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

October 21, 2015

Abstract

Incorporating family decisions in a two-period.model of the world economy, we show that trade liberalization will raise the skill premium in developing countries where the initial share of skilled workers in the adult workforce is large enough (compared with other developing countries but not with developed ones) to attract production activities, previously carried out in the latter, more skill-intensive than those previously carried out in the former. In these countries, the child labour rate will definitelly fall. Elsewhere, trade liberalization will reduce the skill premium, but child labour may still fall because income will rise. The empirical analysis confirms these predictions. Indeed it shows that liberalization reduces child labour everywhere. Where child labour is concerned, liberalization is thus beneficial everywhere, but it induces developing countries that started out with relatively less (more) educated worforce to specialize more (less) in low-skill production activities than they did before.

Key words: trade barriers, technology transmission, skill endowment, skill premium, school enrolment, 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. In more recent decades, this has been accompanied by a reduction in the incidence of child labour. Is there a nexus between these phenomena?

*Email: cigno@unifi.it
†Email: giorgia.giovannetti@unifi.it
‡Email: lsabani@unifi.it

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 the children in the family will be made to 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 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 (see Cigno and Rosati 2003, 2005). 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 work even if the expected return to education is higher than the return to labour. Without credit market imperfections, therefore, the allocation of the children's time between work and study would thus be the outcome of a portfolio decision, independent of parental income. With market imperfections, the decision is subject to a liquidity constraint (see Ranjan 2001, Dehejia and Gatti 2005, and Beegle et al. 2006). For families close to the breadline, the allocation will then depend essentially on parental income. As we move up the income scale, however, we may expect the link between child labour and parental income to become progressively weaker and eventually disappear. How does trade and offshoring come into the picture?

The opportunity to trade and invest across national borders enlarges the opportunity set and raises per-capita GDP. Other things being equal, liberalization may thus be expected to relax the liquidity constraints facing families with children, and bring about a reduction in child labour. Other things are not equal, however, because international trade and investment may 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. 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 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 wage rate will rise relative to the unskilled wage rate in the North, and fall in the South. This prediction does not appear to be borne out by the facts however. Empirical research shows that, in the 1980s and 1990s, increased openness was associated with a rise in the skilled-to-unskilled wage ratio (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).[1]

A limitation of the Heckscher–Ohlin framework is that it only envisages trade in final goods. In recent decades, however, there has been a very 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. Depending on whether this or the Stolper-Samuelson-Wood effect prevailed, the skill premium could have thus risen or fallen. Conversely, if the relocated activities were less skill-intensive than those originally carried out in the destination country, this would have reinforced the Stolper-Samuelson-Wood effect, and the skill premium would have definitely fallen. Child labour could have fallen in either case, because liberalization could have raised the income and thus relaxed the liquidity constraint of the average family, but more likely if the skill premium and thus the incentive for parents to invest in their children's education has risen.

In Section 2 below, we report some broad facts concerning trade, FDI, relative wages, income, education and child labour in developing countries. In Section 3, we graft a family decision model on to a two-period 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 referred to in this section are constructed using country data drawn from ILO, UNESCO, UNICEF, UNIDO, World Bank and the Barro and Lee dataset (detailed variable definitions and data sources can be found in Appendix 2). 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, the correlation is low because many of the children enrolled at school in developing countries work at the same time. Further considering that, as stressed in Cigno (2012), school enrolment is not synonymous of school attendance, and school attendance is not synonymous of study effort (because working children have little time for rest and to do their home work, tend to be absent from school and are too sleepy and tired to take full advantage of school attendance when they do attend), it then follows that child labour rather than non enrollment is the best inverse proxy for effective educational investment.

Figure 2 plots child labour against the log of per-capita GDP. It also shows the child labour rate predicted by a Generalized Linear Model regression with

[1] Indeed, Leamer (1996, 1998) finds that unskilled wage rates did not fall even in the developed world.

a binomial distribution and a logit link function (see Papke and Wooldridge, 1996). By construction, this model takes into account the nonlinearities arising from the fact that the dependent variable is constrained between 0 and 1. The correlation is negative but small, suggesting the presence of other important co-variates. As Table 1 shows, the marginal effect of per-capita GDP is clearly decreasing. For low-income economies (those with per-capita GDP below 1,000 dollars a year), a 1% increase in per-capita GDP is associated with a 10% reduction in child labour. For lower to middle income economies (those with per-capita GDP between 1000 and 4000 dollars), the marginal effect is less than half that estimated for poorer 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 explanations based on income are important for very poor countries, where a large share of the population is close to the subsistence level (and the government's ability to remedy this by taxing and redistributing is severely limited), but other factors are more important in less poor countries.

Figure 3 plots child labour against a measure of trade openness (imports plus exports over GDP) lagged five years to allow for the effects of trade changes to work their way through the economy. The size of the dots refers to the country's skill endowment (measured as the average numbers of years at school of the population over the age of 25) again lagged five years. Like the correlation between child labour and income, the correlation between child labour and trade exposure is negative but low. If we focus on the larger dots, however, we get the impression that the correlation is higher in countries that started out with a large skill endowment than in countries that started out with a low one. It would thus seem that not only income, but also trade and skill endowments, have a beneficial effect on child labour. The literature suggests that foreign direct investment also may have a role. Over the past two decades, developing countries have indeed increased their ability to attract such 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 of the globalization game, have recently started to take an active part. There is, however, no obvious correlation between this variable and child labour The next section will help us to formulate testable hypotheses.

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 θ 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 τ 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 $(0 \leq e \leq \bar{e}$, with $\bar{e} < 1)$. The amount of time $e\theta$ 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_{ti} denote the wage rate accruing to skilled labour, and w_{ti} the one accruing to unskilled labour, in country i in period t . Preferences, technology and relative factor endowments are assumed to be such that

$$\frac{q_{tS}}{w_{tS}} > \frac{q_{tN}}{w_{tN}},\ t = 1, 2. \tag{1}$$

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.

