The Role of Trade and Offshoring in the Determination of Relative Wages and Child Labour

Alessandro Cigno,*Giorgia Giovannetti† and Laura Sabani‡
Department of Economics and Management
University of Florence
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Abstract

Incorporating family decisions in a two-period model of the world economy, we show that foreign trade and investment liberalization will raise the skill premium, and reduce child labour, in developing countries where the initial share of skilled workers in the adult workforce is sufficiently high to attract production activities more skill-intensive than those previously carried out locally. Elsewhere, liberalization will reduce the skill premium, and raise child labour. The empirical analysis confirms these predictions.

Key words: Trade barriers, technology transmission, skill endowments, skill premium, education, child labour.

JEL codes: D13, D33, F16, J13, J24.

1 Introduction

Since the middle of the last century, the world economy has witnessed an unprecedented expansion of international trade and investment. In more recent decades, this has been accompanied by a reduction in the incidence of child labour. Is there a nexus between these two phenomena? A stream of economic literature views child labour as a direct consequence of extreme poverty. According to this line of reasoning, if parental income is sufficient to keep the entire family above subsistence level, children will not work. If it falls below that level, however, all children in the family will work. For an overview of the theory, see Basu and Van (1998). For empirical work along these lines, see Edmonds (2005), and Edmonds and Pavcnik (2006). Another stream of economic
literature (Cigno and Rosati 2002, 2005) views child labour as the outcome of parental optimization. According to this other line of reasoning, decisions concerning the allocation of a child’s time rest on a comparison of the immediate benefits of child labour with the expected future benefits of education. The two approaches are not irreconcilable. If parents cannot borrow, current expenditure cannot exceed current income. In families where this constraint is binding, children will then be sent to work even if the expected return to education is higher than the return to child labour (Ranjan 2001). For empirical work along these lines, see Dehejia and Gatti (2005), and Beegle et al. (2006). Without credit rationing, therefore, the allocation of the children’s time between work and study would be the outcome of a portfolio decision, and thus independent of parental income. With credit rationing, the decision will depend on parental income. How does international trade and investment come into the picture?

The possibility of trading and investing across national borders enlarges the opportunity set and raises per-capita GDP. Other things being equal, liberalization could thus be expected to relax the liquidity constraints facing families with children, and to bring about a reduction in child labour. Other things are not equal however, because international trade and investment alter relative wages. Heckscher-Ohlin theory predicts that, if a country opens itself up to trade, it will specialize further in the production of the goods that make more intensive use of its comparatively more abundant untradable factor. Stolper-Samuelson add that the rate of return to the comparatively more abundant factor will rise relative to that of other factors. If the untradable factors are capital and labour as in the standard North-South model, liberalization will then induce the labour-abundant South to specialize further in the production of labour-intensive goods, and the capital-abundant North to specialize further in that of capital-intensive goods. The wage rate will consequently rise relative to the return to capital in the South, and fall in the North (Stolper-Samuelson theorem). If the untradable factors are skilled (more educated) and unskilled (less educated) labour as in Wood (1994), liberalization will induce the skill-abundant North to specialize further in the production of goods with a high skill content, and the skill-poor South to specialize further in the production of goods with a low skill content. With liberalization, therefore, the skilled-to-unskilled wage ratio (the “skill premium”) will rise in the North, and fall in the South. This prediction is not borne out by the facts however. Empirical research shows that, in the 1980s and 1990s, increased openness was associated with a rise in the skill premium not only in the North, but also in parts of the South, notably in middle-income Latin America (see Freeman and Oostendorp 2001, Feenstra and Hanson 1996, Robbins 1996, Wood 1997) and also in some low-income countries (see UNCTAD 1997). Indeed, Leamer (1996, 1998) finds that unskilled wage rates did not even fall in the developed world.

A limitation of the Heckscher–Ohlin framework is that it only envisages trade in final goods. In recent decades, however, there has been a sharp increase in the volume of trade in intermediate goods, and in the relocation of the factories producing such goods from developed to developing countries (“offshoring”). As pointed out by Feenstra and Hanson (1996), and Zhu and Trefler
(2005), if the productive activities so relocated were more skill-intensive than those originally carried out in the destination country, this will have caused the demand for skilled labour to shift upwards, and thus put upwards pressure on that country's skill premium. The opposite would have happened if the relocated activities were less skill-intensive than those originally carried out in the destination country.

The present paper introduces two additional considerations. The first is that the skill intensity of the relocated activities and the skill premium of the destination country will be simultaneously determined, in equilibrium, by the share of skilled workers in that country's adult labour force ("skill endowment"). The second is that, if a developing country is relatively closed to begin with, the announcement that trade and foreign investment barriers will be lowered in the near future will lead to either a rise or a fall in the expected skill premium and thus in the incentive to invest in education, depending on whether it is rationally expected that the move will attract production activities with higher or lower skill requirements than those previously carried out there. The two considerations are clearly interconnected.

In Section 2 below, we report some broad facts concerning trade, relative wages, income, education and child labour. In Section 3, we graft a model of family decisions in the presence of credit rationing on to a two-period (before and after liberalization) model of the world economy incorporating the insights of recent trade theory. In Section 4, we bring the theory to the data. Section 5 concludes.

2 Stylized facts

The figures and tables shown here are constructed using country data drawn from ILO, UNESCO, UNICEF, UNIDO, World Bank and the Barro-Lee dataset. As will be explained more fully in Section 4, the dataset covers 13 years, from 2000 to 2012, and 207 countries. Summary pooled statistics are reported in Table 1 (for precise variable definitions, see Appendix 2).

