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

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Abstract: This paper examines how trade liberalization affects the demand for child labor employing a dynamic North-South trade framework. Innovating firms in the North are assumed to be heterogeneous and differ in their marginal costs while imitating firms in the South are homogeneous and may employ children in production to reduce their marginal cost. The demand for child labor is dependent not only on domestic factors such
as wages of adults and children, but also on the endogenous rate of innovation in the North and the rate in which these goods are imitated in
the South. Reductions in trade costs increase the demand for new goods produced in the North and reduce the demand for old goods produced in the South. An increase in the population of the North and/or South will increase the overall demand for child labor although the child labor participation rate will increase (decrease) when the population in the North (South) increases.

JEL Codes: F1, J4, O1.

Keywords: Child Labor, Firm Heterogeneity, North-South Trade.

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1 Introduction

Supporters of globalization argue that increased exposure to trade increases incomes of low-skilled households, thereby reducing the incidence of child labor when insufficient income is the root cause. Opponents of trade liberalization in developing countries argue that globalization opens the doors for foreign firms to take advantage of cheap labor, increasing the demand for and the incidence of child workers. While supply factors, such as insufficient income, lack of access to credit markets, and effectiveness of schooling have been examined and empirically researched, conclusions about the relationship between trade liberalization and the incidence of child labor remains in doubt.[1] This is due partly to the complicated linkages between trade liberalization, household income, and the decisions that households make about child schooling that are governed by opposing income and substitution effects (Basu and Van 1998). This paper therefore seeks to narrowly explore the effect of trade liberalization on the effect it has on firm decisions which create a demand for child labor.

As child labor moves away from agricultural work due to urbanization in less developed economies, research has tried to analyze the role that globalization might play on children working in manufacturing. Davis and Voy (2007) and Busse and Braun (2004) are two papers that attempt to empirically examine the relationship between trade liberalization and the incidence of child labor. Davis and Voy (2007) use openness to trade, defined by a country's trade volume as a percentage of GDP, to regress against the incidence of child labor. Controlling for a host of country factors, they find a significant negative relationship between child labor and globalization; however, this relationship vanishes once they control for changes in household income, leaving globalization's effect on firm child labor decisions unsettled. Busse and Braun (2004) similarly find ambiguity in their results when they examine the incidence of child labor and FDI inflows.

To analyze the manufacturing sector in less developed economies, we take as a building block a standard North-South model of trade. North-South trade models have been used to explain many facets of trade where new goods are first produced in the North and over time production shifts to the South as the goods become imitated. In these models, reductions in trade costs tend to increase

[1] Ranjan (2001) and Jafarey and Lahiri (2002) examine the role of credit constraints while Estevez (2011) examines the returns to schooling. See Brown, Deardorff, and Stern (2003) for a review of the theoretical and empirical literature on the economics of child labor.

the rate of innovation in the North and increase the total number of varieties produced. For a summary on the North-South trade literature, see Chui et al. (2002). The use of this model is the first to incorporate this framework to investigate issues related to trade liberalization and child labor.

The model in this paper also incorporates firm heterogeneity for innovating firms as in Melitz and Ottaviano (2008). Firms in the North produce differentiated varieties and have heterogeneous production costs in doing so. The free entry and exit of firms in the North endogenizes the rate of innovation of new product varieties while Southern firms are assumed to be homogeneous. Child labor, while reducing a Southern firm's marginal cost, is assumed to have the trade-off of increasing the probability that a firm receives a negative shock which would drive it out of the market following Estevez and Levy (2014). We find that an increase in the risk of employing children and/or a decrease in trade costs can reduce the demand for child labor.

This paper is organized as follows: Section 2 solves the autarky equilibrium in the North to characterize the critical cost parameter needed for a firm to earn nonnegative profits. This parameter is then compared with the result when we allow Northern firms to export to the South. Section 3 develops the traditional North-South trade model where Southern firms imitate varieties from the North and can use children in production in order to reduce their marginal cost. Section 4 shows the results of comparative static exercises and describes how changes in the level of enforcement, population size, and trade costs affect the demand for child labor. The paper then concludes with some final remarks.

