Demand for Child Labor in a North-South Model of Trade

Kristian Estevez

Universitat de Barcelona

February 22nd, 2013

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146 million Asian children in forced labor

Some as young as 4 making products for Western nations

By Peter James Spielmann
The Associated Press

SYDNEY, Australia — More than 100 million Asian children — some as young as 4 — are forced to work in appalling conditions to make consumer products for Western nations, an Australian group charged yesterday.

The Anti-Slavery Society said between 104 million and 146 million children, most in India, are making car parts, jewelry, clothing, toys, food, fireworks, chemicals and other goods in sweatshops.

"The punishments meted out to these children by their owners defy description," said Paul Bravender-Coyle, spokesman for the Melbourne-based group.

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USA TODAY

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Gap details child labor, coercion in factories

Clothing retailer reports on abuse of workers' rights

By Jean Scheidnes
REUTERS

May 13, 2004

NEW YORK – Clothing retailer Gap Inc. said yesterday that forced labor, child labor, paying below minimum wage, physical punishment and coercion are some of the widespread workers' rights violations occurring at many of its factories worldwide.

The San Francisco-based retailer – whose outlets include the Gap, Old Navy and Banana Republic chains – acknowledged some of the worst abuse cases found among the 3,000 factories around the world that make its products.

The worst and most persistent of the violations led Gap to terminate business with 136 factories in 2003, Gap said in its first-ever social responsibility report. The company issued the report yesterday to coincide with its annual meeting.

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theguardian

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Child labour uncovered in Apple's supply chain

Internal audit reveals 106 children employed at 11 factories making Apple products in past year

Juliette Garside, telecoms correspondent
The Guardian, Friday 25 January 2013 19.22 GMT

Apple's investigation revealed some children had been recruited using forged identity papers.
Photograph: Andy Wong/AP

Apple has discovered multiple cases of child labour in its supply chain, including one Chinese company that employed 74 children under the age of 16, in the latest controversy over the technology giant's manufacturing methods.

An internal audit found a flipside to the western consumer's insatiable thirst for innovative and competitively priced gadgets. It uncovered 106 cases of

Product Cycle

North-South trade models commonly used to analyze product life cycles of manufactured goods (Vernon 1966).

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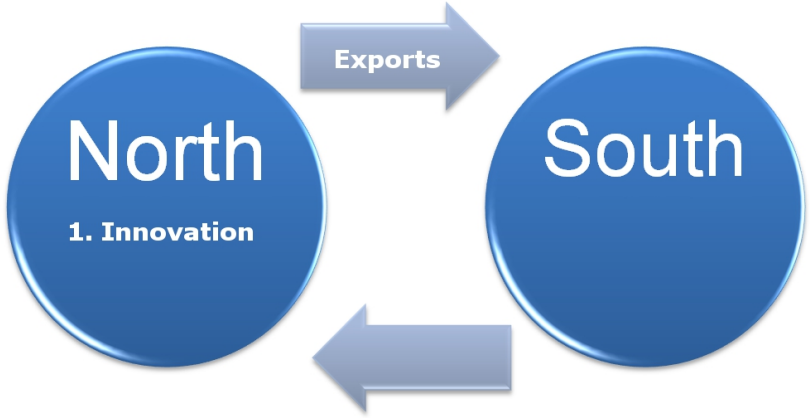

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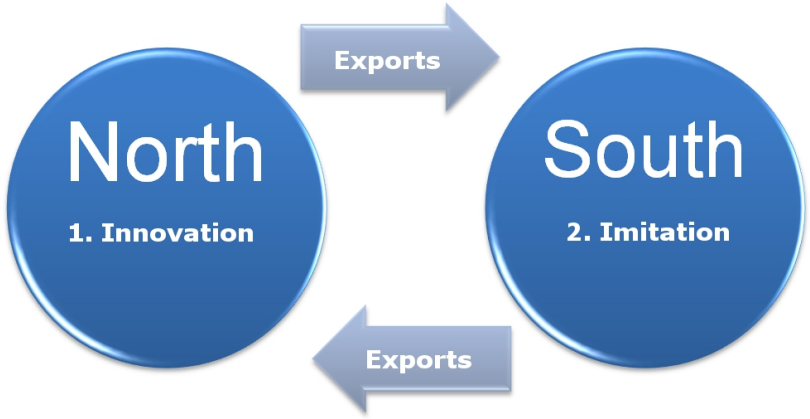