Table 1: Descriptive statistics

Figure 1 plots the child labour rate against the share of school age children not enrolled at school. The correlation is positive but low. As pointed out by Cigno and Rosati (2002, 2005) among others, that is because many of the children enrolled at school in developing countries work at the same time. For these children, work engagement is at the expense of regular school attendance, and of the amount of time they have available for rest and homework, rather than at the expense of school enrolment. As this prevents them from taking full advantage of school attendance when they do attend, child labour rather than school enrolment is thus the better measure of forgone educational investment.\footnote{For a fuller discussion of this issue, and a policy analysis, see Cigno (2012).} Interestingly, child labour tends to be higher in countries where there are fewer adults with completed primary education. This gives us the first clue as to which are the important correlates of child labour.
Figure 1: Child labour and non-school attendance

Figure 2 plots child labour against the log of per-capita GDP. The correlation is negative but small, suggesting the presence of other important co-variates. The same figure shows also the child labour rate predicted by a Generalized Linear Model regression with a binomial distribution and a logit link function (see Papke and Wooldridge, 1996). By construction, this statistical model takes into account the nonlinearities arising from the fact that the dependent variable is constrained between 0 and 1. As Table 2 shows, the marginal effect of per-capita GDP is negative, but gets smaller as per-capita GDP gets larger. For low-income economies (those with per-capita GDP below 1000 US dollars a year), a 1% increase in per-capita GDP is associated with a 10% reduction in child labour. For low-to-middle income economies (those with per-capita GDP between 1000 and 4000 dollars), the marginal effect is less than half that estimated for low-income economies. For upper-middle income economies (those with per-capita GDP above 4000 dollars), the reduction is less than 4%, falling to about 2% for higher-income countries. With reference to our introductory discussion about different ways of explaining child labour, it would thus appear that income is the dominant factor in very poor countries, where a large share of the population is credit constrained (and the government’s ability to subsidize education out of general taxation is severely limited), but the return to education gains in importance as we move up the income scale.

Figure 2: Child labour and per-capita GDP

Figure 3 plots child labour against a measure of trade openness, the trade ratio (imports plus exports over GDP), lagged five years to allow for the effects of liberalization to work their way through the economy. The correlation is negative but very low. The picture changes somewhat, however, if we cut the sample into two subsamples, one containing countries where the share of population aged 25 or more educated to secondary or higher level below the median, and one containing countries where that share is above the median. Figures 4a and 4b show that the sign of the correlation is positive in the former and negative in the latter. As shown in Figures 5a to 6b, the correlation becomes stronger (more positive in the first subsample, more negative in the second) if some outliers are excluded. It would thus appear that the sign of the correlation between child labour and trade openness depends on the size of the stock of educated adults.

Figs 3, 4, 5 and 6: Child labour and trade openness

Over the past two decades, developing countries have increased their ability to attract foreign direct investment. By 2013, these countries accounted for over a half of the FDI total (WIR, 2014), and even those, like Africa, that in earlier decades had remained on the sidelines, have recently started to take an active part in the globalization process. The existing literature suggests that FDI may have a role in the determination of the return to education, and thus ultimately of child labour. However, plotting child labour against FDI shows no obvious correlation between the two. This could be due to the lack of reliable FDI data, or to the fact that the skill premium depends on the skill content of FDI, about which we do not have country-level information, rather than on its size.
3 Theoretical analysis

Consider a two-period, two-country model of the world economy. In each period \( t = 1, 2 \), each country \( i = N, S \) (where \( N \) stands for North and \( S \) for South) is populated by a measure one of families. In period 1, each family consists of a working-age mother and her school-age son. The mother is endowed with one unit of time, and the child with \( \theta \) units of adult-equivalent time \((0 < \theta < 1)\). In period 2, each family consists of a working-age adult (the now grown-up son) endowed with one unit of time.

A family is said to be of type \( H \) if the adult member is skilled, of type \( L \) if he or she is unskilled. We denote by \( a_t \) the share of skilled adults, and by \( 1 - a_t \) the share of unskilled adults, in the South’s adult population in period \( t \) \((0 < a_t < 1)\). In period 1, each Southern mother spends a fraction \( \tau \) of her time endowment looking after her son \((0 < \tau < 1)\), and supplies the rest inelastically to the labour market. In the same period, her son spends a fraction \( e \) of his adult-equivalent time endowment studying, and \( 1 - e \) working \((0 \leq e \leq \bar{e}, \text{with } \bar{e} < 1)\). The outcome of education is uncertain (we can interpret this as saying that it depends on a random variable, the child’s learning ability, unknown before the investment takes place). The amount of time \( e \) that a child spends studying in period 1 determines the probability that he will be a skilled worker in period 2. In the North, \( e \) is constrained to be equal to \( \bar{e} \). (compulsory education). In period 2, each adult (no matter whether Northern or Southern) supplies his entire time endowment inelastically to the labour market.

There are two intermediate goods, \( x_1 \) and \( x_2 \), and three final goods, \( A, B \) and \( C \). \( A \) is costlessly assembled from \( x_1 \) and \( x_2 \). \( B, C, x_1 \) and \( x_2 \) are produced using skilled and unskilled labour. We assume that \( B \) and \( C \) are non tradable. While \( B \) is produced and consumed only in the South, \( C \) is produced and consumed only in the North.\(^2\) Of the intermediate goods, \( x_1 \) can be produced in either part of the world, but \( x_2 \) can be produced only in the North.\(^3\) Trade barriers are prohibitively high in period 1, but it is common knowledge that these barriers will come down in period 2. This implies that, in period 1, the South can produce and consume only good \( B \), because the production of good \( A \) would require an input of the intermediate good \( x_2 \), that cannot be imported from the North. By contrast, the North produces and consumes both \( A \) and \( C \). In period 2, when trade opens, the South can start its production of \( A \) by importing \( x_2 \) from the North and paying for it by exporting part of its production of \( x_1 \). The North may continue to produce \( x_1 \) or relocate its production to the South.

Let \( q_{it} \) denote the wage rate accruing to skilled labour, and \( w_{it} \) the one accruing to unskilled labour, in country \( i \) in period \( t \). Preferences, technology

\(^2\)As in Wood (2002), we assume that the \( B \)-sector is not just subsistence agriculture, but includes also a "modern sector" producing goods of less than export quality.

\(^3\)We can imagine that the technology used to produce \( x_2 \) cannot be imitated by competitors because it is a complex skill-intensive technology that does not generate informational spillovers; see Thoenig and Verdier (2003).
and relative factor endowments are assumed to be such that
\[
\frac{q_{tS}}{w_{tS}} > \frac{q_{tN}}{w_{tN}}, \quad t = 1, 2. \tag{1}
\]

Put another way, we call North the country where skilled labour is so abundant, in period 1, that no matter how much the other country, called South, invests in its children’s education in the course of period 1, it cannot catch up with the North by period 2. We further assume that there is no migration in either period.