2 The Model

The model employed assumes that firms in the North are heterogeneous in their cost structure while firms in the South, are symmetric in their cost structure and their marginal cost is dependent on their use of child labor in production. The model examines how trade liberalization affects the demand for child labor in the economic South. As in Krugman (1979), the rate of imitation by firms in the South is assumed to be exogenous. To highlight the innovation channel, we will first outline a closed version of the model and solve for the autarky equilibrium in the North.

2.1 Consumption

Following Melitz and Ottaviano (2008), consumers are assumed to have quasi-linear preferences with utility dependent on the consumption of a nontradable good, z, and differentiated varieties of a tradable manufactured good, q_i, where $i \in \Omega$:

$$U(z, q_i) = z + \beta \int_{i \in \Omega} q_i \partial i - \frac{\gamma}{2} \int_{i \in \Omega} (q_i)^2 \partial i - \frac{\eta}{2} \left(\int_{i \in \Omega} q_i \partial i \right)^2. \tag{1}$$

A representative consumer maximizes (1) subject to their budget constraint leading to the following inverse demand function for a differentiated variety when demand is nonnegative($q_i > 0$),

$$p_i = \beta - \gamma q_i - \eta Q, \tag{2}$$

where $Q = \int_{i \in \Omega} q_i \partial i$ and the price of the nontradable good acts as the numeraire. Aggregating over all identical consumers leads to the following market demand function for a specific variety,

$$q_i = \frac{\beta L}{(\gamma + \eta M)} - \frac{L}{\gamma} p_i + \frac{\eta M L}{\gamma (\gamma + \eta M)} \bar{p}, \tag{3}$$

where M is the number of consumed varieties, L is the number of consumers, and $\bar{p} = \frac{\int_{i \in \Omega} p_i \partial i}{M}$ is the average price, or price index. The maximum price, p^{Max}, that a firm can charge is the price such that demand is driven to zero, (i.e. $q_i \left(p^{Max}\right) = 0$), and is equal to

$$p^{Max} = \frac{\beta \gamma}{(\gamma + \eta M)} + \frac{\eta M}{(\gamma + \eta M)} \bar{p}. \tag{4}$$

2.2 Production in the North

Production of the numeraire good, z, follows a constant returns to scale production function with labor as the only factor. In the North, production of the numeraire good is equal to $z^N = l_z^N$ resulting in a unitary wage $\left(w^N = 1\right)$. In the South, it is assumed that the numeraire good is produced using less productive labor,

$$z^S = \varepsilon l_z^S, \tag{5}$$

where $\varepsilon < 1$. Therefore, the wage of adult labor in the South is equal to $w^S = \varepsilon$ and lower than its counterpart in the North.

Firms in the differentiated-good sector incur a fixed entry cost, f_E, to conduct research and development in order to create a new variety and enter the market. Once R&D is conducted, firms discover part of their marginal cost in producing their specific variety, c_i. Adult labor is the only factor used in the production of the manufactured good for firms in the North and the amount needed to produce quantity q_i is equal to

$$l_i = (1 + c_i)\, q_i. \tag{6}$$

The marginal cost of a Northern firm with cost parameter c_i is $(1 + c_i)$ and their profit is equal to

$$\pi_i = (p_i - (1 + c_i))\, q_i \tag{7}$$

with the profit-maximizing quantity produced equal to

$$q_i = \frac{L^N}{\gamma} (p_i - (1 + c_i)). \tag{8}$$

Let c^* be the cost parameter that corresponds a firm whose marginal cost is equal to the maximum price,

$$p^{Max} = \frac{\beta\gamma + \eta M \bar{p}}{\gamma + \eta M} = (1 + c^*). \tag{9}$$

This cutoff cost level, c^*, is a function of the parameters of the model and the average price of the differentiated goods ($\bar{p}$). Firms with $c \leq c^*$ earn nonnegative profits and remain in the market while firms with $c > c^*$ earn negative profits and exit the industry. As the average price decreases and the market becomes more competitive, the cutoff cost level, c^*, will also decrease.