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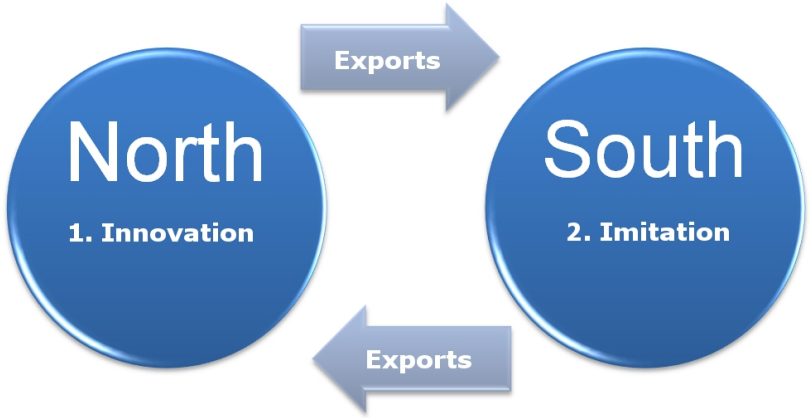

North-South Trade: Krugman (1979), Dollar (1986), Flam and Helpman (1987), Grossman and Helpman (1991), Segerstrom, Anant, and Dinopoulos (1990), Antras and Helpman (2004)

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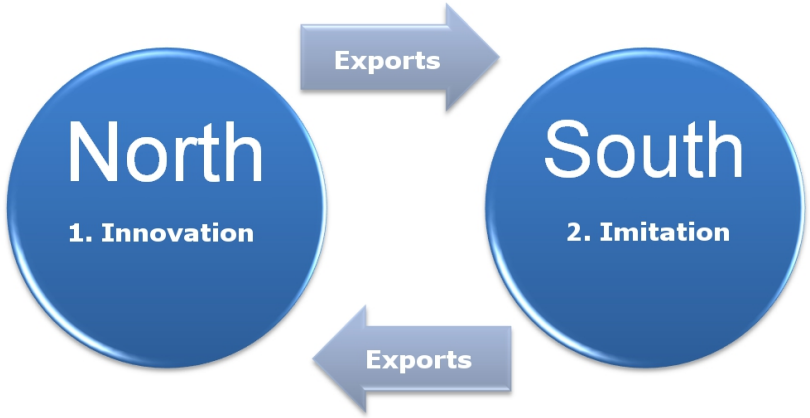

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Child Labor and Globalization: Ranjan (2001), Maskus (1997), Dinopoulos and Zhao (2007)

Autarky Model

Assumptions

- Quasi-linear preferences
- Positive consumption of the non-tradable numeraire good
- Firms are heterogeneous in the North, homogeneous in the South

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Representative consumer maximizes the following:

$$U(z, q_i) = z + \beta \int_{i \in \Omega} q_i di - \frac{\gamma}{2} \int_{i \in \Omega} (q_i)^2 di - \frac{\eta}{2} \left(\int_{i \in \Omega} q_i di \right)^2$$

Demand for a Variety

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Maximum price such that $q_i = 0$:

$$p^{Max} = \frac{\beta \gamma}{(\gamma + \eta M)} + \frac{\eta M}{(\gamma + \eta M)} \bar{p}$$

Production

Production of both goods are constant returns to scale.
Productivity of workers in the numeraire sector pins down wage: $z = \omega l_z \Longrightarrow w^N = \omega \geq 1$

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Timing for differentiated varieties:

1. Firm pays entry cost of R&D and discovers productivity parameter (c_i)
2. If a firm´s marginal cost, $1 + c_i$, is below the maximum price that can be charged, they produce (exit otherwise)
3. Firms face an exogenous probability of receiving a negative shock that will force it to exit each period

Cutoff Cost Parameter

The profit-maximizing price and cutoff cost level are equal to:

$$p_i = \frac{\gamma q_i}{L^N} + (1 + c_i)\,\omega \iff p^{Max} = \frac{\beta\gamma + \eta M \bar{p}}{\gamma + \eta M} = (1 + c^*)\,\omega$$

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Profit-maximizing price, output, revenue, and profit for firm c_i:

$$p_i(c_i) = \frac{\omega}{2}(2 + c^* + c_i) \qquad q_i(c_i) = \frac{\omega L}{2\gamma}(c^* - c_i)$$
$$r_i(c_i) = \frac{\omega^2 L}{4\gamma}(c^* - c_i)(2 + c^* + c_i) \qquad \pi_i(c_i) = \frac{\omega^2 L}{4\gamma}(c^* - c_i)^2$$

