies to agriculture especially designed to benefit poorer section of the working population in the agricultural sector of the economy are not capable of mitigating the incidence of child labour and simultaneously improving welfare of the poor families that supply child labour. It is a common belief that agriculture should be subsidized as poorer groups of the working population are employed in this sector who send many of their children out to work to supplement low family incomes. If 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 by 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 prevent child labour to work in 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 set-up we have shown that a price subsidy policy designed to benefit the poorer section of the working population that affects the child labour problem only through the supply side cannot ultimately be able to deliver the goods. Although the policy exerts a downward pressure on the child labour incidence through the supply side by raising adult wage income it increases the demand for child labour through an expansion of backward agriculture. But as the demand side effect dominates over the supply side effect the incidence of child labour gets a boost although welfare of the poor families improves. On the contrary, a subsidy policy to benefit advanced agriculture mitigates the child labour problem only at the cost of welfare of the poorer group of the working families. So, our analysis clearly demonstrates that the indirect poverty alleviation programs through subsidies to agriculture irrespective of whether advanced or backward would not be able to achieve both the targets concurrently. As possible alternatives we have analyzed the efficacies of a direct cash transfer program to poor families and a policy of growth via FDI. We have found that each of these two policies can tackle the problem of child labour through both demand and supply sides. These policies increase incomes from non-child labour source(s), raise the consumption of children's leisure and hence lower the supply of child labour by these altruistic

poor families. These automatically improve their family welfare. All these effects take place through the supply side of the problem. On the demand side, the demand for child labour decreases as advanced agriculture expands that does not use child labour and backward agriculture contracts. This is how both demand and supply side effects work together to lessen the gravity of the child labour incidence.

It should, however, be mentioned that the policy of promotion of economic growth via FDI is believed to work on poverty primarily through the so-called 'percolation effects'. Higher economic growth means higher economic activities which in turn would lead to higher employment and wages and hence less poverty. However, in a developing economy with labour market imperfections and chronic unemployment, this 'percolation theory' may not always work and produce the desired results. It is, of course, true that higher economic growth will lead to higher government revenues. But, there is no gainsaying that the additional public resources should necessarily be redistributed among the poorer section of the working population so as to enable them to derive at least a part of the benefits accrued due to FDI. Hence, the importance of redistribution of income remains quite crucial and a direct cash transfer scheme is possibly the best way to achieve that objective of a welfare state.

Finally, it should be pointed out that certain assumptions of the paper are restrictive and the structure of the model may seem to be constructed with a view to derive certain preconceived results. For example, child labour is used only in backward agriculture, nothing has been said about how the subsidies are financed, and the effects of the policies on national welfare have not been studied. However, these may be defended as follows. One may quite easily introduce an informal sector (say, sector M) that either produces a non-traded intermediate good for the formal sector (sector 3) by means of adult labour, child labour and capital or a non-traded final good/services with the help of two types of labour that is consumed by the richer section of the population consisting of adult workers employed in sector 3 earning a high unionized wage, landowners and capitalists. However, it may intuitively be checked that most of the important results of the paper hold under different sufficient conditions containing terms of relative intensities in which child labour and the other input(s) are used in the two child labour-using sectors.[48] Furthermore, considering national income at domestic or international prices as the measure of social welfare it would not be difficult in analyzing the effects of different policies on

[48] See also footnote 15 in this context.

social welfare. Finally, despite abstraction and simplicity the results of this model are important because these can at least question the desirability of the indirect poverty alleviation programs through distortionary agricultural subsidies and suggest alternative policies which can successfully eradicate the menace of child labour from the system and improve welfare of the poorer section of the working population.

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.

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

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

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

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

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

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.

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

Appendix II: Changes in factor prices

As r is determined from equation (3), it is independent of any changes in P_2 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.