The quantity, price, revenue, and per-period profit of a firm with productivity c_i can be summarized as functions of c^*:

$$p_i(c_i) = \frac{1}{2}(2 + c^* + c_i), \tag{10}$$

$$q_i(c_i) = \frac{L}{2\gamma}(c^* - c_i), \tag{11}$$

$$r_i(c_i) = \frac{L}{4\gamma}(c^* - c_i)(2 + c^* + c_i), \tag{12}$$

$$\pi_i(c_i) = \frac{L}{4\gamma}(c^* - c_i)^2. \tag{13}$$

Firms with higher costs will charge a higher price, produce less output, and earn lower revenues and profits. Firms in the North are assumed to face an exogenous probability of death, δ^N, so that a firm's expected value, V_i, is equal to

$$V_i = \sum_{t=0}^{\infty} \left(1 - \delta^N\right)^t \pi_i = \frac{L}{4\gamma\delta^N}(c^* - c_i)^2. \tag{14}$$

In the steady-state equilibrium, the ex-ante value from conducting research and development must equal the fixed entry cost:

$$E(V) = \frac{L}{4\gamma\delta^N} \int_0^{c^*} (c^* - c_i)^2 \, \partial G(c_i) = f_E. \tag{15}$$

This free entry condition determines c^* in the steady-state equilibrium where $G(c_i)$ is the ex-ante cumulative probability distribution of the cost parameter. This equilibrium is illustrated in Figure 1.

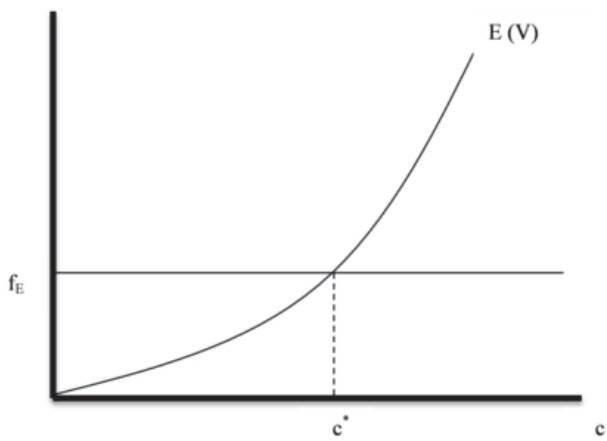

Figure 1: Equilibrium in the North in a closed economy

If the cutoff cost level is above c^*, the probability of successful entry is high and the ex-ante firm value will exceed the fixed entry cost. This induces firms to enter and the increase in competition lowers the price index and drives out the firms high cost firms. This continues until the firm that earns zero economic profit is the one with cost parameter c^*. If the cutoff cost level is below c^*, the ex-ante firm value is not large enough to cover the fixed entry cost. The number of firms exiting each period will exceed those that are willing to enter thereby increasing the price index until the cutoff cost parameter rises to c^*. At the steady-state equilibrium when the cutoff cost level is equal to c^*, the number of firms entering and exiting each period are equalized.

