Trade Liberalization in Agriculture in Developed Nations and Incidence of Child Labour in a Developing Economy

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ABSTRACT: This paper is an attempt to analyze the consequence of trade liberalization in agriculture in the developed countries on the incidence of child labour in a developing economy in terms of a three-sector general equilibrium model with informal sectors. Adult labour and child labour are substitutes to each other in the two informal sectors of the economy and are used together apart from capital in producing two exportable commodities. The interesting result that appears from the analysis is that agricultural trade liberalization in the developed countries may be effective in bringing down the incidence of child labour in the system. The paper substantiates the desirability of trade liberalization in agriculture in the developed nations from the perspective of the developing economies for reason other than welfare improvement.

Keywords: Child labour, trade liberalization in agriculture, informal sector, general equilibrium model.
JEL classification: F10, J10, J13, I28.

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1. Introduction:

The incidence of child labour is presently 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.

In recent literature, the supply of child labour has been attributed to factors such as poverty, lack of educational facilities and poor quality of schooling, capital market imperfection, parental attitudes including the objectives to maximize present household income etc. However, it is generally agreed that the root cause is abject poverty, which compels people to have large families and children to go out in the job market and earn their own means of livelihood. A good deal of research has already focused on the inextricable connection between poverty and child labour. See, for instance, Basu and Van (1998), Basu (1999), Basu and Tzannatos (2003), Edmonds (2001), Admassie (2002) and Grootaert and Patrinos (1999, 2002). They held poverty as the primary reason behind child labour in developing countries.

This connection between poverty and child labour is, however, not without question. Some studies using micro level data failed to demonstrate a strong relationship between household poverty and child labour. Patrinos and Psacharopolous (1997) on their study on Peru, found that none of the potential measures of household assets or income appear to play a significant role. Ray (2000) finds similar result for Peru. But as pointed out by Basu and Tzannatos (2003), "…income that a *household* targets as minimum acceptable may not coincide with the nation's or

[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).

region's official *poverty line*. So if we use the head-count ratio based on the official poverty line to measure poverty, this may not explain the incidence of child labor".

Another critique of poverty-based explanations of child labor has come from Bhalotra and Heady (2002). They have argued, using data from Pakistan and Ghana, that children work more in households which own (or operate) larger amounts of land. Since a larger land holding would typically mean greater wealth, this seems to suggest that greater poverty does not lead to greater child labor. However, there are also a significant number of micro studies reinforcing the role of poverty behind child labour. A recent study by Nagaraj (2002) on the *beedi* industry in Tamil Nadu and Karnataka, India, shows that the number children in the age group 5 to 14 years attending school[2], rises strictly monotonically as the household monthly per capita expenditure rises. Cartwright and Patrinos (1999) find somewhat similar results in Bolivia showing how poverty plays a central role in driving child labour. Edmonds (2001), using rural household survey data from Vietnam, has shown that during 1992-93 and 1997-98 Vietnam's GNP per capita grew at the rate of 6.5% per annum and child labour fell by 26% over the same period. He finds that increase in household income can explain 94% of the decline in child labor for households at the poverty line. Wahba (2002) and Cartwright (1999) also confirm the role of poverty behind child work after conducting empirical surveys in Egypt and Columbia, respectively.

Albeit some exceptions, it thus can be argued that the root cause behind child work is abject poverty.[3] To eradicate the incidence of child labour, *World Development Report 1995* called for a multifaceted approach with programmes that increase income security, reduce education costs, and improve the quality schooling.

In the theoretical literature on child labour, the notable contributors are Basu and Van (1998), Ranjan (1999, 2001), Baland and Robinson (2000), Jafarey and Lahiri (2002), Dessy (2000) and

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[2] In the absence of other data, Nagaraj (2002) treats schooling as a kind of complement of child labor. This may not be completely valid but it does seem to broadly confirm the hypothesis that rising income takes children away from work and into schooling.

[3] Some studies didn't find poverty as a primary factor behind child labour perhaps because, as Basu and Tzannatos (2003) maintained, of measurement errors, inappropriately controlled endogeneity, arbitrary functional forms used in the estimation and their failure to take into account the role of wealth (especially land).

Gupta (2002). 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*), then unfavourable adult labour markets, 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 to be poor and not to have the luxury of sending his children to school. He is forced to send them to the job market to supplement low family income out of sheer poverty. There are some papers in the literature focusing on capital market failure. Ranjan (1999), Baland and Robinson (2000) and Jafarey and Lahiri (2002) emphasize the importance of capital-market imperfection as a contributing factor to inefficient child labor. The dynamic implications of capital market imperfection have been studied by Ranjan (2001), with similar conclusions reached by Basu (1999). On the other hand, Dessy (2000) has advocated the imposition of compulsory education as a means to combat the incidence of child labour. Jafarey and Lahiri (2002) and Gupta (2002) have examined the efficacy of imposition of trade sanctions on export items of the developing countries produced by child labour as a policy in curbing the incidence of child labour.

The ongoing process of globalization was expected to produce sizeable downward pressure on the problem of child labour in the developing countries by reducing the extent of poverty. Over the last two decades, radical measures for reducing tariff barriers and completely doing away with non-tariff barriers to ensure freer global trade have been undertaken in manufacturing commodities that use capital or skilled labour intensively. However, the attempt to subject agricultural commodities to disciplines similar to those that govern trade in manufactures has not so far been successful. Moreover, in agriculture, exports from developing countries remain severely hampered by massive domestic support and export subsidy programs in developed countries, by peak tariffs and difficulties in the implementation of the tariff-quota system (UNCTAD, 1999, pp. 41). Besides, agricultural exports from the rich nations, aided by domestic supports, drive small farmers out of business in many developing countries. This threatens domestic food security and undermines export potentials of the poor nations.