In period 1, agents correctly anticipate period-2 prices and wages. Given this assumption, the equilibrium could be found in one shot (no backward-induction problem). For ease of exposition, however, we first look for the period-2 equilibrium taking period-1 decisions as parameters, and then solve for period-1 decisions. As child labour is concentrated mostly in developing countries, we focus on the South.

[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).

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 in both parts of the world. Here, by contrast, our aim is to establish the effect of period-2 cross-country trade and investment liberalization on the period-2 skill premium, because that will affect period-1 education and child labour decisions. As the analytical techniques used in this subsection are well established in the literature, we concentrate on the economic interpretation, and refer the reader to textbook expositions of the Hecksher-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

$$x_1 = L^{\varepsilon} H^{1-\varepsilon},\ 0 < \varepsilon < 1,$$

and then costlessly assembling the final good A from x_1 and x_2 according the constant-returns-to-scale technology

$$A = x_1^{\alpha} x_2^{1-\alpha},\ 0 < \alpha < 1.$$

The North may now choose to 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,

$$h^*_{x_1} = (\frac{1-\varepsilon}{\varepsilon}\frac{q_{2S}}{w_{2S}})^{-\varepsilon} \tag{2}$$

and

$$l^*_{x_1} = (\frac{1-\varepsilon}{\varepsilon}\frac{q_{2S}}{w_{2S}})^{1-\varepsilon}. \tag{3}$$

The minimized period-2 unit cost of producing x_1 in country S is consequently

$$c_{1S} = w_{2S} l^*_{x_1} + q_{2S} h^*_{x_1}. \tag{4}$$

Denoting by c_{1N} the period-2 unit cost of producing x_1 in country N, and recalling that (1), 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,

$$x_1^* = (\frac{1-\alpha}{\alpha}\frac{c_2}{c_1})^{1-\alpha} \tag{5}$$

and

$$x_2^* = (\frac{1-\alpha}{\alpha}\frac{c_2}{c_1})^{-\alpha}, \tag{6}$$

where c_2 denotes the minimized period-2 unit cost of x_2.[5] The period-2 unit cost of A is

$$c_A = x_1^* c_1 + x_2^* c_2. \tag{7}$$

Good B is produced by the constant-returns-to-scale technology,

$$B = L^\beta H^{1-\beta},\ 0 < \beta < 1, \tag{8}$$

where H_B denotes the quantity of skilled labour, and L_B the quantity of unskilled labour, employed in this activity. The cost-minimizing inputs of skilled and unskilled labour per unit of output are, respectively,

$$h_B^* = (\frac{1-\beta}{\beta}\frac{q_{2S}}{w_{2S}})^{-\beta} \tag{9}$$

and

$$l_B^* = (\frac{1-\beta}{\beta}\frac{q_{2S}}{w_{2S}})^{1-\beta}. \tag{10}$$

The period-2 unit cost of B will thus be[6]

$$c_B = h_B^* q_{2S} + l_B^* w_{2S}.$$

Similar expressions may be derived for the quantities of goods A and C produced by the North.

---

[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 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 Tefler (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 goods A and C. .

3.1.2 Consumption

In the South, the average family (recall that families are differentiated by skill level) solves

$$\begin{aligned} MaxU_{S2} &= \ln B + \gamma \ln A \\ \text{s.t. } Y_{S2} &= P_{B2}B + P_{A2}A, \end{aligned}$$

where U_{S2} is the son's utility, and

$$Y_{S2} = a_2 q_{2S} + (1 - a_2) w_{2S}$$

the average period-2 income. Using the first-order conditions, we can derive the South's period-2 average demands for the two final goods,

$$\begin{aligned} A^D_{S2} &= \frac{\gamma}{1+\gamma}(\frac{Y_{S2}}{P_{A2}}) \\ B^D_2 &= \frac{1}{1+\gamma}\frac{Y_{S2}}{P_{B2}} \end{aligned} \tag{11}$$

and *for the two* intermediate goods,

$$\begin{aligned} x^D_{S1} &= x^*_1 A^D_{S2} \\ x^D_{S2} &= x^*_2 A^D_{S2}. \end{aligned} \tag{12}$$

Therefore,

$$\frac{A^D_{S2}}{B^D_2} = \gamma \frac{P_{B2}}{P_{A2}} \frac{Y_{S2}}{Y_{S2}} = \gamma \frac{P_{B2}}{P_{A2}} \tag{13}$$

The average Northern family's optimization problem is

$$\begin{aligned} MaxU_{N2} &= \ln C + \gamma \ln A \\ \text{s.t. } Y_{N2} &= P_{C2}C + P_{A2}A, \end{aligned}$$

where U_{N2} is the son's utility, and, Y_{N2} the average period-2 income. Therefore, the North's demands are

$$A^D_{N2} = \frac{\gamma}{1+\gamma}\frac{Y_{N2}}{P_{A2}} \tag{14}$$

$$C^D_{N2} = \frac{1}{1+\gamma}\frac{Y_{N2}}{P_{A2}} \tag{15}$$

and

$$\begin{aligned} x^D_{N1} &= x^*_1 A^D_{N2} \\ x^D_{N2} &= x^*_2 A^D_{N2} \end{aligned} \tag{16}$$

Using the balance-of-trade equilibrium condition

$$x_2^* A_{S2}^D = x_1^* A_{N2}^D,$$

and substituting from (11) and (14), we then find

$$\frac{x_2^* A_{S2}^D}{x_1^* A_{N2}^D} = \frac{x_2^* Y_S}{x_1^* Y_N} = 1.$$

3.1.3 Equilibrium

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

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

and

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

Equilibrium in the South's labour markets further requires

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

and

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

As A_{N2} is determined by the North's market equilibrium conditions and thus a parameter, we have then four non-linear equations in four unknowns, A_{S2}, B_2, q_{2S} and w_{2S} [7]

We now make the following standard assumption.