We first look for the period-2 equilibrium taking period-1 decisions as parameters, and then solve for period-1 decisions, assuming that in period 1 agents correctly anticipate period-2 prices and wages. As child labour is concentrated in developing countries, we focus on the South.

3.1 Period 2

The period-2 set-up builds on the theoretical insights of Tang and Wood (2000), Wood (2002) and Zhu and Trefler (2005). In Tang and Wood and Zhu and Trefler, however, the objective of the analysis is to examine, respectively, the effect of a reduction in the cost of cooperation and of the South’s catching-up on wage inequality. Here, by contrast, our aim is to establish the effect of period-2 cross-country trade and investment liberalization on the South’s period-2 skill premium, because that will affect the South’s period-1 education and child labour decisions. As the analytical techniques are well established in the literature, we concentrate on the economic interpretation, and refer the reader to textbook expositions of the Heckscher-Ohlin model for technical details.

3.1.1 Production

In this period, the South can import \( x_2 \) from the North. This gives the former the opportunity of domestically producing the intermediate good \( x_1 \) by the constant-returns-to-scale technology
\[
x_1 = L^\varepsilon H^{1-\varepsilon}, \quad 0 < \varepsilon < 1,
\]
and then costlessly assembling the final good \( A \) from \( x_1 \) and \( x_2 \) according to the constant-returns-to-scale technology
\[
A = x_1^\alpha x_2^{1-\alpha}, \quad 0 < \alpha < 1.
\]
The North can import \( x_1 \) from the South instead of producing it.

The period-2 cost-minimizing quantities of skilled and unskilled labour employed in country \( S \) to produce a unit of \( x_1 \) are, respectively,
\[
h_{x_1}^* = \left( \frac{\varepsilon}{1 - \varepsilon \frac{q_{2S}}{w_{2S}}} \right)^{-\varepsilon} \tag{2}
\]
and
\[
l_{x_1}^* = \left( \frac{\varepsilon}{1 - \varepsilon \frac{q_{2S}}{w_{2S}}} \right)^{1-\varepsilon}. \tag{3}
\]
The minimized period-2 unit cost of producing \( x_1 \) in country \( S \) is consequently
\[
c_{1S} = w_{2S}l_{x_1}^* + q_{2S}h_{x_1}^*.
\] (4)

Denoting by \( c_{1N} \) the period-2 unit cost of producing \( x_1 \) in country \( N \), and recalling that (1) holds, we can realistically assume
\[
c_{1N} > c_{1S},
\]
and thus that \( x_1 \) will be produced only in country \( S \). We may interpret this as saying that the North’s \( x_1 \) producers relocate their factories in the South.\(^4\)

As \( x_1 \) will be produced only in the South, and \( x_2 \) can be produced only in the North, we will then write, dispensing with country subscripts,
\[
x_1^* = \left( \frac{\alpha}{1 - \alpha c_1} \right)^{1-\alpha} c_2
\] (5)
and
\[
x_2^* = \left( \frac{\alpha}{1 - \alpha c_1} \right)^{-\alpha} c_2
\] (6)
where \( x_1^* \) and \( x_2^* \) are the cost minimizing quantities of intermediate goods \( x_1 \) and \( x_2 \) employed in country \( S \) and \( N \) to produce one unit of good \( A \). Note that \( c_2 \) denotes the minimized period-2 unit cost of \( x_2 \).\(^5\)

The period-2 unit cost of \( A \) is
\[
c_A = x_1^* c_1 + x_2^* c_2.
\] (7)

Good \( B \) is produced by the constant-returns-to-scale technology,
\[
B = L^\beta H^{1-\beta}, \quad 0 < \beta < 1,
\] (8)
The cost-minimizing inputs of skilled and unskilled labour per unit of output are, respectively,
\[
h_B^* = \left( \frac{\beta}{1 - \beta} \right) \frac{q_{2S}}{w_{2S}}
\] (9)
and
\[
l_B^* = \left( \frac{\beta}{1 - \beta} \right) \frac{q_{2S}}{w_{2S}}
\] (10)
The period-2 unit cost of \( B \) will thus be\(^6\)
\[
c_B = h_B^* q_{2S} + l_B^* w_{2S}.
\]

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\(^4\) In Tang and Wood (2000), this is induced by a fall in co-operation cost that makes it advantageous to transfer entrepreneurs, designers, engineers and other professionals from the North to the South. In Feenstra and Hanson (1996), offshoring is made profitable by the fall in the cost of production of the South relative to that of the North. This fall is explained by capital flows lowering the interest rate in the South relative to the North. In Zhu and Tepper (2005) it is the Southern catch up that makes profitable relocating the production of some goods from the North to the South. All these arguments could be applied also to our model. For simplicity, however, we have directly assumed that trade liberalization makes it possible and advantageous for the North to import \( x_1 \) from the South.

\(^5\) As we have not modelled the production of \( x_2 \), we do not have a cost function for it. We will thus treat \( c_2 \) as a parameter.

\(^6\) Similar expressions may be derived also for the North for good \( C \).
3.1.2 Consumption

In the South, the average individual (recall that individuals are differentiated by skill level) solves

\[ \begin{align*}
\text{Max} U_{S2} & = \ln B + \gamma \ln A \\
\text{s.t.} \quad Y_{S2} & = P_{B2}B + P_{A2}A,
\end{align*} \]

where \( U_{S2} \) is this person’s utility, and

\[ Y_{S2} = a_2 q_{2S} + (1 - a_2) w_{2S} \]

is the average period-2 income\(^7\). Using the first-order conditions, we can derive the South’s period-2 average demands for the two final goods,

\[ \begin{align*}
A^D_{S2} & = \frac{\gamma Y_{S2}}{1 + \gamma P_{A2}} \\
B^D_{S2} & = \frac{1}{1 + \gamma P_{B2}}
\end{align*} \]  

(11)

and for the two intermediate goods,

\[ \begin{align*}
x^D_{S1} & = x^*_1 A^D_{S2} \\
x^D_{S2} & = x^*_2 A^D_{S2}.
\end{align*} \]  