To simplify the analysis, a uniform distribution of the cost parameter is assumed. The ex-ante cumulative and probability distribution functions are equal to $G(c_i) = \frac{c_i}{c^{Max}}$ and $g(c_i) = \frac{1}{c^{Max}}$, respectively, with support $\left[0, c^{Max}\right]$. The cutoff cost level that solves (15) is equal to

$$c^* = \left[\frac{12\gamma\delta^N c^{Max} f_E}{L}\right]^{\frac{1}{3}}. \tag{16}$$

To ensure an interior solution, $c^* < c^{Max}$, it is assumed that the population in the North is large enough such that the following condition holds:

$$c^{Max} > \left[\frac{12\gamma\delta^N f_E}{L}\right]^{\frac{1}{2}}. \tag{17}$$

With the cutoff cost determined by (16), the price index and the average cost parameter are

$$\bar{p} = \left(\frac{3c^*}{4} + 1\right), \tag{18}$$

$$\bar{c} = \frac{c^*}{2}. \tag{19}$$

The number of firms in the autarky equilibrium is derived from (9):

$$M = \frac{4\gamma\left(\beta - c^* - 1\right)}{\eta c^*}. \tag{20}$$

Let M_{PE} represent the number of potential entrants. The number of successful entrants each period has to equal the number of firms exiting in the steady-state equilibrium, $G(c^*) M_{PE} = \delta^N M$. Lastly, welfare is derived from (1):

$$W = 1 + \frac{1}{2}\left(\eta - \frac{\gamma}{M}\right)^{-1}(\beta - \bar{p})^2 - \frac{1}{2\gamma c^{Max}}\int_0^{c^*}\left(p_i\left(c_i\right) - \bar{p}\right)^2 \partial c. \tag{21}$$

A decrease in the cutoff cost level, c^*, reduces the price index and increases the number of varieties available to consumers, leading to an increase per capita welfare as the market becomes more competitive.

2.3 Exporting Firms in the North

For analytical purposes, assume for now that firms in the North can export to the South (preferences of consumers are identical in both countries). Let L^N be the population in the North, L^S the population in the South, and $\bar{L} = L^N + L^S$ the world population. Northern firms that export incur iceberg trade cost, $\tau \geq 1$. The per-period profit from exporting, π_i^{NX}, for a Northern firm with cost parameter c_i is equal to

$$\pi_i^{NX} = \frac{L^S}{4\gamma}\left(1 + c^* - \tau\left(1 + c_i\right)\right)^2. \tag{22}$$

The cutoff export cost level, c^{NX*}, is the cost parameter such that a firm will break even exporting their variety and can be defined as a function of the domestic cutoff cost level

$$c^{NX*} = \frac{c^* - (\tau - 1)}{\tau}. \tag{23}$$

Firms with a low cost parameter, $c_i \leq c^{NX*}$, will both export to the South and produce for the domestic market, firms with $c_i \in (c^{NX*}, c^*]$ will produce solely for the domestic market, and firms with $c_i \in (c^*, c^{Max}]$ will be unprofitable and exit the market.

The value of a firm that produces for both markets is

$$V_i\left(c_i \leq c^{NX*}\right) = \frac{L^N\left(c^* - c_i\right)^2 + L^S\left(1 + c^* - \tau\left(1 + c_i\right)\right)^2}{4\gamma\delta^N}. \tag{24}$$

A potential entrant into the market has to take into account the probability that it will have a cost parameter low enough that will allow it to become an exporter. The free entry condition again determines both cutoff cost values:

$$E(V) = \frac{L^N}{4\gamma\delta^N} \int_0^{c^*} (c^* - c_i)^2 \, \partial G(c_i) + \frac{L^S}{4\gamma\delta^N} \int_0^{c^{NX*}} (1 + c^* - \tau(1 + c_i))^2 \, \partial G(c_i) = f_E. \tag{25}$$

When there are no trade costs ($\tau = 1$), $c^* = c^{NX*}$ and all producing Northern firms will serve both markets. As trade costs increase, the probability that a firm will have a cost parameter that would make it profitable to export decreases causing a divergence between c^* and c^{NX*}.

The autarky case occurs when $c^{NX*} = \frac{c^* - (\tau - 1)}{\tau} = 0$. A sufficient condition for autarky is $\tau > c^{Max} + 1$ in which no Northern firm will find it profitable to export to the South. Figure 2 compares the expected firm value in autarky, $E^A(V)$, with the expected firm value with free trade, $E^{FT}(V)$.