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

where:

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

$|\lambda|^{12}_{NL} = (\lambda_{N1}\lambda_{L2} - \lambda_{L1}\lambda_{N2}) > 0$ 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.

$$\hat{W} = -\frac{1}{\Delta}\{\lambda_{L2}S^2_{LC}A_1 - (S^2_{CC} - \frac{\gamma W}{l_C W_C})A_2\}\theta_{N1}\hat{P}_2 - \frac{1}{\Delta}\theta_{N1}\theta_{C2}A_3\hat{K} \tag{A.7}$$

(-) (+) (-) (+) (+) (-) (+)

$$\hat{W}_C = \frac{1}{\Delta}\{\overline{S}_{LL}A_1 - \lambda_{K1}S^1_{KL}A_3 - (S^2_{CL} + \frac{\gamma W}{l_C W_C})A_2\}\theta_{N1}\hat{P}_2 - \frac{1}{\Delta}(\theta_{L1}\theta_{N2} - \theta_{N1}\theta_{L2})A_3\hat{K} \tag{A.8}$$

(-) (-) (+) (+) (+) (+) (+) (-) (-) (+)

$$\hat{R} = \frac{1}{\Delta}\{\lambda_{L2} S^2_{LC} A_1 - (S^2_{CC} - \frac{\gamma W}{l_C W_C}) A_2\}\theta_{L1}\hat{P}_2 + \frac{1}{\Delta}\theta_{L1}\theta_{C2} A_3 \hat{K} \qquad \text{(A.9)}$$

(-) (+) (-) (+) (+) (-) (+)

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

$$(\hat{W} - \hat{W}_C) = -\frac{1}{\Delta}[A_1(\lambda_{L2} S^2_{LC} + \overline{S}_{LL}) - A_2(S^2_{CC} + S^2_{CL}) - \lambda_{K1} S^1_{KL} A_3)]\theta_{N1}\hat{P}_2$$

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

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

$$(\hat{W} - \hat{W}_C) = -\frac{1}{\Delta}[A_1\lambda_{L1} S^1_{LL} - \lambda_{K1} S^1_{KL} A_3]\theta_{N1}\hat{P}_2$$

(-) (+) (-) (+) (+)

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

(-) (-) (+)

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

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

(i) $\hat{W} > 0, \hat{R} < 0$ and $\hat{W}_C > 0$ when $\hat{P}_2 > 0$;

(ii) $(\hat{W} - \hat{W}_C) < 0$ when $\hat{P}_2 > 0$

(iii) $\hat{W} > 0, \hat{R} < 0$ and $\hat{W}_C < 0$ when $\hat{K} > 0$;

(iv) $(\hat{W} - \hat{W}_C) > 0$ when $\hat{K} > 0$

(A.11)

Appendix III: Changes in output composition

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

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

$$-\frac{\lambda_{L3}}{(1-\lambda_{L3})}\lambda_{L2} S^2_{LC}\lambda_{K1} S^1_{KL})]\theta_{N1}\lambda_{N2}\hat{P}_2$$

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

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

or,

$$\hat{X}_1 = -\frac{1}{\Delta}[-(S^2_{CC} - \frac{\gamma W}{l_C W_C})(\lambda_{L1} S^1_{LL}\lambda_{K3} - \lambda_{K1} S^1_{KL}\lambda_{L3}) - \frac{\lambda_{L3}}{(1-\lambda_{L3})}\lambda_{L2} S^2_{LC}\lambda_{K1} S^1_{KL})]\theta_{N1}\lambda_{N2}\hat{P}_2$$

(-) (-) (-) (+) (+)

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

(-) (+) (-) (-)

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

(-) (+)

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

(-) (-) (-) (+) (+) (+)

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

(-) (+) (-) (-)

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

(-) (+)

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

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

$$-\{(S^2_{LC} + \frac{\gamma W}{l_C W_C})\lambda_{L2}S^2_{LC}\lambda_{K1} - (S^2_{CC} - \frac{\gamma W}{l_C W_C})(\bar{S}_{LL}\lambda_{K1} - \lambda_{L1}\lambda_{K1}S^1_{KL})\}\lambda_{N2}]\theta_{N1}\hat{P}_2$$

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

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

or,

$$\hat{X}_3 = -\frac{1}{\Delta}[-\lambda_{L2}S^2_{LC}S^1_{KL}\lambda_{N1} + (S^2_{CC} - \frac{\gamma W}{l_C W_C})\{S^1_{KL}\left|\lambda\right|^{12}_{NL} + \lambda_{N2}\lambda_{L1}S^1_{LL}\}]\lambda_{K1}\theta_{N1}\hat{P}_2$$

(-) (+) (-) (+) (-) (+)

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

(-) (+) (-) (+) (-)

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

(-) (+) (+)

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

(v) $\hat{X}_1 < 0, \hat{X}_2 > 0$ when $\hat{P}_2 > 0$;

(vi) $\hat{X}_3 < 0$ when $\hat{P}_2 > 0$

under the sufficient condition that $\{S^1_{KL}\left|\lambda\right|^{12}_{NL} + \lambda_{N2}\lambda_{L1}S^1_{LL}\} \geq 0$ (A.15)

(vii) $\hat{X}_1 > 0, \hat{X}_2 < 0$ when $\hat{K} > 0$;

(viii) $\hat{X}_3 > 0$ when $\hat{K} > 0$.