(12)

Therefore,

\[ \frac{A^D_{S2}}{B^D_{S2}} = \gamma \frac{P_{B2} Y_{S2}}{P_{A2} Y_{S2}} = \gamma \frac{P_{B2}}{P_{A2}} \]  

(13)

The average Northern individual’s optimization problem is

\[ \begin{align*}
\text{Max} U_{N2} & = \ln C + \gamma \ln A \\
\text{s.t.} \quad Y_{N2} & = P_{C2}C + P_{A2}A,
\end{align*} \]

where \( U_{N2} \) is this person’s utility, and \( Y_{N2} \) the North’s average period-2 income. Therefore, the North’s demands are

\[ \begin{align*}
A^D_{N2} & = \frac{\gamma Y_{N2}}{1 + \gamma P_{A2}} \\
C^D_{N2} & = \frac{1}{1 + \gamma P_{A2}}
\end{align*} \]  

(14)

(15)

and

\[ \begin{align*}
x^D_{N1} & = x^*_1 A^D_{N2} \\
x^D_{N2} & = x^*_2 A^D_{N2}
\end{align*} \]  

(16)

\(^7\)Note that in the budget constraint we are using the balance-of-trade equilibrium condition.
3.1.3 Equilibrium

For the zero-profit condition, prices will be equal to unit costs. Therefore,

\[ P_{A2} = c_A = x_1^* w_{2S} + x_1^* h_{x_1}^* q_{2S} + x_2^* c_2 \]  
(17)

and

\[ P_{B2} = l_B^* w_{2S} + h_B^* q_{2S}. \]  
(18)

Equilibrium in the South’s labour markets further requires

\[ a_2 = h_B^* B_2 + x_1^* h_{x_1}^* (A_{S2} + A_{N2}) \]  
(19)

and

\[ 1 - a_2 = l_B^* B_2 + x_1^* l_{x_1}^* (A_{S2} + A_{N2}). \]  
(20)

We have then four non-linear equations in four unknowns, \( A_{S2}, B_2, q_{2S}, \) and \( w_{2S} \).

We now make the following standard assumption.

Assumption 1. No factor-intensity reversal (NFIR): \( \frac{q_{2S}}{w_{2S}} \), either

\[ \frac{x_1^* h_{x_1}^*}{x_1^* l_{x_1}^*} > \frac{h_B^*}{l_B^*} \]  
(21)

or

\[ \frac{x_1^* h_{x_1}^*}{x_1^* l_{x_1}^*} < \frac{h_B^*}{l_B^*} \]  
(22)

Given NFIR, and noting that \( x_2^* c_2 = (1 - \alpha) P_{A2} \), (17) – (18) implies a two-way relationship between \( P_{A2} \) and \( q_{2S} \) such that

\[ \frac{P_{A2}}{P_{B2}} = \frac{1}{\alpha} \frac{q_{2S}}{w_{2S}}, \quad \varphi > 0 \text{ for (21)}, \quad \varphi' < 0 \text{ iif (22)}, \]  
(23)

Substituting from (23) into (13), and then into (19) – (20), we obtain due equations in the two unknowns, \( q_{2S} \) and \( w_{2S} \). Straightforward computation gives us the period-2 skill premium \( \frac{q_{2S}}{w_{2S}} \), as a function of of the period-2 labour force skill composition, \( a_2 \), and of the technological and preference parameters, \( \alpha \) and \( \gamma \),

\[ \frac{q_{2S}}{w_{2S}} = G(a_2, \alpha, \gamma), \quad \varphi' < 0. \]  
(24)

The function \( G(\cdot) \) will differ according to whether (21) or (22) holds true. Denoting the first case by the superscript \( U \), and the second by the superscript \( D \), it can be easily shown that, for any \( (a_2, \alpha, \gamma) \),

\( ^8 \)Similar equations determine \( A_{N2}, C_2, q_{2N} \) and \( w_{2N} \) in country \( N \). For the sake of simplicity we skip the North equilibrium analysis, thus we take \( A_{N2} \) as a parameter.
\begin{align*}
G^U(a_2, \alpha, \gamma) > G^D(a_2, \alpha, \gamma), \quad G^U_\alpha > 0, \quad G^U_\gamma > 0, \quad G^D_\alpha < 0 \quad \text{and} \quad G^D_\gamma < 0. \tag{25}
\end{align*}

If trade barriers had not come down in this period, the South would have continued to produce only good \( B \) as in period 1. Since, by Assumption 1, \( \frac{h_B}{P_B} \) may be either lower or higher than \( \frac{x_B^b}{w_{S2}} \) for all \( q_2 \in S_2 \), it then follows that, had the economy remained closed in period 2, the period-2 equilibrium skill premium, denoted by \( G^M(a_2) \), would have fallen between \( G^U(a_2, \alpha, \gamma) \) and \( G^D(a_2, \alpha, \gamma) \),

\begin{align*}
G^D(a_2, \alpha, \gamma) < G^M(a_2) < G^U(a_2, \alpha, \gamma). \tag{26}
\end{align*}

### 3.2 Period 1

Having obtained \( q_{2S} \) as a function of \( a_2 \) under the assumption that the economy is open in period 2, we are now ready to determine \( e \) and thus \( a_2 \) under this assumption, and under the alternative one that the economy will stay closed in period 2 too.

#### 3.2.1 Consumption and education

In the current period, mothers inelastically supply all the time left over from child care to the labour market. To avoid carrying too many constants around, we set \( \theta = \tau = \frac{1}{2} \). Recall that sons spend a fraction \( e \) of \( \theta \) studying, and a fraction \( 1 - e \) working.\(^9\) A child spending \( e \theta \) units of time studying in period 1 has a probability \( \pi(e) \) of becoming a skilled adult worker in period \( 2 \).\(^10\) For simplicity, we assume

\[ \pi(e) = e. \]

As child labour is obviously unskilled, and having assumed that it is substitutable for unskilled adult labour at the constant rate \( \theta \), the opportunity-cost of education per unit of adult-equivalent time is \( w_{S1} \). We abstract from other educational costs.