As a consequence of developing countries' vehement demand for providing accessibility to markets of the developed countries the WTO is now embarking upon a new round of negotiations on agricultural trade. Multilateral liberalization in the context of the WTO negotiations will primarily imply reduced protection of agriculture in developed countries. It will imply reduced

protection against imports and reduced subsidies for domestic production, including reduced export subsidies. As multilateral liberalization in agriculture following the Uruguay round has been limited in scope and is still being phased in, there is not yet much direct evidence available to judge empirically the consequences of such liberalization (see Haug and Øygard 1999). However, if the result of reduced trade barriers and increased international competition are uniform in both developed or developing countries, the prices of the primary agricultural exports of the developing countries are likely to rise because of the probable reductions of the multilateral tariffs by the large trading countries and increases in their import demands. Model simulations of multilateral trade liberalization, e.g. (Hoekman and Anderson, 1999) are quite unanimous in predicting that such liberalization would result in higher world market prices than otherwise for those goods currently being protected and subsidised.

The implications of the worldwide trade liberalization in agriculture will be far reaching for the developing countries. As these countries are generally exporters of labour-intensive agricultural commodities social welfare would definitely improve due to improvements in their terms-of-trade. Most of the people in these countries will be benefited as a consequence, as they are directly or indirectly dependent on agriculture.[4] Poverty is likely to fall and its allied problems such as the incidence of child labour are expected to be ameliorated.

Under the circumstances, it would be an interesting theoretical exercise to study the possible consequence of the proposed trade liberalization in agriculture in the developed countries on the incidence of child labour in the developing economies. However, it should be mentioned that any policy effect on the child labour incidence should be carried out in a multi-sector general equilibrium framework. This is because a policy designed to mitigate the problem of child labour in a targeted sector may drive the children into other sectors of the economy and undertake illegal and more hazardous activities. Thus, one cannot evaluate the success of a particular policy unless one takes into account its effect on the aggregate number of child workers, spread over different sectors of an economy. Unfortunately, economists have so far paid very little attention to analyze the problem of child labour using the general equilibrium framework. A few notable exceptions, however, are Gupta (2002), Chaudhuri and Mukhopadhyay (2003) and Chaudhuri and Gupta (2004).

[4] Nevertheless, the net consumers of the agricultural product might be worse off as their real incomes fall in terms of the said product.

The present paper aims to analyze the consequences of trade liberalization in agriculture in the developed nations on the incidence of child labour in a developing economy in terms of a three-sector general equilibrium model with informal sectors. There are two informal sectors in the economy where child labour and adult labour are substitutes and are used together with capital in producing two exportable commodities: one agricultural and the other manufacturing. The result that appears from the analysis is that trade liberalization in agriculture in the developed countries, which raises the prices of the agricultural commodities, is likely to be effective in bringing down the magnitude of child labour in the system. The paper points out that agricultural trade liberalization in the developed countries is desirable from the perspective of the developing countries not only for welfare reasons but also because of the fact that it might be helpful in lessening the gravity of the problem of child labour. It should be mentioned that Edmonds and Pavcnik (2004) have found that an increase in the price of agricultural export commodity has significantly contributed to reductions in the incidence of child labour in Vietnam in the 1990s. The present exercise may be viewed to provide a theoretical foundation of their empirical findings.[5]

2. The Model:

We consider a small open backward agricultural economy with three sectors: one formal and two informal. One of the two informal sectors (sector 1) produces an agricultural exportable product, X_1, with the help of adult labour, child labour and capital. The other informal sector (sector 2) produces an exportable manufacturing commodity X_2 [6], using both types of labour and capital. The formal sector (sector 3) is the import-competing sector of the economy producing a manufacturing commodity, X_3. It uses adult labour and capital in its production. We assume that

[5] Edmonds and Pavcnik (2004) have empirically examined the relationship between regional and intertemporal price movements of a primary export commodity (rice) and the economic activities of children using a panel of Vietnamese households. They have observed that reductions in child labor are increasing with rice prices. According to their findings overall rice price increase can account for almost half of the decline in child labor in Vietnam in the 1990s.

[6] Carpet weaving, leather bag manufacturing, diamond cutting are some of the examples of unorganized exportable production activities.

the *Substitution Axiom*[7] of Basu and Van (1998) holds so that in the two informal sectors adult and child labour are substitutes and produce two internationally traded commodities.[8] Owing to effective wage legislation and unionization of labour, the adult wage rate in the formal sector is fixed at W^*, which is greater than the competitive informal sector adult wage rate, W. Capital is perfectly mobile among the three sectors of the economy. It is reasonable to assume that the formal manufacturing sector is more capital-intensive vis-à-vis the two informal sectors with respect to adult labour. In other words, this implies that $(\lambda_{K1}/\lambda_{L1}),(\lambda_{K2}/\lambda_{L2}) < (\lambda_{K3}/\lambda_{L3})$.

Let us now make assumptions regarding relative factor-intensities of the two informal sectors. The informal agricultural sector (sector 1) is more child labour intensive (with respect to adult labour and less capital intensive (with respect to adult labour) than the informal manufacturing sector (sector 2). By transitivity it then implies that sector 1 is also less capital intensive compared to sector 2 with respect to child labour. In mathematical terms, we may write

$$(\lambda_{C1}/\lambda_{L1}) > (\lambda_{C2}/\lambda_{L2}),(\lambda_{K1}/\lambda_{L1}) < (\lambda_{K2}/\lambda_{L2}); \text{ and, } (\lambda_{K1}/\lambda_{C1}) < (\lambda_{K2}/\lambda_{C2}) \qquad (1)$$

Available empirical evidence suggests 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. In backward agriculture, the production techniques are

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[7] The substitution axiom emphasizes that adult and child labor are substitutes. In other words, it means that adults can do what children do. Some studies presume that there are certain tasks specific to children. Expressions like 'nimble fingers' to describe child labour tended to perpetuate this belief. The substitution axiom expresses a contrary view on this. The 'nimble fingers' argument, which once has been put forward, especially to carpet weaving, is an excuse given by employers and fails to convince researchers (see Burra (1997) and Weiner (1991)). A careful study of the technology of production involving children by Levison et al (1998) lends strong support to the substitution axiom. They show that adults in India are as good, if not better, in producing hand-knotted carpets as children. So from a purely technical point of view it is possible to replace child labour with adults. But of course adults cost more and for that reason firms may be reluctant to make the transition to adults-only labor. This argument is also applicable to girl child labour helping household chore where from a purely technical point of view adult female labour can do what girls do.