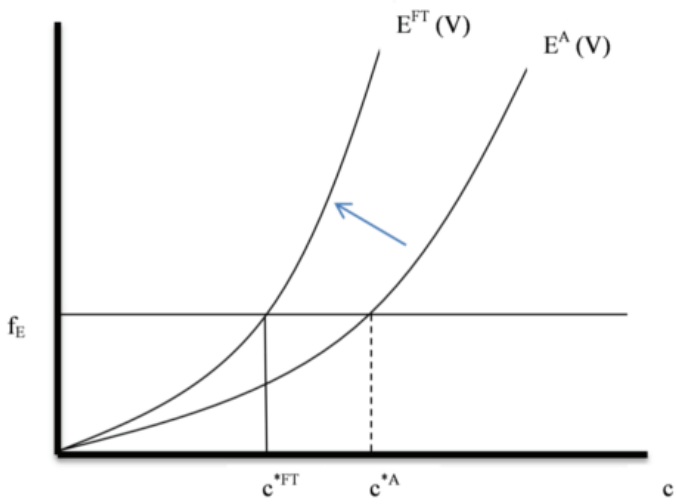

Figure 2: Equilibrium in the North with and without free trade

As trade costs are reduced, the ex-ante firm value from entering the market increases. The increased entry of firms will decrease the cutoff cost level, c^*, while the cutoff export cost level, c^{NX*}, rises. By reducing c^* and increasing the number of available varieties, reduction in trade costs will increase consumer welfare as is standard in the trade literature.

3 Integrated Equilibrium

This section examines the equilibrium where Southern firms can imitate Northern products following the seminal paper by Krugman (1979). Southern firms are assumed to be symmetric and face a probability of death that is positively related with their use of child labor in production. This section will assume no trade costs ($\tau = 1$) so that producing firms in both countries will serve all markets.

3.1 Production in the South

The profits of a representative firm in the South is given by

$$\pi^S = \left(p^S - c^S(a)\right) q^S, \tag{26}$$

where $c^S(a)$ is the firm´s marginal cost which is decreasing at a decreasing rate with respect to a, the proportion of output produced using child labor. A firm in the South can always lower their marginal cost by employing more children relative to adult workers. The production function for a firm in the South is

$$q^S = l_A^S + b_0 l_C, \tag{27}$$

where l_A^S is the firm's employment of adult labor, l_C is their employment of children, and b_0 is an adult-scaling constant that accounts for productivity differences between adults and children.[2] If $a \in [0,1]$ defines the proportion of output produced using effective child labor, $a = \frac{b_0 l_C}{q^S}$ and $1 - a = \frac{l_A^S}{q^S}$, then it also defines the effective amount of child labor relative to the total supply of effective labor, $a = \frac{b_0 l_C}{l_A + b_0 l_C}$. If a firm in the South chooses not to use any child labor, $a = 0$, their marginal cost is equal to the adult wage in the South, $w^S = \varepsilon < 1$. Therefore, firms in the South will always have a cost advantage over firms in the North even if they choose not to employ children since the lowest marginal cost for a Northern firm is equal to unity.

The profit-maximizing quantity and price charged by a Southern firm can be defined as a function of the cutoff cost level in the North:

$$q^S\left(c^S\right) = \frac{\bar{L}}{2\gamma}\left(1 + c^* - c^S(a)\right), \tag{28}$$

[2] See Dinopoulos and Zhao (2007) and Estevez (2011) for examples of the use of an adult scaling constant to account for productivity differences between adult and child workers.

$$p^S\left(c^S\right) = \frac{1}{2}\left(1 + c^* + c^S\left(a\right)\right). \tag{29}$$