Free Entry and Exit

Ex-ante Firm Value

$$E(V) = \frac{\omega^2 L}{4\gamma\delta N} \int_0^{c^*} (c^* - c_i)^2 \, dG(c_i) = f_E$$

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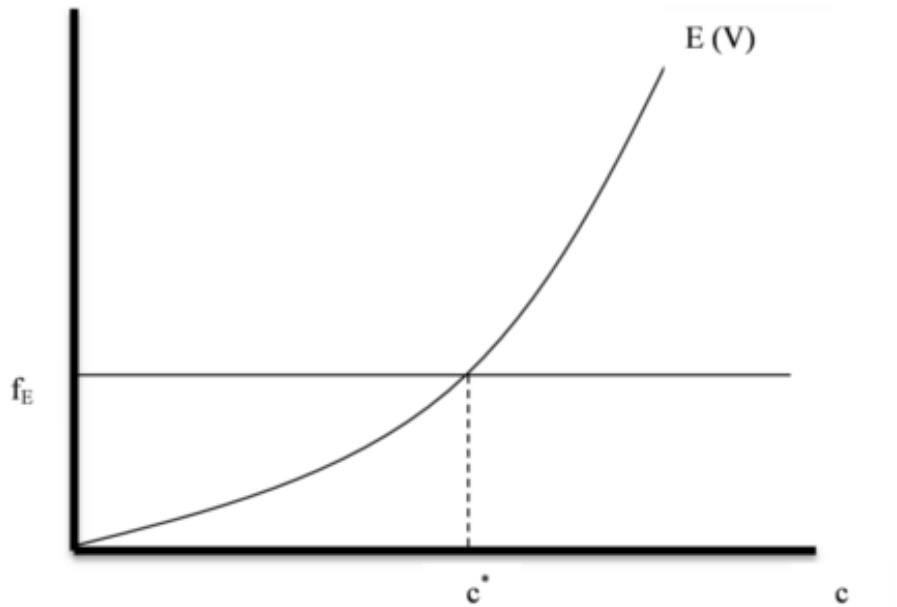

Figure 1: Autarky equilibrium

Steady-State Equilibrium

Assume a uniform distribution of c with cumulative distribution function $G(c_i) = \frac{c_i}{c^{Max}}$ with support $\left[0, c^{Max}\right]$.

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Steady-state equilibrium:

$$c^* = \left[\frac{12\gamma\delta^N c^{Max} f_E}{\omega^2 L}\right]^{\frac{1}{3}}$$

$$\bar{p}^N = \left(\frac{3c^*}{4} + 1\right)\omega$$

$$M^* = \frac{4\gamma\left(\beta - \left(c^* + 1\right)\omega\right)}{\eta\omega c^*}$$

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Number of firms that exit each period, $\delta^N M^*$, must equal the number of new entrants, $M_{PE} G(c^*)$.

Exporting Firm

Iceberg trade costs: firms export $\tau \geq 1$ units for each unit sold in the foreign country.

Exporting profits:

$$\pi_i^{NX} = \frac{\omega^2 L^S}{4\gamma} \left(1 + c^* - \tau \left(1 + c_i\right)\right)^2$$

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The exporting cutoff cost level, c^{NX*}, is a function of c^*:

$$c^{NX*} = \frac{c^* - (\tau - 1)}{\tau}$$

Free Entry and Exit

Ex-ante Firm Value

$$E(V) = \frac{\omega^2 L^N}{4\gamma\delta N} \int_0^{c^*} (c^* - c_i)^2 \, dG(c_i) +$$
$$\frac{\omega^2 L^S}{4\gamma\delta N} \int_0^{c^{NX*}} (1 + c^* - \tau(1 + c_i))^2 \, dG(c_i) = f_E$$

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Sufficient condition for an autarky equilibrium: $\tau > 1 + c^{Max}$