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

$$\frac{x_1^* h_{x_1}^*}{x_1^* l_{x_1}^*} > \frac{h_B^*}{l_B^*} \quad (21)$$

or

$$\frac{x_1^* h_{x_1}^*}{x_1^* l_{x_1}^*} < \frac{h_B^*}{l_B^*} \quad (22)$$

Given NFIR, and noting that $x_2^* c_2 = (1-\alpha)P_{A2}$, $(17) - (18)$ implies a two-way relationship between $\frac{P_{A2}}{P_{B_2}}$ and $\frac{q_{2S}}{w_{2S}}$ such that

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

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

[7] Similar equations determine A_{N2}, C_2, q_{2N} and w_{2N}.

force skill composition, a_2, and of the technological and preference parameters, α and γ,

$$\frac{q_{2S}}{w_{2S}} = G(a_2,\alpha,\gamma),\ G^{'}_{a_2} < 0. \tag{24}$$

The function $G(.)$ 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,α,γ),

$$G^U(a_2,\alpha,\gamma) > G^D(a_2,\alpha,\gamma),\ G^{'U}_{\alpha} > 0,\ G^{'U}_{\gamma} > 0,\ G^{'D}_{\alpha} < 0 \text{ and } G^{'D}_{\gamma} < 0. \tag{25}$$

If trade barriers did not come down in period 2, the South would continue to produce only good B as in period 1. Since, by Assumption 1, $\frac{h^*_B}{l^*_B}$ is either lower or higher than $\frac{x^*_1 h^*_{x_1}}{x^*_1 l^*_{x_1}}$ for all $\frac{q_{2S}}{w_{2S}}$, it then follows that, if the economy were to remain closed in period 2, the period-2 equilibrium skill premium would fall between $G^U(a_2,\alpha,\gamma)$ and $G^D(a_2,\alpha,\gamma)$. Denoting the closed economy case by the superscript M, we can then write

$$G^D(a_2,\alpha,\gamma) < G^M(a_2) < G^U(a_2,\alpha,\gamma). \tag{26}$$

3.2 Period 1

Having obtained $\frac{q_{2S}}{w_{2S}}$ as a function of a_2 under the assumption that the economy is open in period 2, we shall now go on to determine e and thus a_2 under this assumption, and under the competing assumption that the economy is closed not only in period 1, but also in period 2.

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 their time endowment (measured in adult-equivalent units) studying, and a fraction $1-e$ working.[8] A child spending e units of time studying in period 1 has a probability $\pi(e)$ of becoming a skilled adult worker in period 2.[9] For simplicity, we assume

$$\pi(e) = e.$$

[8] 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 *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.

[9] That is true in the North as in the South. In the former, however, children are obliged to study full time.

As child labour is obviously unskilled, and having assumed that it is perfectly substitutable for unskilled adult labour at the rate $\theta = \frac{1}{2}$, the opportunity-cost of education per unit of adult-equivalent time is w_{S1}. We do not consider 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}, w_{1S}, q_{2S} and w_{2S}, a type- j family $(j = H, L)$ solves

$$\begin{aligned} MaxU_{S1}^{j} &= E\left[\ln B_j + \gamma(\ln k_j)\right] \\ \text{s.t. } 0 &\leq e_j \leq \bar{e} \\ R_j &= P_{B1}B_j, \end{aligned}$$

where U_{S1}^{j} is the mother's utility function, and

$$\begin{aligned} R_j &= \frac{1}{2}(w_{1S} + (1 - e_j)w_{1S}) \text{ if } j = L \\ R_j &= \frac{1}{2}(q_{1S} + (1 - e_j)w_{1S}) \text{ if } j = H \\ k &= q_{2S} \text{ with probability } e_j \\ k &= w_{2S} \text{ with probability } 1 - e_j. \end{aligned}$$

The dependence of U_{S1}^{j} on k reflects an altruistic interest in the child's future earning capacity and thus consumption.

At an interior solution,

$$B_{j1}^{D} = \frac{w_{1S}}{P_{B1}2\gamma \ln\left(\frac{q_{2S}}{w_{2S}}\right)}, \ j = H, L,$$

$$e_H^{*} = 1 + \frac{q_{1S}}{w_{1S}} - \frac{1}{\gamma \ln\left(\frac{q_{2S}}{w_{2S}}\right)} \tag{27}$$

and

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

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

$$B_1^{D} \equiv a_1 B_{H1}^{D} + (1 - a_1)\, B_{L1}^{D} = \frac{w_{1S}}{P_{B1}2\gamma \ln\left(\frac{q_{2S}}{w_{2S}}\right)}$$

and

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

There are also two possible corner solutions, one with $e_j = 0$ and the other with $e_j = \bar{e}$. For w_{1S} sufficiently low, the first one may realistically apply to type-L mothers, whose income would then be $R_L = w_{1S}$. That is interesting because, in such a case, a sufficiently large increase in income would raise the demand for education, and reduce the supply of child labour, as theorized by Ranjan (2001), and exemplified by our Table 1 and Figure 2.

Proposition 1 *For w_{1S} sufficiently low, e_L^* is increasing in R_L.*

In what remains of this section, we will focus on the case where both family types are at an interior point.