[8] In this paper we have taken care of the child labour engaged directly or indirectly in the export sectors. Child labour is used in many cases to produce intermediaries for the export sectors (see Swaminathan (1998)) for detailed list of activities carried out by child workers). But there is no need from the theoretical point of view to consider these non-traded intermediaries as separate sectors. This is because these sectors can be vertically integrated to either or both of the two informal export sectors and this case is equivalent to the present one.

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. Although most adult employment in developing countries is still in agriculture, the proportion of aggregate child labour used in agriculture is greater than that of adult labour.[9] On the other hand, in carpet weaving, leather bag and shoe manufacturing, diamond cutting, matchbox and fireworks, garments industries etc. child labour is often used in many intermediate stages of production. Many of these industries have split up into tiny units and shifted the production process to urban slums, in order to utilize labour services including child labour at lower wages.[10] 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 and less than 9 per cent are involved in manufacturing. The corresponding figures are 79.1 per cent and 3.3 per cent in the case of India where the concentration of child labour is the largest in the world. Including all other activities 19.9 per cent of child labour in India are engaged in nonagricultural activities. On the other hand, in India 64.81 per cent of the adult labour force are engaged in agriculture and allied sectors while 25.84 per cent are employed in the informal manufacturing sector (Census of India 1991, Selected Socioeconomic Statistics, India 2002).[11] Comparison of the two types of production activities in the agricultural and informal manufacturing sectors and the employment statistics from India[12] should justify the factor-intensity conditions as expressed in (1).

Production functions satisfy constant returns to scale with positive but diminishing returns to each factor. Markets, except the formal sector labour market, are perfectly competitive. The adult labour allocation mechanism is of the following type. Adult workers first try to get employment

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[9] See Ashagrie (1998) and NSSO (2000).

[10] One may go through Swaminathan (1998).

[11] These data have also been cited in Chaudhari (1997). Using these figures we find that in India in 1991 the child labour-adult labour ratios in agriculture, $(\lambda_{C1} / \lambda_{L1})$, and nonagricultural informal sector, $(\lambda_{C2} / \lambda_{L2})$, were 1.22 and 0.77, respectively.

[12] Although employment statistics on adult labour in 2001 (Census of India 2001) are available, the corresponding data on child labour are still unavailable.

in the formal manufacturing sector that offers a contractual and high wage and those who are unable to find employment in the said sector are automatically absorbed in the two informal sectors, as there is complete wage flexibility in the latter sectors. Complete mobility of capital among the three sectors of the economy ensures full utilization of capital in equilibrium. Owing to the small open economy assumption all the three commodity prices are given internationally. Finally, we assume that any two factors are substitutes to each other in the different sectors. This means that any cross partials of the factor coefficients are positive.

The following symbols will be used in the formal presentation of the model.

a_{Li} = adult labour-output ratio in the i-th sector, i = 1, 2, 3;

a_{Ci} = child labour-output ratio in the i-th sector, i = 1, 2;

a_{Ki} = capital-output ratio in the i-th sector, i = 1, 2, 3;

θ_{ji} = distributive share of the j-th input in the i-th industry, j = L, K, C; and, i = 1, 2, 3;

λ_{ji} = proportion of the j-th input employed in the i-th industry, j = L, K, C; and, i = 1, 2, 3;

P_i = world price of the i-th good, i = 1, 2, 3 (exogenously given);

X_i = level of production of the i-th commodity, i = 1, 2, 3;

W^* = unionized adult wage rate in the formal sector;

W = informal sector adult wage rate;

W_C = child wage rate;

R : return to capital;

C_i = consumption of the i-th commodity by each poor working family, i = 1,2, 3;

L = adult labour endowment;

$L_F = (a_{L3}X_3)$ = number of adult workers employed in the formal sector;

$L_I = (L - a_{L3}X_3)$ = number of adult workers employed in the two informal sectors;

K = capital stock of the economy;

n = number of children in each family;

l_C = supply of child labour by each poor household;

L_C = aggregate supply of child labour;

S^i_{jk} = the degree of substitution among factors in the i th sector, i = 1,2,3. For example, $S^1_{LK} \equiv (R/a_{L1})(\partial a_{L1}/\partial R)$, $S^1_{LL} \equiv (W/a_{L1})(\partial a_{L1}/\partial W)$ etc.;

$\wedge$ = proportional change.

2.1 Derivation of Supply Function of Child Labour

In this section, 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 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.[13] A distinctive paper in this regard is that of Basu and Van (1998). Following their '*Luxury Axiom*' we assume that there exists a critical level of family (or adult labour) income, $\overline{W}$, from non-child labour sources, 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, W^*, sufficiently greater than this critical level. So, the workers belonging to this group do not send their children to work. On the other hand, adult workers employed in the informal sectors earn W amount of wage income, which is less than $\overline{W}$ and, therefore, send many of their children to the job market to supplement low family income.