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

(ix) $\hat{K}_3 < 0$ when $\hat{P}_2 > 0$; and, (A.16)

(x) $\hat{K}_3 > 0$ when $\hat{K} > 0$.

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.

$$\hat{L}_C = -\frac{1}{\Delta}[-\frac{\gamma W}{l_C W_C}(A_1\lambda_{L1}S^1_{LL} - \lambda_{K1}S^1_{KL}A_3)$$
$$\text{(-)} \qquad \text{(-)} \quad \text{(+)}$$
$$-\frac{\lambda_{L3}}{(1-\lambda_{L3})}\{-\lambda_{L2}S^2_{LC}S^1_{KL}\lambda_{N1} + (S^2_{CC} - \frac{\gamma W}{l_C W_C})(S^1_{KL}\left|\lambda\right|^{12}_{NL} + \lambda_{N2}\lambda_{L1}S^1_{LL})\}\lambda_{K1}]\theta_{N1}\hat{P}_2$$
$$\text{(+)} \qquad \text{(-)} \qquad \text{(+)} \qquad \text{(-)} \qquad \text{(+)}$$
$$+\frac{1}{\Delta}[\frac{\gamma W}{l_C W_C}\{\theta_{N1}\theta_{C2} - (\theta_{L1}\theta_{N2} - \theta_{N1}\theta_{L2})\}A_3$$
$$\text{(-)} \quad \text{(+)} \qquad \text{(-)} \qquad \text{(+)}$$

$$-\frac{\lambda_{L3}}{(1-\lambda_{L3})}\{\{\lambda_{L2}S^2_{LC}\lambda_{N1} - (S^2_{CC} - \frac{\gamma W}{l_C W_C})(\lambda_{N1}\lambda_{L2} - \lambda_{L1}\lambda_{N2})\}(\theta_{L1}\theta_{N2} - \theta_{N1}\theta_{L2})$$
$$\text{(+)} \qquad \text{(-)} \qquad \text{(+)} \qquad \text{(-)}$$
$$+\theta_{N1}\theta_{C2}\{\bar{S}_{LL}\lambda_{N1} - (S^2_{CL} + \frac{\gamma W}{l_C W_C})(\lambda_{N1}\lambda_{L2} - \lambda_{L1}\lambda_{N2})\}\}]\hat{K} \qquad \text{(A.17)}$$
$$\text{(-)} \qquad \text{(+)} \qquad \text{(+)}$$

From (A.17) we get the following results.

$\hat{L}_C > 0$ when $\hat{P}_2 > 0$ under the sufficient condition $\{S^1_{KL}\left|\lambda\right|^{12}_{NL} + \lambda_{N2}\lambda_{L1}S^1_{LL}\} \geq 0$

Rewriting (A.17) in a different way it can be checked that the above result also hold under the sufficient condition that $S^2_{LC}S^1_{KL} \geq S^2_{CC}S^1_{LL}$.

Appendix V: Effects on family welfare

We substitute the optimum values of consumption of commodities (C_1, C_2 and C_3) (from equations (A.2) - (A.4)) and children's leisure $(n - l_C)$ (from equation (10)) into the utility function (equation (8)) to get the following expression.

$$V = H\frac{(nW_C + W)}{(W_C)^{\gamma}} \tag{A.18}$$

where V stands for family welfare and $H = \gamma A(\frac{\alpha}{\gamma})^{\alpha}(\frac{\beta}{\gamma P_2})^{\beta}(\frac{\rho}{\gamma P_3})^{\rho} > 0$.

Totally differentiating the above expression we get the following.

$$\hat{V} = \frac{(l_C W_C \hat{W}_C + W\hat{W})}{(nW_C + W)} \tag{A.19}$$

From the above expression it is clear that family welfare is an increasing function of both W and W_C.