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,

$$h_B^* = (\frac{1-\beta}{\beta}\frac{q_{1S}}{w_{1S}})^{-\beta} \tag{30}$$

and

$$l_B^* = (\frac{1-\beta}{\beta}\frac{q_{1S}}{w_{1S}})^{1-\beta}. \tag{31}$$

Thus, perfect competition requires

$$P_{B1} = l_B^* w_{1S} + h_B^* q_{1S},$$

labour market equilibrium requires

$$\frac{1}{2}a_1 = h_B^* B_1 \tag{32}$$

and

$$\frac{1}{2}((1-a_1) + \frac{1}{2}(1-a_2)) = l_B^* B_1, \tag{33}$$

and goods market equilibrium requires

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

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

$$\frac{a_1}{2-a_1-a_2} = \frac{h_B^*}{l_B^*} = \frac{1}{\frac{1-\beta}{\beta}\frac{q_{1S}}{w_{1S}}}.$$

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

$$\frac{q_{1S}}{w_{1S}} = \frac{\beta}{1-\beta}(\frac{2-a_1-a_2}{a_1}). \tag{34}$$

Substituting from (29) and (34), we obtain

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

whence

$$2 - a_1 - a_2 = (1-\beta) (\frac{1}{\gamma \ln (G^m (a_2, \alpha, \gamma))}). \tag{35}$$

Proposition 2 *There exists a unique equilibrium relationship $a_2^m(a_1)$ such that (i) $a_2^{m\prime}(a_1) < 0$, $m = U, D$, and (ii) $a_2^U(a_1) > a_2^M(a_1) > a_2^D(a_1)$ 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 it is still a closed economy), 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 is independent of it, aggregate educational investment is then decreasing in a_1 The second part of the proposition tells us that foreign trade and investment *may* reduce child labour. The reason, in this case, is that foreign trade and investment *may* raise $\frac{q_2}{w_2}$, and thus increase the incentive for parents in the South to invest in their children's education.

3.3 Testable implications

The analysis so far has assumed that the South is a homogeneous entity. In reality, the South consists of different countries, all skill-poor compared with the North, but some more than others.[10] Suppose that the intermediate good x_1 (tradable in period 2) can be produced by a continuum of technologies indexed $0 < z < 1$. Given $\frac{q_2}{w_2}$, 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 $\frac{h(z)}{l(z)}$ 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,

$$(\frac{q_2}{w_2})^N < (\frac{q_2}{w_2})^{S_1} < (\frac{q_2}{w_2})^{S_2}.$$

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}

[10] The converse applies to the North, but this is of no consequence for the present argument.

lies below both C_{S_2} and C_N. The two cut-off points are implicitly defined by, respectively,

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

and

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

The diagram tells us that trade liberalization will make it advantageous for the North to relocate the production of intermediate goods with skill intensity $Z_1 < z < Z_2$ 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,

$$y(a_1) \equiv \frac{x_1^* h_{x_1}^*}{x_1^* l_{x_1}^*} - \frac{h_B^*}{l_B^*},\ y'(a_1) > 0. \tag{36}$$

Taken together with the foregoing proposition, (36) implies that the better endowed with skilled labour a developing country is before liberalization, the higher will its skill premium and the lower its decreasing in the income of low-skill families. These are testable propositions.

In view of Proposition 1, another testable proposition is that, if the low-skill wage rate is sufficiently low, the child labour rate is decreasing in the income of low-income families, and in the share of these families in the total population.

4 Empirical analysis

In this section, we test our theoretical predictions using two different datasets (see Appendix 2 for precise variable definitions and data sources). The first dataset was constructed merging the WDI (World Bank) and UNESCO databases, which provide comparable information on trade, FDI and various measures of the skill endowment, 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. The second dataset was constructed matching and merging the data on child labour, trade, FDI and skill endowment provided by UNICEF, UNESCO, World Bank, ILO, and Barro-Lee. 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". Child labour is measured as the percentage of children in the 5-14 age range recorded as working. Trade exposure (open) is measured as the ratio of imports plus exports to GDP. The skill endowments are alternatively measured by the share of individuals with primary education only (edu_pri) and the share of individuals with secondary or higher education (edu_sec), by the primary education survival rate to the final grade of primary education (edupri_sur) or by the average number of years in education of the population aged 25 or more.

Given that, according to our theoretical analysis, the child labour effects of exposing a country to foreign trade come through induced skill-premium and income changes, child labour, income and the skill premium should be estimated simultaneously. As we do not have a dataset containing both child labour and the skill premium, however, we had little choice but to separately estimate an equation for each of these variables. We did not estimate an income equation, but included the log[11] of real per capita GDP (lnGDP_pc) in the list of right-hand-side variables common to both equations. Being aware that income is potentially endogenous, we tried instrumenting it with its lagged value, which is highly correlated with the explanatory variable itself but uncorrelated with the error term. In both the skill premium and the child labour equations, our measures of trade openness and skill endowments are lagged five years because it takes time for trade exposure to fully deploy its effects (at the given initial skill endowments). The explanatory variables thus include L5open and, alternatively, L5edu_pri and L5edu_sec, L5edupri_sur or L5edu_years. We also tried to interact the lagged trade measure with the lagged skill endowment measure or measures. As an additional control, we alternatively tried the Chinn-Ito index of foreign investment openness (kaopen) or actual net inward foreign direct investment as a percent of GDP (fdi_perc). We would have liked to control also for the skill content of such investment, bur we do not have country-level data on it. The year when the (final) level of the skill premium and of the share of working children are recorded may vary from country to country (usually between 2007 and 2012). Year dummies take care of that. The descriptive statistics shown in Table 2 highlight the disparity between the number of observations available for the skill premium and the number available for child labour, and thus the difference between the size of the sample used to estimate the former and the size of the sample used to estimate the latter.

Table 4 reports two alternative OLS estimates of the skill-premium equation. The explanatory variables are those already mentioned, plus the lagged trade-lagged skill endowments interaction terms. As the dataset is assembled from different surveys concerning different years, we could only carry out cross-section estimates. In the first regression, L5edu_pri and L5edu_sec affect the skill premium negatively and significantly, but their interaction with L5open affects the said premium positively and significantly. Notice that the coefficient of the stock of workers educated to primary school level *and no further* is very similar to (actually slightly larger and more significant than) the one of workers with secondary or higher education. This suggests that what matters most for present purposes (i.e., given the way the skill premium is measured) is the number of workers educated *at least* to primary school level. As the second regression shows, dropping L5edu_sec and L5edu_sec X L5_open would in fact increase

[11] Because we know from Table 1 that income affects child labour non-linearly.

the size and significance of the constant term at the expense of L5edu_prim and L5edu_prim X L5_open. Rather than adding together L5edu_prim and L5edu_sec to get the share of adults educated at least to primary level, we preferred to keep the two skill endowments separate, and thus to use the more precise estimates obtained with the first regression.