The supply function of child labour by each poor working family is determined from the utility maximizing behaviour of the representative altruistic household. 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 work place. The utility function of the household is given by

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[13] In Section 1, it has been discussed in details that abject poverty is the root cause behind the widespread existence of child labour in the developing world.

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

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

$$U = A(C_1)^{\alpha}(C_2)^{\beta}(C_3)^{\rho}(n - l_C)^{\gamma} \quad (2)$$

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.

$$P_1C_1 + P_2C_2 + P_3C_3 = (W_C l_C + W) \quad (3)$$

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

Maximization of the utility function subject to the above budget constraint gives us the following labour supply function.[14]

$$l_C = \{(\alpha + \beta + \rho)n - \gamma(W / W_C)\} \quad (4)$$

This is the supply function of child labour by each poor family. We now analyze its properties. First, 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 lower number of children to the workplace. An increase in W_C, on the other hand, produces a negative price effect, which increases the supply of child labour from the family.[15]

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

$$L_C = [(\alpha + \beta + \rho)n - \gamma(W / W_C)](L - a_{L3}X_3) \quad (5)$$

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[14] See Appendix I for mathematical derivation.

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

2.2 *The General Equilibrium Analysis*

Given the assumption of perfectly competitive markets the usual price-unit cost equality conditions relating to the three sectors of the economy are given by the following three equations, respectively.

$$Wa_{L1} + W_C a_{C1} + Ra_{K1} = P_1 \tag{6}$$

$$Wa_{L2} + W_C a_{C2} + Ra_{K2} = P_2 \tag{7}$$

$$W^* a_{L3} + Ra_{K3} = P_3 \tag{8}$$

The factor endowment equations for adult labour, capital and child labour are the following, respectively.

$$a_{L1}X_1 + a_{L2}X_2 + a_{L3}X_3 = L \tag{9}$$

$$a_{K1}X_1 + a_{K2}X_2 + a_{K3}X_3 = K \tag{10}$$

$$a_{C1}X_1 + a_{C2}X_2 = L_C \tag{11}$$

Using (5) equation (11) can be rewritten as follows.

$$a_{C1}X_1 + a_{C2}X_2 = [(\alpha + \beta + \rho)n - \gamma(W / W_C)](L - a_{L3}X_3) \tag{11.1}$$

Here, we have seven endogenous variables in the system: W, W_C, R, X_1, X_2, X_3 and L_C and seven independent equations (namely equations (5) – (10) and (11.1)). The parameters in the system are: $P_1, P_2, P_3, L, K, W^*, \alpha, \beta, \rho, \gamma$ and n. Equations (6) – (8) constitute the price system. The system possesses the decomposition property since the three unknowns factor prices, W, W_C and R can be determined from the price system alone, independently of the output system. Once the factor prices are known the factor coefficients, a_{ji} s, are also known. Now X_1, X_2 and X_3 are simultaneously obtained from equations (9), (10) and (11.1). Finally, L_C is determined from (5).

2.3 *Comparative Static Exercises*

In this section, we shall analyze the effect of trade liberalization in agriculture in the developed countries on the supply of child labour in the developing economy. The effect of agricultural trade liberalization in the developed countries in this model is captured by an increase in the international price of the agricultural commodity, P_1.

Differentiating (6) and (7) it is easy[16] to find that $(\hat{W} - \hat{W}_C) < 0$ when $\hat{P}_1 > 0$. So an increase in P_1 lowers the (W / W_C) ratio. From (4) it then follows that l_C rises as l_C and (W / W_C) are negatively related. This leads to the following proposition.

PROPOSITION 1: Trade liberalization in agriculture raises the supply of child labour by each poor working family.

Proposition 1 can be explained in economic terms in the following way. As R is determined from the zero profitability condition for sector 3 (equation (8)) and remains unchanged despite a change in P_1, sectors 1 and 2 together can effectively be regarded as a *Modified Hechscher-Ohlin subsystem (MHOSS)*. The modification is due to the fact that those two sectors apart from capital use adult labour and child labour as inputs where the supply of the latter is endogenously determined. An increase in P_1 raises the child wage rate, W_C and lowers the adult wage, W following a *Stolper-Samuelson effect* as sector 1 is more child labour intensive than sector 2 with respect to adult labour. As a sequel, the (W / W_C) ratio falls, which in turn raises the supply of child labour from each poor working family, l_C.

Now, differentiating equations (9), (10) and (11) and solving it can be proved[17] that $\hat{X}_3 > 0$ when $\hat{P}_1 > 0$ under the sufficient conditions: (i) $(\lambda_{K3} / \lambda_{L3}) \geq (|\lambda|^{12}_{CK} / |\lambda|^{12}_{CL})$; and, (ii) $E \geq 0$. Here $(\lambda_{K3} / \lambda_{L3})$ is the capital-labour ratio of sector 3,

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[16] See Appendix II for derivation.

[17] This has been derived in Appendix III.

$|\lambda|^{12}_{CK} = (\lambda_{C1}\lambda_{K2} - \lambda_{K1}\lambda_{C2})$; $|\lambda|^{12}_{CL} = (\lambda_{C1}\lambda_{L2} - \lambda_{L1}\lambda_{C2})$; and, $E = [\{(\lambda_{K1}S^1_{KL} + \lambda_{K2}S^2_{KL})\theta_{C2}\} - \{(\lambda_{K1}S^1_{KC} + \lambda_{K2}S^2_{KC})\theta_{L2}\}]$. S^i_{jk} s are the degrees of substitution between different inputs in sector i; for $i = 1,2$. From our assumptions about the relative factor intensities of the two informal sectors (given by (1)) we find that $|\lambda|^{12}_{CL}, |\lambda|^{12}_{CK} > 0$. However, it is important to note that the above result holds under a few other sufficient conditions[18] as well. It now follows that $\hat{L}_F (= \hat{X}_3) > 0$ in such a situation. This establishes the following proposition.