Since firms in the South imitate products produced by the North, the lowest price that a Northern firm can charge is equal to its marginal cost. If the wage gap between the North and South is small, firms in the South will be forced to charge a limit price infinitesimally smaller than the Northern firm's marginal cost. A sufficient condition that ensures a high-wage gap is that $\varepsilon < 1 - c^*$. This allows for Southern firms to charge their monopolist price instead of a limit price. Assuming a high-wage gap exists, the per-period profit of a firm in the South is equal to

$$\pi^S\left(c^S\right) = \frac{\bar{L}}{4\gamma}\left(1 + c^* - c^S\left(a\right)\right)^2 \tag{30}$$

where the firm's marginal cost is given by

$$c^S\left(a\right) = \left(1 - a\right) w^S + \frac{a w^C}{b_0}. \tag{31}$$

3.2 Child Labor Decision

Firms in the South maximize their firm value with respect to the proportion of output produced using child labor, a:

$$V^S\left(a\right) = \sum_{t=0}^{\infty}\left(\delta^S\left(a\right)\right)^t \pi^S\left(c^S\right) = \frac{\bar{L}\left(1 + c^* - c^S\left(a\right)\right)^2}{4\gamma\delta^S\left(a\right)}, \tag{32}$$

where $\delta^S\left(a\right)$ is a Southern firm's probability of receiving a negative shock that will put it out of business. This probability of death is increasing (at an increasing rate) with respect to the firm's employment of child labor as in Estevez and Levy (2014). The optimal proportion of child labor is found maximizing (32) with respect to a:

$$\frac{\partial V^S}{\partial a} = \frac{\bar{L}}{4\gamma\left[\delta^S\left(a\right)\right]^2}\left[-2\delta^S\left(a\right)\left(1 + c^* - c^S\left(a\right)\right)\frac{\partial c}{\partial a} - \left(1 + c^* - c^S\left(a\right)\right)^2\frac{\partial \delta^S}{\partial a}\right] = 0, \tag{33}$$

$$\left(1 + c^* - c^S\left(a\right)\right)\frac{\partial \delta^S}{\partial a} = -2\delta^S\left(a\right)\frac{\partial c^S}{\partial a}. \tag{34}$$

Since $\frac{\partial c^S}{\partial a} < 0$, $\frac{\partial^2 c^S}{\partial a^2} = 0$, $\frac{\partial \delta^S}{\partial a} > 0$, and $\frac{\partial^2 \delta^S}{\partial a^2} > 0$, there exists a unique a, denoted by a^*, such that (33) holds for a given c^*. An increase in c^* increases the first term in (34) which decreases the proportion of child labor used by a Southern firm, $\frac{\partial a^*}{\partial c^*} < 0$.

3.3 Free-Entry Condition for Northern Firms

The free-entry condition for a firm in the North, like in the autarky case, will determine c^*:

$$\frac{\bar{L}}{4\gamma\delta^{NI}} \int_0^{c^*} (c^* - c_i)^2 \, \partial G(c_i) = f_E, \tag{35}$$

$$c^* = \left[\frac{12\gamma\delta^{NI} c^{Max} f_E}{\bar{L}} \right]^{\frac{1}{3}}, \tag{36}$$

where $\delta^{NI} = \delta^N + \delta^I \left(1 - \delta^N\right)$ is the joint probability of a Northern firm being forced to exit, whether through an exogenous negative shock or by having their product imitated by a Southern firm with an exogenous probability δ^I. The mass of Southern firms in the steady-state equilibrium will depend positively on the number of firms in the North.

3.4 Share of Firms

The total number of firms and varieties globally, M^T, is equal to the total number of firms in the North, M^N, plus the total number of firms in the South, M^S. Let $\phi = \frac{M^N}{M^T}$ represent the share of varieties located in the North and $1 - \phi = \frac{M^S}{M^T}$ the share of firms located in the South. In the steady-state equilibrium, the number of Northern firms that are imitated each period must equal the number of new firms in the South. This must also equal the number of Southern firms that exit each period.