According to these estimates, the effect of a small change in trade openness on the skill premium five years hence is equal to $-7.421 + 9.708L5edu\_pri + 9.146L5edu\_sec$. Therefore, the effect will be nonnegative if and only if the country's initial skill endowments satisfy

$$9.708L5edu\_pri + 9.146L5edu\_\sec \geq 7.421. \tag{37}$$

Where this condition is not satisfied, trade exposure will reduce the skill premium. For a poor developing country where hardly anybody has secondary or higher education, (37) means that trade liberalization will raise the skill premium only if more than three quarters of the adult population completed primary education. Not all OECD countries satisfy (37), and not all non-OECD countries violate it. Consistently with the theoretical prediction that the skill premium is affected by the (endogenously determined) FDI skill content, rather than by its actual or potential volume, neither fdi_perc nor kaopen are significant. Income is never significant, and instrumenting it with its lagged value makes no qualitative difference to the estimates.[12]

Table 3 shows OLS and IV estimates of the child labour equation. The number of observations is relatively small. For most of the 108 countries with child labour data, we can construct L5edu_pri, but not L5edu_sec because many of these countries do not have secondary education statistics. We thus use the lagged value of the most widely available statistic, namely the survival rate to the final year of primary education again lagged five years (L5edu_prisurv). Nothing of substance changes if we use L5edu_pri or L5edu_years instead. The sample gets even smaller if we introduce kaopen or fdi_perc. These data limitations prevented us from interacting trade with skill endowments. Irrespective of whether income is taken to be exogenous or instrumented with its lagged value, and provided that we do not control for the potential FDI flow (kaopen), child labour turns out to be negatively and significantly affected by per-capita income, lagged skill endowments and lagged trade openness.[13] While kaopen is not significant, fdi_perc is significantly negative, but introducing either of these variables takes significance away from ln_GDPpc. With a bounded dependent variable such as child labour, it would be better to use a Generalized Linear Model with a binomial distribution and a logit link function as in Section 2. The results obtained by this approach, shown in Table 5, are remarkably similar to those obtained using the other two methods, but give us the additional information that the best model (the one with the lower values of the model selection statistics, AIC and BIC) has neither kaopen nor fdi as an explanatory variable. This confirms our earlier remark that what matters is neither

[12] IV estimates available on request from the authors.

[13] Cigno et al. (2002) and Cigno (2003) find the same using a dichotomic index of trade openness instead of the trade ratio.

the actual nor the potential size of foreign direct investment, but rather the endogenously determined skill content of this investment.

Where countries with skill endowments satisfying (37) are concerned, the finding that trade exposure reduces child labour (see Table 3) is consistent with the finding that trade *raises* the skill premium (see Table 4). What about the finding that trade reduces child labour not only in these countries, but also in those where it *lowers* the skill premium? Assuming that trade enhances productivity, because it expands the production possibility set and limits policy-induced distortions, we may explain this by saying that, in the presence of trade, the skill endowment variable picks up the child labour reducing effect of trade-induced per-capita income changes. Having estimated (see Table 1) that income reduces child labour, and explained this by saying (see Section 3) that income relaxes the credit constraint on educational investment, and given that the share of credit-constrained households will be larger (for any given level of per-capita income) in countries where the share of educated adults is smaller than in countries where this share is larger, it is in fact arguable that, in countries that liberalized when their skill endowments did not satisfy (37), the child labour reducing effect of the induced income increase more than offset the child labour raising effect of the induced skill premium reduction. Elsewhere, the two effects have the same sign, and child labour will have consequently fallen more sharply for any given degree of trade openness.

Take for example Brazil. In 2007, this country's trade ratio was 1.217, and its skill endowments were such that the estimated marginal effect of trade on the 2012 skill premium was negative (-0.632). Between 2007 and 2012, the skill premium did in fact fall slightly (-0.05 per cent), but real per-capita GDP rose sufficiently (+13.5 per cent) for the share of children in the 5-14 age range recorded as working to fall by 2.5 percentage points nevertheless. Similarly, in 2005, Iran had a trade ratio of 1.008, and skill endowments such that the estimated marginal effect of trade on the 2010 skill premium was again negative (-0.481). Between 2005 and 2010, Iran's skill premium fell (-0.25 per cent), but its real per-capita GDP rose so strongly (+17.8 per cent) that the share of children in work fell by 3 percentage points. As an example of a developing country where trade exposure raised the skill premium take Costa Rica. In 2006, this country's trade ratio was 0.655, and its skill endowments were such that the estimated marginal effect of trade exposure was positive (+0.218). Between 2006 and 2011, not only the skill premium but also real per-capita income rose, and the combined effect of these two changes was to reduce the share of working children by a very substantial amount (23 percentage points).

5 Discussion and conclusion

Our Feenstra-Hanson and Zhu-Trefler inspired theoretical analysis, emphasizing trade in intermediates and technology transfer via offshoring theoretical analysis predicts that (a) child labour is decreasing in both the skill premium (because this premium constitutes an incentive for parents to invest in their children's education) and parental income (because income relaxes the credit constraint on educational investment), and (b) the better endowed with skilled labour a developing country is when it opens itself up to trade, the more likely it is that its skill premium will rise. Assuming that trade raises average income (because it enlarges the production set and reduces policy-induced distortions), the child labour rate will then definitely fall in countries where trade raises the skill premium, but it may fall also in countries where trade lowers the skill premium because, in those countries, the share of credit-constrained households is larger, and the effect of the induced income change consequently stronger. These predictions are not rejected by the data.