PROPOSITION 2: The formal sector expands both in terms of output and employment following trade liberalization in agriculture if (i) $(\lambda_{K3} / \lambda_{L3}) \geq (|\lambda|^{12}_{CK} / |\lambda|^{12}_{CL})$; and, (ii) $E \geq 0$.

We explain proposition 2 as follows. As the (W / W_C) ratio falls owing to an increase in P_1, producers in the two informal sectors would substitute child labour by adult labour. So a_{C1} and a_{C2} fall and a_{L1} and a_{L2} increase. This generates a Rybczynski type effect and produces an expansionary (a contractionary) effect on sector 1 (sector 2) as sector 1 is more intensive in the use of child labour vis-à-vis sector 2 with respect to adult labour. This is a well-known result in the theory of international trade that a Stolper-Samuelson effect contains an element of Rybczynski effect if the technologies of production are of the variable coefficient type. The capital-output ratios in these two sectors (i.e. a_{K1} and a_{K2}) may also change depending on the factor relationships between capital and adult labour/child labour.

On the other hand, as the supply of child labour from each poor household increases, the aggregate supply of child labour also increases at given X_3 (i.e. at given $L - a_{L3}X_3$). This, in turn, produces another expansionary (contractionary) effect on sector 1 (sector 2) following a pure Rybczynski effect. However, sector 3 expands if the subsystem releases some amounts of capital and adult labour. This, in turn, depends on the relative factor intensities of the three sectors and the degrees of substitution between capital and adult labour/child labour in the two

18 See Appendix III.

informal sectors.[19] Sector 3 expands under the sufficient conditions as stated in proposition 2. Nevertheless, we should note that one can find out a few other sufficient conditions (see footnote 19) under which sector 3 expands. As a_{L3} does not change[20] , an expansion of sector 3 implies a higher level of employment of adult labour in the formal sector. So the number of poor adult workers employed in the two informal sectors decreases.

If the capital-output ratios of the two informal sectors are technologically given, a_{K1} and a_{K2} are constants. This implies that S_{Kj}^{i} s are equal to zero for $i = 1,2$ and $j = L, C.$ Hence, the expansion of sector 3 depends only on the relative factor intensities of the different sectors. Therefore, the following corollary trivially follows.

Corollary 1: When the capital-output ratios of the two informal sectors are technologically fixed, an increase in P_1 leads to an expansion of the formal sector both in terms of output and employment if $(\lambda_{K3} / \lambda_{L3}) \geq (|\lambda|_{CK}^{12} / |\lambda|_{CL}^{12})$.

Finally, to examine the implication of trade liberalization in agriculture on the incidence of child labour in the economy we use the aggregate child labour supply function, which is given by equation (5). We should note that the 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 (we call this the *adult labour reallocation effect*); 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_C / W) ratio (this may be called the *relative wage effect*).

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[19] This is a full-employment model. So, if the subsystem releases capital to sector 3, it also releases adult labour.

[20] R is determined from equation (4), as W^* is given exogenously. So an increase in P_1 cannot affect the (W^* / R) ratio and hence a_{L3} .

Differentiating equation (5) one can derive the following expression.[21]

$$\hat{L}_C = (1/|\lambda|)(1/|\theta|)[\ (\gamma W / l_C W_C)F + (\lambda_{L3}/1-\lambda_{L3})\{B - D + |\lambda|^{12}_{CL} E\}]\hat{P}_1 \qquad (12)$$

where $F = (\theta_{C2} + \theta_{L2})(\lambda_{L3}|\lambda|^{12}_{CK} - \lambda_{K3}|\lambda|^{12}_{CL})$;

(+) (+)

$B = |\lambda|^{12}_{LK}[(\lambda_{C1}S^1_{CL} + \lambda_{C2}S^2_{CL})\theta_{C2} - (\lambda_{C1}S^1_{CC} + \lambda_{C2}S^2_{CC})\theta_{L2}] > 0$; and,

(+) (+) (−)

$D = |\lambda|^{12}_{CK}[(\lambda_{L1}S^1_{LL} + \lambda_{L2}S^2_{LL})\theta_{C2} - (\lambda_{L1}S^1_{LC} + \lambda_{L2}S^2_{LC})\theta_{L2}] < 0$;

(+) (−) (+)

From (12), the following proposition follows immediately.

PROPOSITION 3: Trade liberalization in agriculture in the developed nations is effective in reducing the gravity of the problem of child labour in the developing countries under the sufficient conditions: (i) $|\lambda| > 0$; and, (ii) $[(\gamma W / l_C W_C)F \quad + (\lambda_{L3}/1-\lambda_{L3})|\lambda|^{12}_{CL} E] \geq 0$.

From proposition 1 we find that the supply of child labour from each poor working family, l_C, rises as (W/W_C) decreases. This is the *relative wage effect* that raises the aggregate supply of child labour in the economy. On the other hand, the formal sector (sector 3) expands both in terms of output and employment under the sufficient conditions as stated in proposition 2. As the formal sector expands, the number of poor working families, which are considered to be the suppliers of child labour, $(L - a_{L3}X_3)$, decreases. We call this the *adult labour reallocation effect* that exerts a downward pressure on the aggregate supply of child labour, L_C. Therefore, there are two opposite effects on L_C.[22] The *adult labour reallocation effect* dominates over the

[21] This has been derived in Appendix IV.

[22] The supply of child labour by each poor working family, l_C, rises as the (W/W_C) ratio falls. This is a partial equilibrium result although as to why the (W/W_C) ratio falls following an increase in P_1 is a general equilibrium consequence. But, the *adult labour reallocation effect* is

relative wage effect under the sufficient conditions as stated in proposition 3.[23] So the incidence of child labour in the economy is likely to decrease following the agricultural trade liberalization in the developed countries.