Recall that a fraction \( a_1 \) of Southern mothers is skilled, and a fraction \( 1 - a_1 \) unskilled. Let \( P_{B1} \) denote the price of good \( B \) in period 1. Given \( P_{B1} \), \( q_{1S} \),\(^9\) As noted in the last section, the correlation between labour participation and non-school enrolment is positive but less than perfect. Here, however, \( e \) is the \textit{fraction} of time that a child spends studying (including homework), rather than the share of school-age children enrolled for education. As we are talking of poor countries, it seems reasonable to simplify the analysis by assuming that the time left to a child after taking the minimum necessary amount of rest will be entirely spent studying or working. For a fuller analysis, see Cigno (2012) and references therein.

\(^{10}\)That is true in the North as in the South. In the former, however, children are obliged to study full time.
\( w_{1S}, q_{2S} \) and \( w_{2S} \), a type- \( j \) family \((j = H, L)\) solves

\[
\begin{align*}
\text{Max} \quad & \quad EU_{S1}^j = \ln B_j + \gamma E(\ln k_j), \quad 0 < \gamma < 1 \\
\text{s.t.} \quad & \quad 0 \leq e_j \leq \bar{e} \\
R_j = & \quad P_{B1}B_j,
\end{align*}
\]

where \( U_{S1}^j \) is the mother’s utility function, and

\[
\begin{align*}
R_L &= \frac{1}{2} [(w_{1S} + (1 - e_L)w_{1S})] \\
R_H &= \frac{1}{2} [(q_{1S} + (1 - e_H)w_{1S})] \\
k &= q_{2S} \text{ with probability } e_j \\
k &= w_{2S} \text{ with probability } 1 - e_j.
\end{align*}
\]

The dependence of \( EU_{S1}^j \) on \( k \) reflects an altruistic interest on the part of the mother in the son’s future earning capacity, and thus consumption.

At an interior solution,

\[
\begin{align*}
B_{j1}^D &= \frac{w_{1S}}{P_{B1}2\gamma \ln \left( \frac{q_{2S}}{w_{2S}} \right)}, \quad j = H, L, \\
e_H^* &= 1 + \frac{q_{1S}}{w_{1S}} - \frac{1}{\gamma \ln \left( \frac{q_{2S}}{w_{2S}} \right)} \quad (27)
\end{align*}
\]

and

\[
e_L^* = 2 - \frac{1}{\gamma \ln \left( \frac{q_{2S}}{w_{2S}} \right)}. \quad (28)
\]

Therefore, the South’s aggregate period-1 demands for goods and education are, respectively,

\[
\begin{align*}
B_1^D &\equiv a_1 B_{H1}^D + (1 - a_1) B_{L1}^D = \frac{w_{1S}}{P_{B1}2\gamma \ln \left( \frac{q_{2S}}{w_{2S}} \right)} \\
\end{align*}
\]

and

\[
e^* \equiv a_2 = a_1 e_H^* + (1 - a_1) e_L^* = 2 + a_1 \left( \frac{q_{1S}}{w_{1S}} - 1 \right) - \frac{1}{\gamma \ln \left( \frac{q_{2S}}{w_{2S}} \right)}. \quad (29)
\]

There are also two possible corner solutions, one with \( e_j = 0 \) and the other with \( e_j = \bar{e} \). The former may realistically apply to unskilled parents \((j = L)\), who could be so poor, that they cannot invest in their children’s education even if the expected return is relative high. The latter can only apply to skilled parents \((j = H)\), who could be rich enough to want to invest in their children’s education even if the expected return is low.
3.2.2 Equilibrium

As we saw in the last subsection, the cost-minimizing inputs of skilled and unskilled labour per unit of $B$ are, respectively,

\[ h^*_B = \left( \frac{\beta}{1 - \beta} \frac{q_{1S}}{w_{1S}} \right)^{-\beta} \]  

(30)

and

\[ l^*_B = \left( \frac{\beta}{1 - \beta} \frac{q_{1S}}{w_{1S}} \right)^{1-\beta}. \]  

(31)

Thus, perfect competition requires

\[ P_{B1} = l^*_B w_{1S} + h^*_B q_{1S}, \]

labour market equilibrium requires

\[ \frac{1}{2} a_1 = h^*_B B_1 \]  

(32)

and

\[ \frac{1}{2} ((1 - a_1) + \frac{1}{2} (1 - a_2)) = l^*_B B_1, \]  

(33)

and goods market equilibrium requires

\[ B_1 = B_1^D = \frac{w_{1S}}{P_{B1} 2\gamma \ln \left( \frac{q_{1S}}{w_{2S}} \right)}. \]

The period-1 equilibrium skill premium is determined by period-1 relative labour endowments. Using (30) – (31), we find

\[ \frac{1}{2 - a_1 - a_2} = \frac{h^*_B}{l^*_B} = \frac{1}{\beta} \frac{q_{1S}}{w_{1S}}. \]

Hence, solving for $\frac{q_{1S}}{w_{1S}}$,

\[ \frac{q_{1S}}{w_{1S}} = \frac{1 - \beta}{\beta} \left( \frac{2 - a_1 - a_2}{a_1} \right). \]  

(34)

Assuming that the family optimization problems have interior solutions, and substituting from (29) and (34), we then obtain

\[ a_2 = 2 + a_1 \left[ \frac{1 - \beta}{\beta} \left( \frac{2 - a_1 - a_2}{a_1} \right) - 1 \right] - \frac{1}{\gamma \ln (G^m(a_2))}, \quad m \in \{U, M, D\} \]

whence

\[ 2 - a_1 - a_2 = \frac{1}{\gamma \ln (G^m(a_2, a_1, \gamma))}. \]  

(35)

**Proposition 1** If the choice of $e_H$ and $e_L$ is interior, there exists a unique equilibrium relationship $a_m^2(a_1)$ such that (i) $\frac{da_m^2}{da_1} < 0$, $m = U, M, D$, and (ii) $a_M^2(a_1) > a_U^2(a_1) > a_D^2(a_1)$ for all $a_1$.