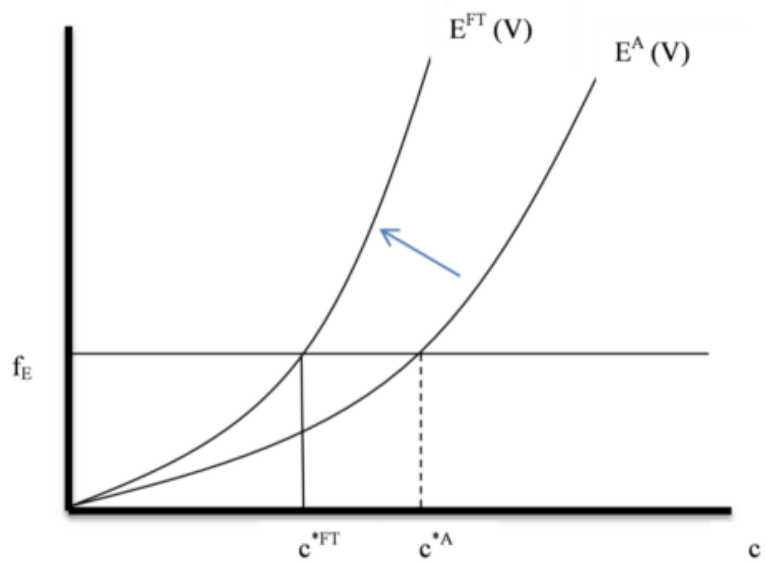

Figure 2: Autarky and free trade equilibrium

Production in the South

Homogeneous Southern firms pay a fixed cost to imitate an exogenous proportion, δ^I, of Northern varieties each period. Southern firms can employ children to lower their marginal cost $c^S(a)$, where $\frac{dc^S}{da} < 0$ and $\frac{d^2c^S}{da^2} > 0$.

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Assuming a large wage gap ($\Delta = 1 - \epsilon > c^*$):

$$\pi^S\left(c^S\right) = \frac{\bar{L}}{4\gamma}\left(1 + c^* - c^S(a)\right)^2$$

Note: free entry in the South means that more potential entrants implies a lower probability of successfully imitating a Northern firm

Optimal Proportion of Child Labor

The probability of receiving a negative shock for a Southern firm is dependent on the use of child labor $\delta^S(a)$, where $\delta^S(0) = \frac{\delta_0^S}{1+\delta_0^S}$ and $\frac{d\delta}{da} > 0$ and $\frac{d^2\delta}{da^2} > 0$.

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Firm value of a Southern firm:

$$V^S(a) = \frac{\bar{L}\left(1 + c^* - c^S(a)\right)^2}{4\gamma\delta^S(a)}$$

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Firm value of a Southern firm:

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Optimal proportion of child labor:

$$\frac{d\delta^S}{da}\left(1 + c^* - c^S(a^*)\right) + 2\delta^S(a^*)\frac{dc^S}{da} = 0$$

As c^* increases, the proportion of child labor employed will decrease $\left(\frac{da^*}{dc^*} < 0\right)$.

Distribution of Firms

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Which then determines the average price and total number of firms:

$$\bar{p} = \phi^* \left(\frac{3c^*}{4} + 1 \right) + (1 - \phi^*) \frac{1 + c^* + c^S(a^*)}{2}$$

$$M^T = \frac{\gamma(\beta - (c^* + 1)\omega)}{\eta(1 + c^* - \bar{p})}$$

Demand for Child Labor

Let the share of output produced using child labor be equal to $\frac{a^*}{1+a^* b_0}$. Then the demand for child labor from each Southern firm:

$$l_C = \frac{\bar{L} a^*}{2\gamma (1 + b_0 a^*)} \left(1 + c^* - c^S (a^*)\right)$$

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Total demand for child labor:

$$L_C = \frac{\bar{L} a^* \left(1 - \phi^*\right) \left(1 + c^* - c^S\left(a^*\right)\right) \left(\beta - c^* - 1\right)}{2\gamma \left(1 + b_0 a^*\right) \left(1 + c^* - \bar{p}\right)}$$

Since $\beta > 1$, $c^S < 1$, and an increase in ϕ^* monotonically reduces the average price, an increase in c^*, all else equal, will reduce the demand for child labor, $\frac{dL_C}{dc^*} < 0$.