The empirical analysis shows that liberalization raises the skill premium in countries that started out with a sufficiently large stock of educated workers, and reduces it elsewhere, but child labour everywhere it was present before the liberalization. In this perspective, liberalization is thus beneficial for all countries. But it is more beneficial in countries that started out with a sufficiently large endowment of skilled labour, where the effect of the induced income increase is compounded by that of the induced skill premium increase, than in other countries, where the two effects have opposite signs. In a broader perspective, liberalization creates a divide between 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 developing countries that, having started out on the wrong foot, will specialize even further in low-skill activities.

For the second group of countries, our analysis yields qualitatively the same results as traditional Heckscher–Ohlin and Stolper-Samuelson theory. For the first group of countries, by contrast, our results are the opposite of those of traditional trade theory. Looking back to a period preceding the one included the present empirical analysis, the first group of countries would seem to include the so-called Asian Tigers (Hong Kong, Singapore, South Korea, and Taiwan) who, in the course of the 1960s and 1970s, invested massively in education before liberalizing in both the economic and the political sense. This allowed Hong Kong and Singapore to become major exporters of financial services, and South Korea and Taiwan of IT goods. Their example was followed some years later by the so-called Tiger Cub Economies (Indonesia, Malaysia, Philippines and Thailand). Tigers and their cubs are now classified as emerging or newly industrialized countries.

6 References

Anderson, E., P. Tang and A. Wood (2006), "Globalization, cooperation costs and wage inequalities", *Oxford Economic Papers* 58, pp. 569-95

Barro, R. and J.-W. Lee (2010), "A new data set of educational attainment in the world, 1950-2010", *Journal of Development Economics* 104, pp.184-198

Basu, K. and P. H. Van (1998), "The economics of child labor", *American Economic Review* 88, pp. 412-427

Chinn, M. D. and H. Ito (2006), "What matters for financial development? Capital controls, institutions, and interactions", *Journal of Development Economics* 81, pp. 163-192

Cigno, A. (2003), “Globalization can help reduce child labour”, *CESifo Economic Studies* 49, pp. 515-526

— — — — (2012), “How to deal with covert child labor, and give children an effective education, in a poor developing country”, *World Bank Economic Review* 26, pp. 61-67

— — — — , L. Guarcello and F. C. Rosati (2002), "Does globalization increase child labour?", *World Development* 30, pp. 1579-89

— — — — and F. C. Rosati (2002), “Child labour, education and nutrition in rural India”, *Pacific Economic Review* 7, pp. 65-83

— — — — and F. C. Rosati (2005), *The Economics of Child Labour*, New York and Oxford: Oxford University Press

Dehejia, R. H. and R. Gatti (2005), "Child labour: the role of income variability and access to credit in a cross section of countries", *Economic Development and Cultural Change* 53 (4), pp. 913–932

Feenstra, R. and G. Hanson (1996), "Foreign investment outsourcing and relative wages" in R. Feenstra,G. Grossman,and D. Irwin (eds.), *Political Economy of Trade Policy. Essays in Honour of Jagdish Bhagwati*, Cambridge: MIT Press

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

— — — — — — — and N. Pavcnik (2006), "International trade and child labor: cross country evidence", *Journal of International Economics* 68, pp. 115–140

Freeman, R. B. and R. H. Oostendorp (2001), "The occupational wages around the World Data File", *International Labour Review* 140, pp. 379-401

Leamer, E. (1996), "In Search of Stolper-Samuelson effects on U.S. wages", NBER Working Papers 5427

— — — — — (1998), "In search for Stolper-Samuelson linkages between international trade and lower wages" in S.Collins (ed.), *Imports, Exports,and the American Worker*, Washington DC: Brookings Institution Press

Papke, L. E., and J. M. Wooldridge (1996), "Econometric methods for fractional response variables with an application to 401 (k) plan participation rates", *Journal of Applied Econometrics* 11, pp. 619-632

Ranjan, P. (2001), "Credit constraints and the phenomenon of child labour", *Journal of Development Economics* 64, pp. 81–102

Robbins, D. (1996), "Evidence on trade and wages in developing world", Technical Paper 119, OECD Development Centre, Paris

Tang, P., and A. Wood (2000) "Globalization, cooperation costs and wage Inequalities". Unpublished paper,. Netherlands Planning Bureau and Institute of Development Studies, University of Sussex, Brighton (www.ids.ac.uk/ids/global/ttint.html).

Thoenig, M. and T. Verdier (2003), "A theory of defensive skill-biased innovation and globalization", *American Economic Review* 93, pp. 709-728

UNCTAD (1997), *Trade and Development Report*, Geneva: UNCTAD

UNCTAD (2014), *World Investment Report, Investing in the SDGs: An Action Plan*, Geneva: UNCTAD

Wood, A. (1994), *North-South trade, Employment and Inequality: Changing Fortunes in Skill-Driven World*, Oxford: Claredon Press

———— (1997), " Openness and wage inequality in developing countries: the Latin America challenge to East Asia conventional wisdom", *World Bank Economic Review* 11, pp. 33-57

———— (2002), "Globalization and wage inequalities: a synthesis of three theories", *Weltwirtschaftliches Archiv* 138, pp. 54-82

Zhu, S. C. and D. Trefler (2005), "Trade and inequality in developing countries: a general equilibrium analysis", *Journal of International Economics* 65, pp. 21-48

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

$$G^m_{a_2}(a_2, \alpha, \gamma) \text{ for } m \in \{U, M, D\},$$

$$\frac{da_2}{da_1} = -\frac{F_{a_1}(a_1, a_2)}{F_{a_2}(a_1, a_2)} = -\frac{1}{1 + \frac{1-\beta}{\gamma \ln G^m(a_2,\alpha,\gamma)} \frac{G^m_{a_2}(a_2,\alpha,\gamma)}{G^m(a_2,\alpha,\gamma)}} < 0.$$

Now let

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

and

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

For $0 < a_2 < 1$,

$$1 - a_1 < H(a_2) < 2a_1$$

and

$$0 < K^m(a_2) < 1.$$

From monotonicity, $K^m(a_2)$ can cross $H(a_2)$ only once, and this will surely happen since $K^m \to \infty$ as $a_2 \to 1$. Noting that $K'^U < K^D \ \forall a_2$, the result

$a_2^U(a_1) > a_2^D(a_1) \ \forall a_1$ 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.

lnGDP_pc is the log of per capita GDP

open is the trade ratio (imports plus exports over GDP).

fdi_perc is net inward FDI as a percent of GDP

kaopen is the Chinn-Ito index of capital account openness.