**Proof.** See Appendix 1.  ■
Recalling that $a_2 = e$, the first part of this proposition tells us that the higher is the South’s skill endowment, the less will parents in the South invest in their children’s education. That is because, for any given expectation of $\frac{q_2}{w_2}$, the more skill-abundant the South is in period 1, when its economy is still closed, the lower will $\frac{q_1}{w_1}$ be. Given that, in view of (27) – (28), the amount $H$-type parents invest in their children’s education is increasing in $\frac{q_1}{w_1}$, and the amount $L$-type parents invest in it is independent of $\frac{q_1}{w_1}$, aggregate educational investment is then decreasing in the period-1 share of skilled parents. The second part of the proposition tells us that, given $a_1$, the expectation that barriers to foreign trade and investment will come down in period 2 may either raise or lower child labour depending on whether the production activity expected to be relocated to the South in period 2 is more or less skill-intensive than those already carried out there.

3.3 Testable implications

So far, the analysis has assumed that the South is an homogeneous entity. In reality, the South consists of different countries, all skill-poor compared with the North, but some more than others.\textsuperscript{11} Suppose that the intermediate good $x_1$ (tradable in period 2) can be produced by a continuum of technologies indexed $0 < z < 1$. Given $\frac{p_2}{q_2}$, each unit of the good produced with technology $z$ will employ $h(z)$ units of skilled labour, and $l(z)$ units of unskilled labour. Arrange inputs so that $h(z)$ is increasing in $z$. Let $C(z)$ be the unit cost of producing a good of skill-intensity $z$. For any $\frac{q_2}{w_2} > 1$, $C(z)$ is increasing and continuous in $z$. Suppose there is one developed country labelled $N$, and two developing countries labelled $S_1$ and $S_2$, such that $S_2$ has the lowest and $N$ the highest relative skill endowment. Then,

$$\left(\frac{q_2}{w_2}\right)_N < \left(\frac{q_2}{w_2}\right)_{S_1} < \left(\frac{q_2}{w_2}\right)_{S_2}.$$ 

In Figure 6, adapted from a diagram in Feenstra and Hanson (1996), the straight lines $C_N$, $C_{S_1}$ and $C_{S_2}$ are the graphs of the cost function $C(.)$ for, respectively, $N$, $S_1$ and $S_2$. For $z < Z_1$, $C_{S_2}$ lies below both $C_N$ and $C_{S_1}$. For $z > Z_2$, $C_{S_2}$ lies above both $C_N$ and $C_{S_1}$. For intermediate values of $z$, $C_{S_1}$ lies below both $C_{S_2}$ and $C_N$. The two cut-off points are implicitly defined by, respectively,

$$C(z_2, \left(\frac{q}{w}\right)_{S_2}) = C(z_2, \left(\frac{q}{w}\right)_{S_1})$$

and

$$C(z_1, \left(\frac{q}{w}\right)_{S_1}) = C(z_1, \left(\frac{q}{w}\right)_N).$$

The diagram tells us that trade liberalization will make it advantageous for the North to relocate the production of intermediate goods with skill intensity

\textsuperscript{11}The converse applies to the North, but this is of no consequence for the present argument.
$Z_1 < z < Z_2$ to country $S_1$, and the production of intermediate goods with skill intensity $0 < z < Z_1$ to country $S_2$. In general, therefore, the better endowed with skilled labour a developing country is when it opens itself up to foreign trade and investment, the more skill-intensive will the production activities relocated to that country be. Formally,

$$y(a_1) = \frac{x_1 h^*_1}{x_1 I_{x_1}^*} - \frac{h^*_2}{I_B^*}, \; y_{a_1} > 0.$$ (36)

In light of the second part of Proposition 1, (36) tells us that, if the production activities relocated to the country in question are more skill-intensive than those that would have been carried out there in the absence of foreign trade and investment, the skill premium will then be higher in the open than in the closed economy equilibrium. In light of the first part of the same proposition, (36) also tells us that child labour will be lower in the open than in the closed economy equilibrium if the country is sufficiently well endowed with skilled adult labour for the skill premium to be higher in the former than in the latter. Otherwise, child labour will be higher than or the same as in the closed economy equilibrium. These are testable predictions.

4 Empirical analysis
In this section, we test our theoretical predictions using a panel and a collapsed dataset (where averages for all variables are calculated to increase the number of available information). Both datasets are constructed merging the WDI (World Bank) and UNESCO databases, which provide comparable information on trade, FDI and skill endowments, with the Industrial Statistics Database of the United Nations Industrial Development Organization (UNIDO), which provides annual information on the manufacturing sector disaggregated at the 2-digit level of the International Standard Industrial Classification (ISIC) revision 2 for the 1963-2008 period, and with UNICEF, UNESCO, World Bank, ILO, and Barro and Lee (2010) data on child labour, trade, FDI and skill endowments. Precise variable definitions and data sources are reported in Appendix 2.

The descriptive statistics shown in Table 1 reveal a disparity between the number of observations available for the skill premium and that available for child labour, and thus between the size of the sample used to estimate the former and that used to estimate the latter. This is due to the fact that the panel is unbalanced (i.e., that the annual data do not perfectly overlap for all variables). For instance, per-capita GDP is available for all 207 countries in each of the 13 years considered, giving us a total of 2691 observations, and our measure of the degree of trade openness is available for most countries and most years, giving us a total of 1666 observations. But we have only 127 observations concerning child labour, because most countries either do not have child labour or do not record it, and few of those who do have data for more than one year. Similarly, some countries have education but not child labour data, while others have child labour but not education data.
Child labour is measured as a percentage of the number of children in the 5-14 age range recorded as working. To get a measure of the skill premium for each UNIDO country in each year, we divided the average wage rate in industries classified by the OECD as "high or medium-high technology" by the average wage rate in industries classified as "low technology". We are aware that this is not a very good proxy for the skilled-to-unskilled wage ratio, but it is the only one available for the countries with child labour data. Trade openness ($open$) is measured by the trade ratio, and taken to be exogenous. The skill endowment is alternatively measured as the share of individuals with primary education only ($edu_{pri}$), the share of individuals with at least secondary education ($edu_{sec}$), the survival rate to the final grade of primary education ($edupri_{sur}$), or the average number of years in education ($edu_{years}$), in the population aged 25 or more. As a further alternative, we tried the ISCED1 $totalveryhigh$ variable, obtained adding up the shares of the individuals with secondary, tertiary and post-tertiary education in the population aged 25 or more. As these are all stock measures, and thus practically constant within each year, it is legitimate to use them as explanatory variables, along with our lagged measure of trade openness, in the determination of flow variables like the skill premium and the child labour rate.