Simulations with Endogenous Imitation

Let $\chi \in (0,1)$ be the probability of a Southern firm conducting R&D and successfully imitating a Northern good. The free entry conditions in the North and South jointly determine the following:

$$c^* = \left[\frac{4\gamma\delta^S(a) f_E}{\chi \bar{L}}\right]^{\frac{1}{2}} + c^S(a^*) - 1$$

$$\delta^I = \frac{\bar{L}(c^*)^3}{12\gamma c^{Max} f_E}$$

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Simulation Parameters										
	$\bar{L}$	β	γ	η	f_E	c^{Max}	w^S	w^C	δ^N	χ
Values	1000	10	.5	.3	5000	2	.3	.2	.2	.25

Child Labor Enforcement

Assume the risk of using child labor has the following functional form:

$$\delta^S(a) = \frac{\delta_0 + \kappa a}{1 + \delta_0}$$

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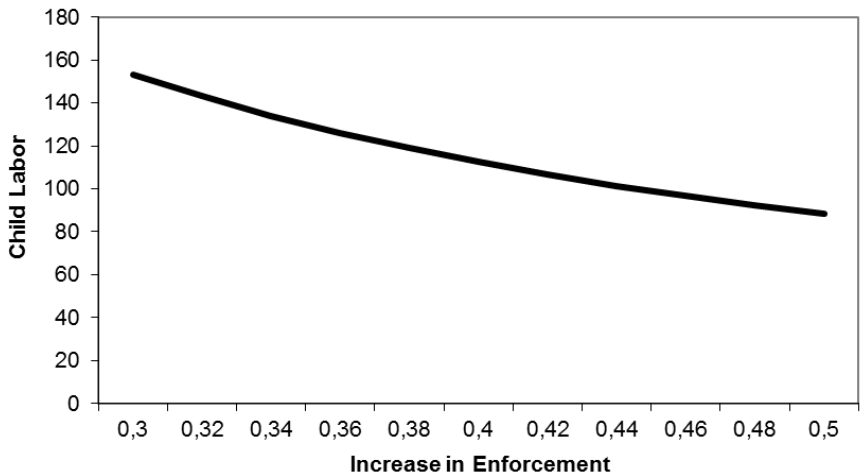

Increase in Market Size

An increase in the market size (population) in either country will result in increased competition ($c^* \downarrow$) and more varieties.

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Increases the demand of child labor throught three channels:

1. Child Labor Selection
2. Shift in the Allocation of Firms
3. Increased Output

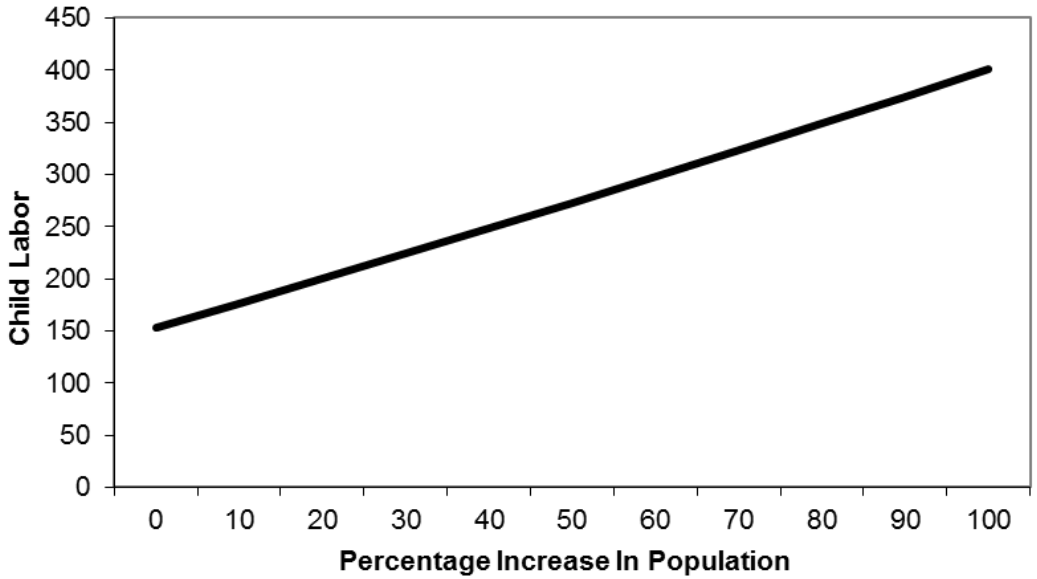

Figure 4: Increase in population

Trade Costs

For firms in the North, the addition of trade costs has the same affect as it did in the one-way trade scenario except for the fact that the presence of Southern firms decreases the average price in the North.