We also note that a_{K1} and a_{K2} are constants if the capital-output ratios in the two informal sectors are given technologically. In this case, S_{Kj}^{i}s are equal to zero for $i = 1,2$; and, $j = L, C$. So, $E = 0$ in this case. So the following corollary immediately follows.

Corollary 2: When capital-output ratios of the two informal sector are technologically given, trade liberalization in agriculture lowers the incidence of child labour in a developing economy if (i) $|\lambda| > 0$; and, (ii) $F \geq 0$.

3. Concluding Remarks:

Trade liberalization in agriculture in the developed countries will be a hotly debated agenda in the next few series of meeting of the WTO. The developing countries will leave no stone unturned in wresting as much benefits as possible from the rich nations. Although agricultural trade liberalization is a long-term process, it depends on the political will of the developed countries. In the wealthy nations, agriculture is a politically sensitive sector, subject to strong lobbying from interest groups. However, most experts agree that trade liberalization in agriculture will bring net benefits to all trading nations and developing nations in particular. If trade in agriculture were liberalized the consequence would be increases in the prices of the agricultural commodities. The terms-of-trade would move in favour of the developing countries, which are the net exporters of primary agricultural products thereby improving their national welfare. The present paper has analyzed the consequence of such a liberalized trade policy in agriculture in the developed nations on the incidence of child labour in the developing economies.

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indeed a general equilibrium outcome. We are grateful to one of the two anonymous referees for drawing our attention to this point.

[23] In Appendix IV it has been shown that this result holds under other sufficient conditions as well.

The analysis has been carried out in terms of a three-sector general equilibrium model with one formal and two informal sectors where adult labour and child labour are substitutes and are used simultaneously in the informal sectors of the economy. We have studied the impact of trade liberalization in agriculture in the developed countries on the incidence of child labour in this setup and found that the incidence of child labour in the society may decrease under reasonable sufficient conditions. The paper presents a theoretical foundation of the empirical findings of Edmonds and Pavcnik (2004) by explaining as to how price increases in the exportables caused a steep decline in the incidence of child labour in Vietnam in the 1990s. The paper also provides a rationale for trade liberalization in agriculture in the developed economies for reason other than welfare improvement by pointing out that the policy may also help to lessen the gravity of the problem of child labour, which the developing countries are disconcerted with. However, how much accessibility to the markets for agricultural commodities in the developed countries, the developing nations can extort in the next few rounds of the WTO meetings would ultimately be the deciding factor in this regard.

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APPENDIX I: Derivation of supply function of child labour

Maximizing equation (2) with respect to C_1, C_2, C_3 and l_C and subject to the budget constraint (3) the following first-order conditions are obtained.

$$((\alpha U)/(P_1C_1)) = ((\beta U)/(P_2C_2)) = ((\rho U)/(P_3C_3)) = ((\gamma U)/(n - l_C)W_C) \quad \text{(A.1)}$$

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

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

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

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

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.

$$l_C = \{(\alpha + \beta + \rho)n - \gamma(W/W_C)\} \quad \text{(4)}$$

APPENDIX II: Effects of trade liberalization in agriculture on W and W_C

As R is determined from equation (8), it is independent of any changes in P_1. In other words, we have $\hat{R} = 0$. Differentiating (6) and (7), solving and putting $\hat{R} = 0$, the following expressions are obtained.

$$\hat{W} = (1/|\theta|)\theta_{C2}\hat{P}_1 \quad \text{(A.5)}$$

$$\hat{W}_C = -(1/|\theta|)\theta_{L2}\hat{P}_1 \quad \text{(A.6)}$$

From (A.5) and (A.6) it follows that

$$(\hat{W} - \hat{W}_C) = (1/|\theta|)(\theta_{C2} + \theta_{L2})\hat{P}_1 \quad \text{(A.7)}$$

where, $|\theta| = (\theta_{L1}\theta_{C2} - \theta_{C1}\theta_{L2}) < 0$ as the informal agricultural sector is more child labour-intensive vis-à-vis the informal manufacturing sector with respect to adult labour. Given that $|\theta| < 0$, from (A.7) it follows that $(\hat{W} - \hat{W}_C) < 0$ when $\hat{P}_1 > 0$. So, an increase in P_1 lowers the (W/W_C) ratio.

APPENDIX III: Effects of agricultural trade liberalization on X_3 and $a_{L3}X_3$

As the rate of return to capital, R, is determined from equation (8), we have $\hat{R} = 0$ when $\hat{P}_1 > 0$. Now total differentiation of (9) yields

$$\Sigma a_{Li} dX_i = -\Sigma X_i da_{Li}$$

or

$$\begin{aligned}\Sigma(X_i a_{Li}/L)\hat{X}_i = &-(X_1/L)\{(\partial a_{L1}/\partial W)dW + (\partial a_{L1}/\partial W_C)dW_C + (\partial a_{L1}/\partial R)dR\} \\ &-(X_2/L)\{(\partial a_{L2}/\partial W)dW + (\partial a_{L2}/\partial W_C)dW_C + (\partial a_{L2}/\partial R)dR\} \\ &-(X_3/L)\{(\partial a_{L3}/\partial R)dR\}\end{aligned}$$

Using the result that $\hat{R} = 0$ from the above expression we can write

$$\lambda_{L1}\hat{X}_1 + \lambda_{L2}\hat{X}_2 + \lambda_{L3}\hat{X}_3 = -(\lambda_{L1}S^1_{LL} + \lambda_{L2}S^2_{LL})\hat{W} - (\lambda_{L1}S^1_{LC} + \lambda_{L2}S^2_{LC})\hat{W}_C \qquad \text{(A.8)}$$