We now substitute $\hat{W}$ and $\hat{W}_C$ from (A.7) and (A.8) into (A.19) to get the following.

$$\hat{V} = \frac{1}{\Delta(nW_C + W)}[-W\{\lambda_{L2}S^2_{LC}A_1 - (S^2_{CC} - \frac{\gamma W}{l_C W_C})A_2\} + \{\bar{S}_{LL}A_1 - \lambda_{K1}S^1_{KL}A_3$$
$$(-) \qquad\qquad (+) \qquad (-) \quad (+) \quad (-) \qquad (+)$$
$$-(S^2_{CL} + \frac{\gamma W}{l_C W_C})A_2\}]\theta_{N1}\hat{P}_2 - \frac{1}{\Delta(nW_C + W)}[\theta_{N1}(W\theta_{C2} - l_C W_C \theta_{L2}) + l_C W_C \theta_{L1}\theta_{N2}]A_3\hat{K} \tag{A.20}$$
$$(+) \quad (+) \qquad (-) \qquad\qquad\qquad\qquad (+) \quad (+)$$

Now from (A.20) we have

$$(W\theta_{C2} - l_C W_C \theta_{L2}) = (\frac{WW_C}{P_2})[a_{C2} - a_{C2}l_C] = (\frac{WW_C}{P_2})[a_{C2} - \frac{a_{L2}a_{C2}X_2}{(a_{L1}X_1 + a_{L2}X_2)}]$$
$$= (\frac{W\theta_{C2}a_{L1}X_1}{a_{L1}X_1 + a_{L2}X_2}) > 0. \tag{A.21}$$

(obtained after using (4), (7), (10) and (11).)

From (A.20) and (A.21) we can obtain the following results.

(i) $\hat{V} > 0$ when $\hat{P}_2 > 0$;

(ii) $\hat{V} > 0$ when $\hat{K} > 0$.

Appendix VI: Effects of a change in G on child labour incidence

As we introduce direct cash transfer in our model this modifies the family child labour supply function (equation 12). This will modify equation (7.1) and its modified form would be as follows.

$$a_{C2}X_2 = [(1-\gamma)n - \gamma\{(W+G)/W_C\}](L - a_{L3}X_3) \qquad (7.2)$$

Thus, the aggregate supply function of child labour in the economy is now given by

$$L_C = [(1-\gamma)n - \gamma\{(W+G)/W_C\}](L - a_{L3}X_3) \qquad (11.1)$$

Now totally differentiate equations (1), (2), (4) – (6) and (7.2) and then solving by Cramer's rule the following expressions are obtained.

$$\hat{W} = \frac{1}{\Delta}\theta_{N1}\theta_{C2}A_2\frac{\gamma G}{l_C W_C}\hat{G} \qquad (A.22)$$

(-) (+)

$$\hat{W}_C = -\frac{1}{\Delta}(\theta_{L1}\theta_{N2} - \theta_{N1}\theta_{L2})A_2\frac{\gamma G}{l_C W_C}\hat{G} \qquad (A.23)$$

(-) (-) (+)

$$\hat{X}_3 = \frac{1}{\Delta}[\theta_{N1}\theta_{C2}\lambda_{L1}\lambda_{K1}S^1_{KL} - \lambda_{L2}S^2_{LC}\lambda_{K1}\lambda_{N2}(\theta_{L1}\theta_{N2} - \theta_{N1}\theta_{L2})$$

(-) (+) (+) (-)

$$-\theta_{N1}\theta_{C2}\bar{S}_{LL}\lambda_{K1}\lambda_{N2}]\frac{\gamma G}{l_C W_C}\hat{G} \qquad (A.24)$$

(-)

where, $\Delta = [\{\lambda_{L2} S^2_{LC} A_1 - (S^2_{CC} - \frac{\gamma(W+G)}{l_C W_C}) A_2\}(\theta_{L1}\theta_{N2} - \theta_{N1}\theta_{L2})$

$$+\theta_{N1}\theta_{C2}\{\bar{S}_{LL} A_1 - \lambda_{K1} S^1_{KL} A_3 - (S^2_{CL} + \frac{\gamma W}{l_C W_C}) A_2\}] < 0 \qquad \text{(A.25)}$$