Skill endowments are proxied by a number of different stock variables: **edu_pri** and **edu_sec** are, respectively, the shares of the population aged 25 or over with primary education only and with secondary or higher education; **edu_prisurv** is the survival rate to the last grade of primary school; **edu_years** is the population's average number of completed years of education.

L5open, L5edu_pri, etc. are open, 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.

Skill endowments. http://data.uis.unesco.org/, accessed on line September 2014 and December 2014, Barro and Lee (2010) and Wittgenstein Centre for Demography and Global Human Capital (2014).

Trade and GDP. United Nations.

FDI. World Bank.

Capital account openness. Chinn and Ito (2006).

FIGURE 1: Child labour and non-school attendance

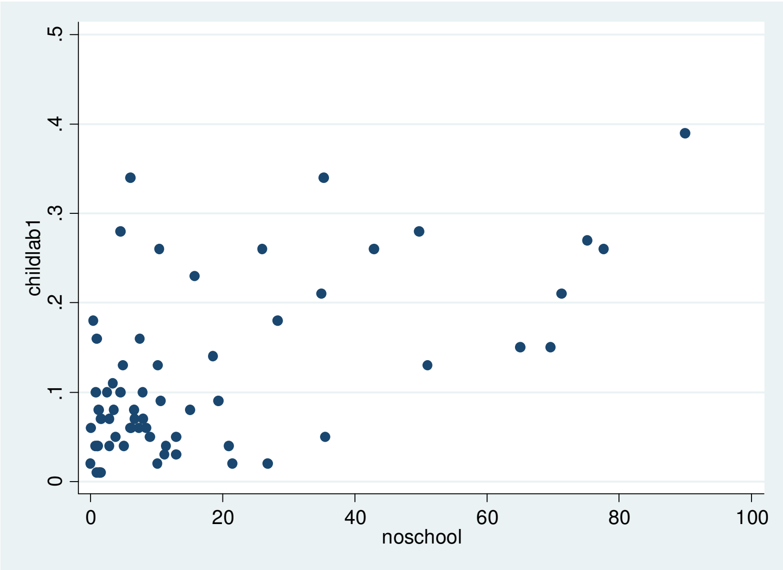

FIGURE 2: Child labour and per-capita GDP

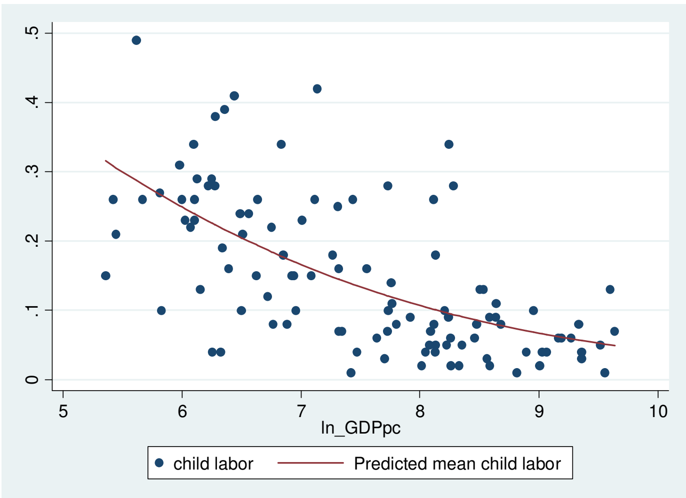

FIGURE 3: Child labour and trade openess

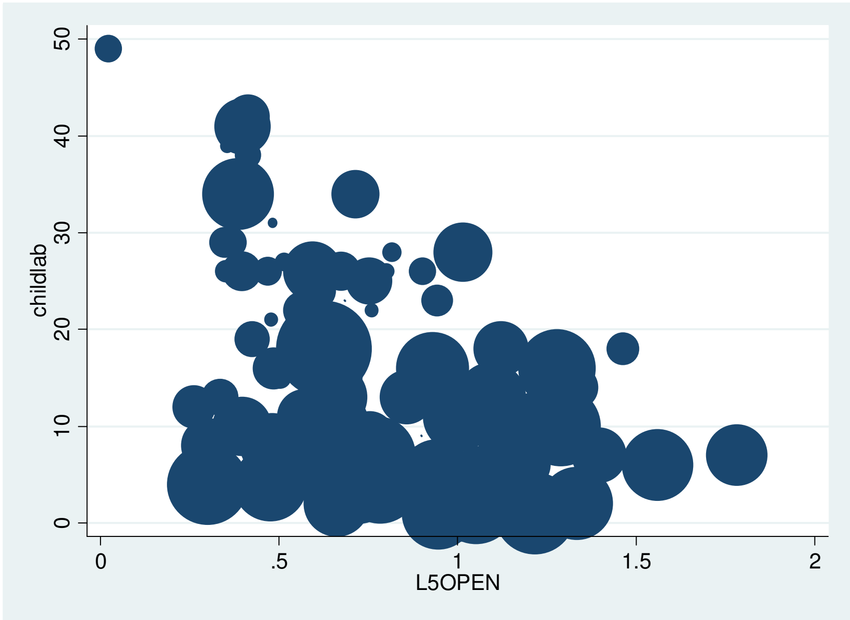

FIGURE 4: Skill endowment thresholds

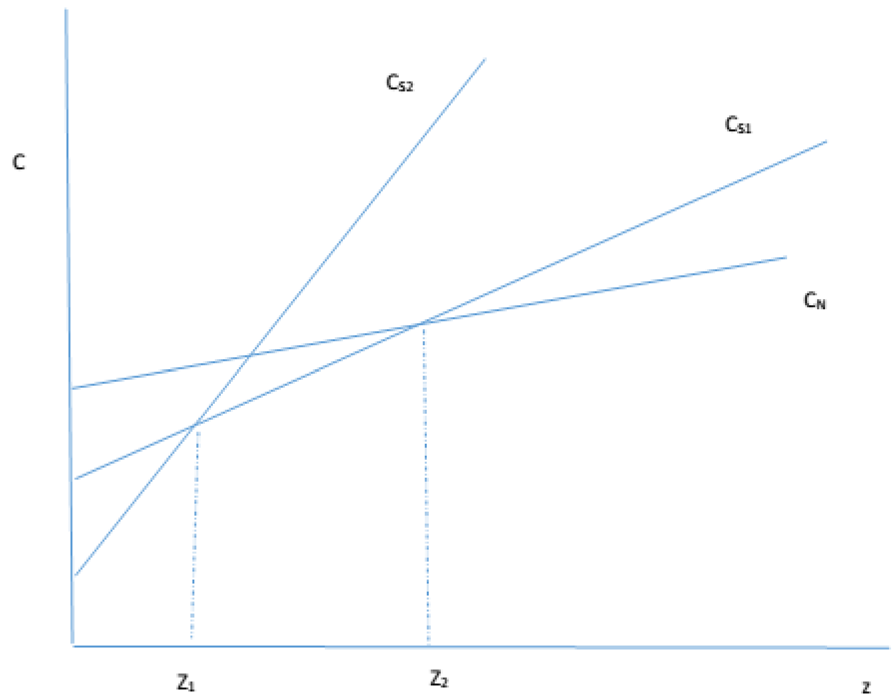

TABLE 1: Marginal child labour effects of per-capita GDP

GDPpc ($)	dy/dx	Std. Err.	z	P>z	[95% Conf.	Interval]
100	-0.123	0.018	-6.92	0	-0.158	-0.088
200	-0.111	0.017	-6.43	0	-0.145	-0.077
500	-0.090	0.013	-6.71	0	-0.116	-0.064
1,000	-0.073	0.010	-7.60	0	-0.092	-0.054
2,000	-0.057	0.006	-9.32	0	-0.069	-0.045
3,000	-0.049	0.004	-10.88	0	-0.057	-0.040
5,000	-0.039	0.003	-13.53	0	-0.045	-0.034
10,000	-0.029	0.002	-16.50	0	-0.033	-0.026
20,000	-0.021	0.002	-14.05	0	-0.024	-0.018

TABLE 2: Descriptive statistics

Variable	Observations	Mean	Std. Deviation	Min	Max
childlab (%)	108	14.796	10.955	1	49
skill premium	3828	1.27	0.675	0	18.108
ln_GDPpc	2691	8.282	1.660	4.383	12.109
edu_pri	663	0.297	0.176	0	0.89
edu_sec	657	0.433	0.172	0.005	0.802
edu_years	8550	8.24	3.061	1.1	14.2