Similarly differentiating (10) and (11.1) the following expressions are obtained, respectively.

$$\lambda_{K1}\hat{X}_1 + \lambda_{K2}\hat{X}_2 + \lambda_{K3}\hat{X}_3 = -(\lambda_{K1}S^1_{KL} + \lambda_{K2}S^2_{KL})\hat{W} - (\lambda_{K1}S^1_{KC} + \lambda_{K2}S^2_{KC})\hat{W}_C \qquad \text{(A.9)}$$

and,

$$\begin{aligned}&\lambda_{C1}\hat{X}_1 + \lambda_{C2}\hat{X}_2 + \{\lambda_{L3}/(1-\lambda_{L3})\}\hat{X}_3 = \\ &-\{\lambda_{C1}S^1_{CL} + \lambda_{C2}S^2_{CL} + (\gamma W/l_C W_C)\}\hat{W} - \{\lambda_{C1}S^1_{CC} + \lambda_{C2}S^2_{CC} - (\gamma W/l_C W_C)\}\hat{W}_C \qquad \text{(A.10)}\end{aligned}$$

Solving (A.8)–(A.10) by Cramer's rule and simplifying one gets

$$\begin{aligned}\hat{X}_3 = &-(1/|\lambda|)[(\lambda_{L1}\lambda_{K2} - \lambda_{K1}\lambda_{L2})\{\lambda_{C1}S^1_{CL} + \lambda_{C2}S^2_{CL} + (\gamma W/l_C W_C)\} \\ &+(\lambda_{C1}\lambda_{L2} - \lambda_{L1}\lambda_{C2})(\lambda_{K1}S^1_{KL} + \lambda_{K2}S^2_{KL}) - (\lambda_{C1}\lambda_{K2} - \lambda_{K1}\lambda_{C2})(\lambda_{L1}S^1_{LL} + \lambda_{L2}S^2_{LL})]\hat{W} \\ &-(1/|\lambda|)[(\lambda_{L1}\lambda_{K2} - \lambda_{K1}\lambda_{L2})\{\lambda_{C1}S^1_{CC} + \lambda_{C2}S^2_{CC} - (\gamma W/l_C W_C)\} \\ &+(\lambda_{C1}\lambda_{L2} - \lambda_{L1}\lambda_{C2})(\lambda_{K1}S^1_{KC} + \lambda_{K2}S^2_{KC}) - (\lambda_{C1}\lambda_{K2} - \lambda_{K1}\lambda_{C2})(\lambda_{L1}S^1_{LC} + \lambda_{L2}S^2_{LC})]\hat{W}_C\end{aligned}$$

Substituting $\hat{W}$ and $\hat{W}_C$ from (A.5) and (A.6) into the above expression and rearranging terms we may write

$$\hat{X}_3 = -(1/|\lambda|)(1/|\theta|)[|\lambda|^{12}_{LK}(\gamma W/l_C W_C)(\theta_{C2} + \theta_{L2}) + B - D + |\lambda|^{12}_{CL}E]\hat{P}_1 \qquad \text{(A.11)}$$

Here,

$$|\lambda| = [(\lambda_{L3}/1-\lambda_{L3})|\lambda|^{12}_{LK} + \lambda_{K3}|\lambda|^{12}_{CL} - \lambda_{L3}|\lambda|^{12}_{CK}] \qquad \text{(A.12)}$$

where $|\lambda|^{12}_{LK} = (\lambda_{L1}\lambda_{K2} - \lambda_{K1}\lambda_{L2}) > 0$; $|\lambda|^{12}_{CL} = (\lambda_{C1}\lambda_{L2} - \lambda_{L1}\lambda_{C2}) > 0$; $|\lambda|^{12}_{CK} = (\lambda_{C1}\lambda_{K2} - \lambda_{K1}\lambda_{C2}) > 0$; $B = |\lambda|^{12}_{LK}[(\lambda_{C1}S^1_{CL} + \lambda_{C2}S^2_{CL})\theta_{C2} - (\lambda_{C1}S^1_{CC} + \lambda_{C2}S^2_{CC})\theta_{L2}] > 0;$

$$(+) \qquad (+) \qquad (-)$$

$$D = |\lambda|^{12}_{CK}[(\lambda_{L1}S^1_{LL} + \lambda_{L2}S^2_{LL})\theta_{C2} - (\lambda_{L1}S^1_{LC} + \lambda_{L2}S^2_{LC})\theta_{L2}] < 0;$$

$$(+) \qquad (-) \qquad (+)$$

$$E = [(\lambda_{K1}S^1_{KL} + \lambda_{K2}S^2_{KL})\theta_{C2} - (\lambda_{K1}S^1_{KC} + \lambda_{K2}S^2_{KC})\theta_{L2}]$$

$$(+) \qquad (+)$$

[S^i_{jk}s are the degrees of substitution among inputs in sector i; and, $S^i_{CL}, S^i_{KL}, S^i_{LC}, S^i_{LK}, S^i_{KC} > 0$; $S^i_{LL}, S^i_{CC} < 0$, for $i = 1,2$. From our assumptions about relative factor intensities of different sectors (given by (1)) we find that $|\lambda|^{12}_{LK}, |\lambda|^{12}_{CL}, |\lambda|^{12}_{CK} > 0.$]

From (A.12) it follows that $|\lambda| > 0$ under any one of the following two sufficient conditions.

$$(\lambda_{K3}/\lambda_{L3}) \geq (|\lambda|^{12}_{CK}/|\lambda|^{12}_{CL}) \qquad \text{(A.13.1)}$$

$$(1/(1-\lambda_{L3})) \geq (|\lambda|^{12}_{CK}/|\lambda|^{12}_{LK}) \qquad \text{(A.13.2)}$$

It may be pointed out in this context that even if neither (A.13.1) nor (A.13.2) holds, we get $|\lambda| > 0$ when the sum of any one of the two positive terms and the negative term in (A.12) is outweighed by the remaining positive term.