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As long as some Northern firms export to the South, Southern firms will always find it profitable to export to the North. Their per-period profit is equal to:

$$\pi^S = \frac{L^S}{4\gamma}\left(1 + c^* - c^S(a^*)\right) + \frac{L^N}{4\gamma}\left(1 + c^* - \tau c^S(a^*)\right)$$

Average Prices

The average price in the North is given by:

$$\bar{p}^N = \phi^* \left(\frac{3c^*}{4} + 1 \right) + (1 - \phi^*) \frac{1 + c^* + \tau c^S (a^*)}{2}$$

Average Prices

The average price in the North is given by:

$$\bar{p}^N = \phi^* \left(\frac{3c^*}{4} + 1 \right) + (1 - \phi^*) \frac{1 + c^* + \tau c^S(a^*)}{2}$$

The average price in the South is given by:

$$\bar{p}^S = \phi^{NX} \left(\frac{3c^*}{4} + 1 + \tau \right) + (1 - \phi^*) \frac{1 + c^* + c^S(a^*)}{2}$$

where ϕ^{NX} represents the share of Northern firms that export.

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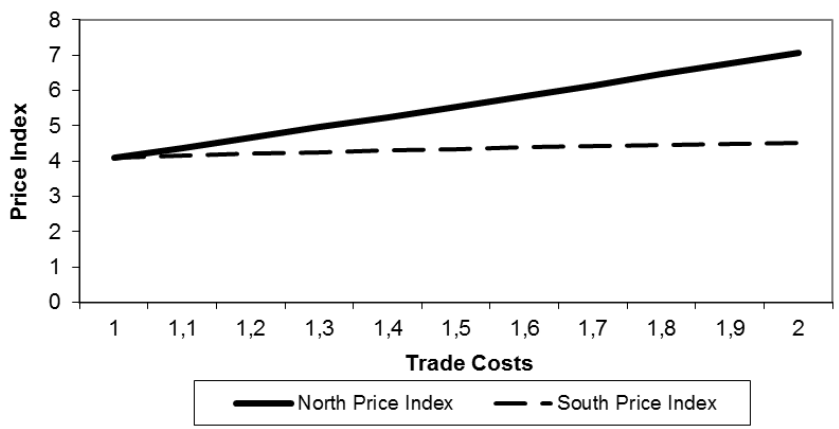

Demand for Child Labor

As trade costs increase, the number of varieties produced in the North decrease as well as the share of Northern firms that export to the South $\left(\phi^{NX}\right)$. The share of firms located in the South$(1-\phi)$ will increase as will the demand from these firms due to the increased prices that Northern firms charge.

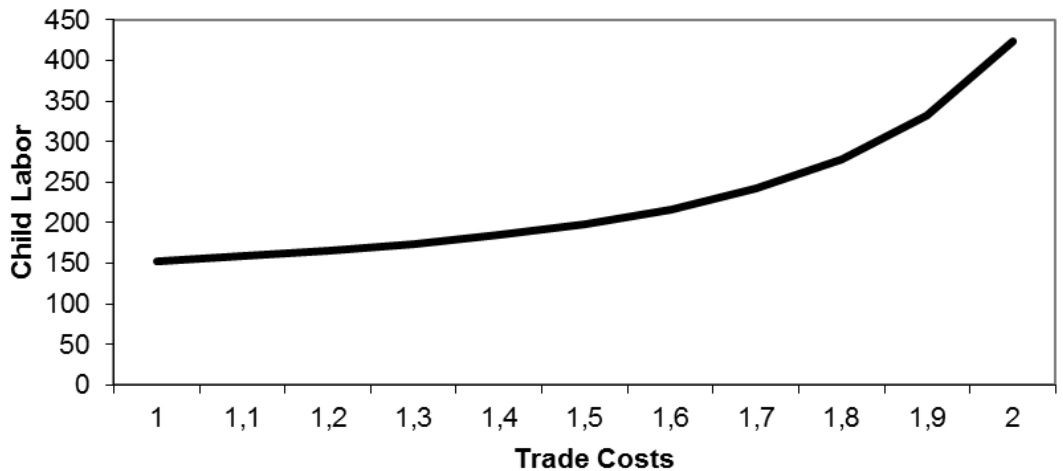

Figure 6: Child labor and trade costs

Conclusion

Trade liberalization should decrease the demand for child labor by increasing competitive environment in the North.

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A reduction in the demand of child labor through increased enforcement reduces welfare; reduction in the demand for child labor through trade liberalization is welfare increasing.