Given that, according to our theoretical analysis, all the endogenous variables are simultaneously determined, child labour and the skill premium should be estimated simultaneously. As we do not have enough data for that, however, we had little choice but to separately estimate a skill premium and a child labour equation. In both equations, trade openness and the different measures of the skill endowment are lagged five years ($L5_{open}$, etc.) to allow for the fact that it takes time for trade exposure to fully deploy its effects. We tried also shorter or longer lags, but the results did not change significantly. To capture the conditionality of trade effects on the size of the skill endowment, we interacted our lagged measures of these two variables.

As our theoretical model does not make any prediction about the productivity effect of foreign trade and investment liberalization, we used the log of per-capita GDP ($lnGDP_{pc}$) as a control variable in both our equations, and checked for possible endogeneity by instrumenting this variable with its lagged value (which is highly correlated with the variable itself but uncorrelated with the error term). As an additional control, we used the net inward foreign direct investment as a percent of GDP ($fdi_{perc}$).\footnote{As an alternative, we tried the Chinn-Ito index of foreign investment openness ($kaopen$). As it was never significant, however, we do not present the results.} We would have liked to control also for the skill content of such investment. As already mentioned, however, we do not have comparable country-level data on this variable. Year dummies are used to account for the fact that the date when the skill premium and the child labour rate are recorded varies from country to country (usually between 2007 and 2012).

Table 3 reports alternative OLS estimates of the skill-premium equation, obtained using alternative measures of the skill endowment, and either including
or excluding the interaction term between this endowment and trade openness. As the dataset is collapsed from different surveys concerning different years, we could only use averages. In all the regressions, the skill premium turns out to be negatively and significantly related to both the lagged trade ratio and the lagged skill endowment, but positively and significantly related to the product of the two. The sign of the trade effect is thus dependent on the size of the skill endowment. Calculating the total derivative of the skill premium with respect to the trade ratio and setting it equal to zero, we find that trade affects the skill premium positively if the skill endowment is above a certain threshold, negatively if it is below it. This finding is consistent with the theoretical prediction that trade liberalization raises the skill premium in countries endowed with a sufficiently well educated labour force, lowers it or leaves it constant elsewhere. The threshold is 0.43 in regression (1), 0.42 in regression (2), and 0.46 in regressions (3) and (4). It would thus appear that what really matters is the share of the labour force with at least completed primary education. Consistently with the theoretical prediction that the skill premium is affected by the (endogenously determined) skill intensity of FDI rather than by its volume, fdi_perc is either insignificant, or significant only at the 10 per cent level. Income is never significant, and instrumenting it with its lagged value makes no qualitative difference to the estimates.

Table 3: The skill premium regression

As already noted, yearly child labour data are strongly unbalanced. As a consequence, we could not exploit the panel dimension of the dataset, and had to limit ourselves to analyzing a cross-section of averaged annual data concerning the 106 countries for which we have both child labour and trade openness data as shown in Figure 3. The number of observations shrinks even further if we consider also the skill endowment, because we have only 56 countries with data on all three variables. For these countries, the mean of the lagged labour force share with at least primary education is 0.40, and the median 0.418 (the 25th percentile is 0.238 and the 75th 0.55). Notice that both the mean and the median are close to the estimated threshold above which trade openness is positively correlated with the skill premium.

Table 4 reports the results of regressing child labour on trade openness and the log of per-capita income. We could not estimate a trade openness-skill endowment interaction terms, but were able to exploit the information provided by Figures 4a to 6b, that the child labour-trade openness correlation changes sign at the median skill endowment, by carrying out separate estimates for countries below and above that threshold. The estimated effect of trade openness is negative but insignificant in the full sample (all), positive, but it becomes moderately significant if we use the share of adults with secondary or higher education as an additional regressor, in the subsample with skill endowments below the median (low edu). This effect is always negative and significant in the subsample with skill endowments above the median (high edu). The effect of the log of per-capita income is significantly negative in all the regressions.

Table 4: Child labour and education

While not conclusive, because the data limitations prevent robust statistical
analyses, these empirical findings do not contradict the theoretical prediction that trade liberalization will raise the skill premium and reduce child labour in developing countries endowed with a sufficiently well educated labour force, but will have the opposite or no effect elsewhere.

5 Conclusion

The theoretical part of our analysis used a bare-bones model of the family emphasizing educational decisions, immersed in model of the world economy emphasizing trade in intermediates and technology transfer via offshoring, to predict the child labour implications of liberalizing foreign trade and investment. According to this analysis, the expectation that barriers to trade and foreign investment will come down in the future will raise or lower a developing country’s skill premium depending on whether the country’s initial stock of skilled adults is or is not large enough to attract productive activities with a higher skill requirement than those originally carried out there. In the first case, child labour will fall. In the second, it will rise. These predictions are not rejected by the data.

According to these predictions, trade liberalization creates a divide between those developing countries that, having started out on the right foot, will specialize in low-skill production activities less than they did before and will eventually become developed countries, and those that, having started out on the wrong foot, will specialize even further in low-skill activities, and stay underdeveloped. For this second group of countries, our trade analysis yields qualitatively the same results as Heckscher–Ohlin and Stolper-Samuelson-Wood theory. For the first group of countries, by contrast, our predictions are the opposite.

As our theoretical analysis is silent regarding the relationship between trade liberalization and per-capita income, our empirical analysis takes both variables to be exogenous. As per-capita income turns out to have no significant effect on the skill premium, but a significantly negative one on child labour, it is then possible that liberalization would reduce child labour not only in countries where the skill endowment is above the threshold required for the move to have a positive effect on the skill premium, but also in some of those where the skill endowment is below the threshold, and trade liberalization has a negative effect on the skill premium.13

6 References


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13Controlling for per-capita income and skill endowments, Cigno et al. (2002) indeed find that trade openness (measured by an index that rates a country as either open or closed depending on whether it does or does not satisfy a number of criteria) reduces child labour everywhere. Skill endowments reduce child labour, but do not affect the sign of the trade openness effect.