From (A.11) it now follows that

$\hat{X}_3 > 0$ when $\hat{P}_1 > 0$ under the following sufficient conditions:

$$\left.\begin{array}{l} \text{(i) } (\lambda_{K3}/\lambda_{L3}) \geq (|\lambda|^{12}_{CK}/|\lambda|^{12}_{CL}) \text{; and,} \\ \text{(ii) } E \geq 0. \end{array}\right\} \qquad \text{(A.14)}$$

The sufficient condition (i) in (A.14) may be replaced by $(1/(1-\lambda_{L3})) \geq (|\lambda|^{12}_{CK}/|\lambda|^{12}_{LK})$ or simply by $|\lambda| > 0$. Besides, condition (ii) also is not a necessary one. Even it can be substituted by other conditions like $(B+E) \geq 0$, $(E-D) \geq 0$, $(B-D+E) \geq 0$ etc.

Now, if the capital-output ratios of the two informal sectors are given technologically, we have $a_{K1},\ a_{K2} = 0.$ This implies that $E = 0.$ Hence, $\hat{X}_3 > 0$ when $\hat{P}_1 > 0$ only under the sufficient condition (i) as given in (A.14).

The formal sector employs $L_F\,(= a_{L3}X_3)$ number of adult workers. As W^* is given and R does not change due to an increase in P_1, a_{L3} remains unchanged. Therefore, we have $\hat{L}_F = \hat{X}_3$. Thus, an increase in P_1 leads to an expansion of the formal sector both in terms of output and employment of adult labour under the sufficient conditions as stated in (A.14).

APPENDIX IV: Effect of trade liberalization in agriculture on L_C

Totally differentiating equation (5) and rearranging terms we get the following expression.

$$\hat{L}_C = -(\gamma W / l_C W_C)(\hat{W} - \hat{W}_C) - (\lambda_{L3}/(1-\lambda_{L3}))\hat{X}_3 - (\lambda_{L3}/(1-\lambda_{L3}))S^3_{LK}\hat{R} \qquad \text{(A.15)}$$

Using (A.7) and (A.11), equation (A.15) can be rewritten as

$$\begin{aligned}\hat{L}_C = {} & -(\gamma W / l_C W_C)(1/|\theta|)(\theta_{C2} + \theta_{L2})\hat{P}_1 \\ & + (\lambda_{L3}/1-\lambda_{L3})(1/|\lambda|)(1/|\theta|)[(\lambda_{L1}\lambda_{K2} - \lambda_{K1}\lambda_{L2})\{(\lambda_{C1}S^1_{CL} + \lambda_{C2}S^2_{CL} + (\gamma W / l_C W_C))\theta_{C2} \\ & \qquad - (\lambda_{C1}S^1_{CC} + \lambda_{C2}S^2_{CC} - (\gamma W / l_C W_C))\theta_{L2}\} \\ & + (\lambda_{C1}\lambda_{L2} - \lambda_{L1}\lambda_{C2})\{(\lambda_{K1}S^1_{KL} + \lambda_{K2}S^2_{KL})\theta_{C2} - (\lambda_{K1}S^1_{KC} + \lambda_{K2}S^2_{KC})\theta_{L2}\} \\ & - (\lambda_{C1}\lambda_{K2} - \lambda_{K1}\lambda_{C2})\{(\lambda_{L1}S^1_{LL} + \lambda_{L2}S^2_{LL})\theta_{C2} - (\lambda_{L1}S^1_{LC} + \lambda_{L2}S^2_{LC})\theta_{L2}\}]\hat{P}_1\end{aligned}$$

Using (A.12), rearranging terms and simplifying we get

$$\hat{L}_C = (1/|\lambda|)(1/|\theta|)[\ (\gamma W / l_C W_C)F + (\lambda_{L3}/1-\lambda_{L3})\{B - D + |\lambda|^{12}_{CL}E\}]\hat{P}_1 \qquad (12)$$

where $F = (\theta_{C2} + \theta_{L2})(\lambda_{L3}|\lambda|^{12}_{CK} - \lambda_{K3}|\lambda|^{12}_{CL})$

$\qquad\qquad\qquad\qquad\qquad\qquad (+) \qquad\quad (+)$

Other notations like B, D, E have already been defined.

From (12) we find that $\hat{L}_C < 0$ when $\hat{P}_1 > 0$ under the following sufficient conditions:

(i) $|\lambda| > 0$; and,

(ii) $[(\gamma W / l_C W_C)F \quad + (\lambda_{L3} / 1 - \lambda_{L3})|\lambda|^{12}_{CL} E] \geq 0.$ } (A.16)

It may be noted that in place of condition (i) in (A.16) one may write $(1/1-\lambda_{L3}) \geq (|\lambda|^{12}_{CK} / |\lambda|^{12}_{LK})$ or $(\lambda_{K3} / \lambda_{L3}) \geq (|\lambda|^{12}_{CK} / |\lambda|^{12}_{CL})$. On the other hand, condition (ii) may be replaced by either $[(\gamma W / l_C W_C)F + (\lambda_{L3} / 1-\lambda_{L3})(|\lambda|^{12}_{CL} E - D)] \geq 0$; or, $[(\gamma W / l_C W_C)F + (\lambda_{L3} / 1-\lambda_{L3})(B + |\lambda|^{12}_{CL} E)] \geq 0.$ Hence, there are quite a few number of sufficient conditions under which $\hat{L}_C < 0$ when $\hat{P}_1 > 0$.