edu_surv	1234	0.833	0.179	0.222	1
open	1666	0.976	0.616	0.145	4.858
kaopen	6250	-0.001	1.525	-1.864	2.439
fdi	2203	5.244	9.884	-161.242	172.716

TABLE 3: Skill premium equation, OLS estimates

	REG 1	REG 2
ln_GDPpc	0.071 (0.162)	(0.133) (0.133)
L5edu_pri	-12.85*** (2.707)	-5.198*** (1.626)
L5edu_sec	-11.77*** (3.313)	
L5_open	-7.421*** (2.731)	-1.573*** (0.629
L5edu_pri X L5_open	9.708*** (3.370)	4.108*** (1.845)
L5edu_sec X L5_open	9.146** (3.869)	
kaopen	0.131 (0.146)	
fdi_perc		-0.005 (0.009)
const.	11.17*** (2.526)	3.367*** (1.499)
n. of obs.	216	225
year dummies	YES	YES

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

TABLE 3: Child labour equation, OLS and IV estimates

	OLS REG 1	OLS REG 2	OLS REG 3	IV REG 1	IV REG 2
ln_GDPpc	-0.0241** (0.0097)	-0.0171 (0.0119)	-0.0202* (0.0114)	-0.0180 (0.0138)	-0.0220* (0.0132)
L5edu_prisurv	-0.243*** (0.0673)	-0.274*** (0.0685)	-0.264*** (0.0681)	-0.271*** (0.0779	-0.257*** (0.0766
L5open	-0.0668*** (0.0242)	-0.0936** (0.0361)	-0.0888** (0.0345)	-0.0932** (0.0372)	-0.0881** (0.0358)
kaopen		0.0010		0.0012	
		(0.0072)		(0.007)	
fdi_perc			-0.0024** (0.0011)		-0.0024* (0.0013)
const.	0.566*** (0.0519)	0.563*** (0.0655)	0.589*** (0.0647)	0.567*** (0.0754)	0.596*** (0.0754)
n. of obs.	82	57	56	57	56
year dummies	YES	YES	YES	YES	YES

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

TABLE 4: Child labour equation, glm LOGIT estimates

	LOGIT REG 1	LOGIT REG 2	LOGIT REG 3
ln_GDPpc	-0.233** (0.095)	-0.148 (0.111)	-0.168 (0.113)
L5edu_prisurv	-1.618*** (0.543)	-1.868*** (0.561)	-1.767*** (0.555)
L5open	-0.571** (0.238)	-0.791*** (0.332)	-0.714** (0.320)
kaopen		0.0233 (0.0556)	
fdi_perc			-0.0184** (0.00921)
const.	1.538*** (0.418)	1.304*** (0.520)	1.428*** (0.544)
n. of obs.	82	57	56
year dummies	YES	YES	YES
AIC	0.65	0.75	0.75
BIC	-340	-207	-202

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1