Now, let the family income from non-child labour sources be denoted by $M = W + G$

So, $\hat{M} = W\hat{W} + G\hat{G}$ (A.26)

Substituting (A.22) in (A.26) and simplifying we can obtain the following expression.

$$\hat{M} = \frac{1}{\Delta}[\{\lambda_{L2} S^2_{LC} A_1 - (S^2_{CC} - \frac{\gamma(W+G)}{l_C W_C}) A_2\}(\theta_{L1}\theta_{N2} - \theta_{N1}\theta_{L2})$$

(-) (+) (-) (-)

$$+\theta_{N1}\theta_{C2}\{\bar{S}_{LL} A_1 - \lambda_{K1} S^1_{KL} A_3 - S^2_{CL} A_2\}]G\hat{G} \qquad \text{(A.27)}$$

(-) (+) (+)

From (A.27) one can easily check that $\hat{M} > 0$ when $\hat{G} > 0$.

Using (A.22) -- (A.24) and (A.27), the following results follow.

(i) $\hat{W} < 0$ and $\hat{W}_C < 0$ when $\hat{G} > 0$;

(ii) $\hat{X}_3 < 0$ when $\hat{G} > 0$; and,

(iii) $M > 0$ when $G > 0$.

To examine the effect of a change in G on the aggregate child labour supply we totally differentiate equation (11.1) and obtain the following expression.

$$\hat{L}_C = -\frac{\gamma G}{l_C W_C}\hat{G} - \frac{\gamma W}{l_C W_C}\hat{W} + \frac{\gamma(W+G)}{l_C W_C}\hat{W}_C - \frac{\lambda_{L3}}{(1-\lambda_{L3})}\hat{X}_3 \qquad \text{(A.28)}$$

Using (A.22) – (A.24) in (A.28) and simplifying the following expression can be obtained.

$$\hat{L}_C = -\frac{1}{\Delta}[-(S_{CC}^2 - \frac{\gamma(W+G)}{l_C W_C})A_2(\theta_{L1}\theta_{N2} - \theta_{N1}\theta_{L2})$$
$$\text{(-)} \qquad \text{(-)} \qquad \text{(+)} \qquad \text{(-)}$$

$$-\theta_{N1}\theta_{C2}S_{CL}^2 A_2 + \frac{\gamma(W+G)}{l_C W_C}(\theta_{L1}\theta_{N2} - \theta_{N1}\theta_{L2})]\frac{\gamma G}{l_C W_C}\hat{G} \qquad \text{(A.29)}$$
$$\text{(+)} \qquad \text{(+)} \qquad \text{(-)}$$

From (A.29) we get the following results.

$\hat{L}_C < 0$ when $\hat{G} > 0$.

Appendix VII: Effect of a change in G on family welfare

Introduction of cash transfer in the model will alter equation (A.19) as follows.

$$\hat{V} = \frac{(G\hat{G} + l_C W_C \hat{W}_C + W\hat{W})}{(G + nW_C + W)} \qquad \text{(A.30)}$$

After substituting $\hat{W}$ and $\hat{W}_C$ from (A.22) and (A.23) in (A.30) and simplifying one finds

$$\hat{V} = \frac{1}{\Delta(G + nW_C + W)}[\{\lambda_{L2}S_{LC}^2 A_1 - (S_{CC}^2 - \frac{\gamma(W+G)}{l_C W_C})A_2\}(\theta_{L1}\theta_{N2} - \theta_{N1}\theta_{L2})$$
$$\text{(-)} \qquad \text{(+)} \qquad \text{(-)} \qquad \text{(-)}$$

$$+\theta_{N1}\theta_{C2}\{\bar{S}_{LL}A_1 - \lambda_{K1}S_{KL}^1 A_3\}G - \gamma G A_2\theta_{L1}\theta_{N2} + G A_2\theta_{N1}(\gamma\theta_{L2} - \theta_{C2}S_{CL}^2]\hat{G}$$
$$\text{(-)} \qquad \text{(+)} \qquad \text{(+)} \qquad \text{(+)}$$

(A.31)

From (A.30) the following result follows.

$\hat{V} > 0$ when $\hat{G} > 0$ under the sufficient condition $(\gamma\theta_{L2} - \theta_{C2}S_{CL}^2) \leq 0$

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