Edmonds, E. V. (2005), "Does child labour decline with improving social status?", *Journal of Human Resources* 40, pp. 77-99.


7 Appendix 1: Proof of Proposition 2

Re-write (35) as

\[ F(a_1, a_2) = 2 - a_1 - a_2 - \frac{1 - \beta}{\gamma \ln G^m(a_2, \alpha, \gamma)} = 0. \]

For the Dini implicit functions theorem, and given that

\[ G^m_{a_2} < 0 \text{ for } m \in \{U, M, D\}, \]

\[ \frac{da_2}{da_1} = -\frac{F'_{a_1}}{F'_{a_2}} = -\frac{1}{\gamma (1 - \beta) \frac{G^m_{a_2}(a_2, \alpha, \gamma)}{(\gamma \ln G^m(a_2, \alpha, \gamma))^2}} < 0. \]

Now let

\[ H(a_2) = 2 - a_1 - a_2, \quad H'_{a_2} < 0 \]

and

\[ K^m(a_2) = \frac{1 - \beta}{\gamma \ln G^m(a_2, \alpha, \gamma)}, \quad K'^{m}_{a_2} > 0. \]

For \( 0 < a_2 < 1 \),

\[ 1 - a_1 < H(a_2) < 2a_1 \]

and

\[ 0 < K^m(a_2) < \infty. \]

From monotonicity, \( K^m(a_2) \) can cross \( H(a_2) \) only once, and this will surely happen since \( K^m \rightarrow \infty \) as \( a_2 \rightarrow 1 \). Finally noting that \( K^U(a_2) < K^M(a_2) < K^D(a_2) \) \( \forall a_2 \) the result \( a_2^U(a_1) > a_2^M(a_1) > a_2^D(a_1) \) \( \forall a_1 \) immediately follows.
8 Appendix 2: Definitions and sources

Definitions

Child labour is defined as the share of children aged 5–14 involved in child labour at the moment of the survey. A child is considered to be involved in child labour under the following conditions: (a) for children aged 5–11 if, during the reference week, if they did at least one hour of economic activity or spent at least 28 hours on household chores, (b) for children aged 12–14 if they did at least 14 hours of economic activity or spent at least 28 hours on household chores.

The skill premium is computed dividing the average wage in high and medium-high tech industries by average wage in low tech industries.

\( \ln \text{GDP}_{pc} \) is the log of per capita GDP.

\( \text{open} \) is the trade ratio (imports plus exports over GDP).

\( \text{fdi}_{perc} \) is net inward FDI as a percent of GDP.

\( \text{kaopen} \) is the Chinn-Ito index of capital account openness.

Skill endowments are proxied by a number of different stock variables: \( \text{edu}_{pri} \) and \( \text{edu}_{sec} \) are, respectively, the shares of the population aged 25 or over with primary education only and with secondary or higher education; \( \text{edu}_{prisurv} \) is the survival rate to the last grade of primary school; \( \text{edu}_{years} \) is the population's average number of completed years of education.

\( \text{L5open} \), \( \text{L5edu}_{pri} \), etc. are open, \( \text{edu}_{pri} \), etc. lagged 5 years.

Sources

Child labour. UNICEF-supported Multiple Indicator Cluster Surveys (MICS) and ILO-supported Statistical Information and Monitoring Programme on Child Labour (SIMPOC) surveys. The data were collected starting in the year 2000 in more than 50 surveys using a standard questionnaire, and using a standard definition of child labour to allow comparison. The surveys cover children aged 5 to 14 engaged in either "economic activities" (paid or unpaid work for someone who is not a member of the family) or in household chores such as cooking, cleaning and caring for younger children. See http://data.unicef.org/child-protection/child-labour, updated November 2014, and http://www.ucw-project.org/pages/interactive-map.aspx. http://www.ilo.org/ipec/Child labour statistics SIMPOC/Questionnaires surveys and reports/lang–en/index.htm contains time series for a limited number of countries.

Skill premium. Industrial Statistics Database of the United Nations Industrial Development Organization (UNIDO) including information on wages, employment, capital, value added and production disaggregated at the 2-digit level of the International Standard Industrial Classification (ISIC), revision 3.


Trade and GDP. United Nations.

FDI. World Bank.

Figure 1: Child labour and non-school attendance

Figure 2: Child labour and per-capita GDP
Fig 3: Child labour and trade openness

Figures 4a and 4b: Child labour and trade openness, with skill endowments below (a) and above (b) the median of the sample
Figures 5a and 5b (same as 4a and 4b but excluding Burkina, Rwanda and Ethiopia)

Fig 6a and 6b (same as 5a and 5b but excluding also Guatemala, Tanzania, Kenya and Mozambique)
# TABLES

## Table 1: Descriptive Statistics, full sample

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## Table 2: Marginal Effects for different GDP levels

| Per-capita GDP ($) | dy/dx     | Std. Err. | z     | P>|z| [95% Conf. Interval] |
|--------------------|-----------|-----------|-------|-------------------------|
| 100                | -0.123    | 0.018     | -6.92 | 0.000                   |
| 200                | -0.111    | 0.017     | -6.43 | 0.000                   |
| 500                | -0.090    | 0.013     | -6.71 | 0.000                   |
| 1,000              | -0.073    | 0.010     | -7.60 | 0.000                   |
| 2,000              | -0.057    | 0.006     | -9.32 | 0.000                   |
| 3,000              | -0.049    | 0.004     | -10.88| 0.000                   |
| 5,000              | -0.039    | 0.003     | -13.53| 0.000                   |
| 10,000             | -0.029    | 0.002     | -16.50| 0.000                   |
| 20,000             | -0.021    | 0.002     | -14.05| 0.000                   |
Table 3: The skill premium regression

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* p<0.1, ** p<0.05, *** p<0.01

Table 4: Child labour and education

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* p<0.1, ** p<0.05, *** p<0.01
Table 5: Child labour and education excluding some outliers (Rwanda, Ethiopia and Burkina)

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*p<0.1, ** p<0.05, *** p<0.01

Table 6: Child labour and education (excluding also Tanzania, Kenya, Guatemala and Mozambique)

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*p<0.1, ** p<0.05, *** p<0.01