The number of Southern firms that exit each period is dependent on the proportion of children employed,

$$\delta^S(a^*) M^S = (1 - \phi) \delta^S(a^*) M^T = \delta^I M^N, \tag{37}$$

where a^* is determined by (34). Therefore, in the steady-state equilibrium, the share of Northern firms must equal

$$\phi^* = \frac{\delta^S(a^*)}{\delta^S(a^*) + \delta^I}. \tag{38}$$

The allocation of firms is dependent on the exogenous rate of imitation, δ^I, and the endogenous rate of death in the South that comes from the child labor decision in (34). All else equal, an increase in the proportion of children employed in the South will increase the share of firms located in the North.

The price index, $\bar{p}$, which is equalized in both countries when there are no trade costs, is dependent on the allocation of firms. The price of Northern products comes from (18) while the price of Southern varieties is determined by (29)

$$\bar{p} = \phi^* \left(\frac{3c^*}{4} + 1\right) + (1 - \phi^*) \frac{1 + c^* + c^S(a^*)}{2}. \tag{39}$$

An increase in c^* will increase the price index, but by an amount less than the change in c^*:

$$\frac{\partial(c^* - \bar{p})}{\partial c^*} = \frac{2 - \phi^*}{4}. \tag{40}$$

Note that with the assumption of a high-wage gap between the North and South, the price charged by firms in the North will always be higher than that charged by firms in the South. Therefore, an increase in the share of Northern firms ϕ^* will increase the average price of the differentiated good. The total number of varieties available to all consumers is equal to

$$M^T = \frac{\gamma(\beta - c^* - 1)}{\eta} \left[1 + c^* - \phi^* \left(\frac{3c^* + 4}{4}\right) - (1 - \phi^*) \frac{1 + c^* + c^S(a^*)}{2}\right]^{-1}. \tag{41}$$

All else equal, an decrease in the cutoff cost level will increase the number of varieties available to all consumers.

3.5 Demand for Child Labor

The quantity produced by a Southern firm is equal to

$$q^S = \frac{\bar{L}}{2\gamma}\left(1 + c^* - c^S(a^*)\right). \tag{42}$$

so the number of children employed by each Southern firm, l_C, is equal to

$$l_C = \frac{q^S a^*}{b_0} = \frac{\bar{L} a^*}{2\gamma b_0} \left(1 + c^* - c^S\left(a^*\right)\right), \tag{43}$$

and the total demand for child labor, L_C, is computed by multiplying (43) by the total number of firms in the South,

$$L_C = \frac{\bar{L}\left(1-\phi^*\right)\left(1 + c^* - c^S\left(a^*\right)\right)\left(\beta - c^* - 1\right) a^*}{2\gamma b_0 \left(1 + c^* - \bar{p}\right)}. \tag{44}$$

All else equal, since $\beta > 1$, $c^S < 1$, and an increase in ϕ^* monotonically increases the average price, an increase in the cutoff cost level, c^*, will reduce the demand for child labor, $\frac{\partial L_C}{\partial c^*} < 0$.

4 Comparative Statics

This section examines how changes in some parameter values that can be impacted by government policy can affect the demand for child labor. Numerical simulations are provided in order to show the extent to which changes in these parameter values affect the dependent variable.[3]

4.1 Increase in Child Labor Enforcement

An increase in child labor enforcement is a policy that increases $\delta^S(a)$ for all $a > 0$. Using the following functional form for the probability of receiving a negative shock for a firm in the South,

$$\delta^S(a) = \frac{\delta_0 + \kappa a^2}{1 + \delta_0}, \tag{45}$$

an increase in child labor enforcement is captured by an increase in the parameter κ where $\delta^S = \frac{\delta_0}{1+\delta_0}$ denotes the minimum probability of a negative shock if child labor is not used in production. Although an increase in κ will decrease the proportion of child labor that every Southern firm chooses, this will not impact the cutoff cost level in the North. The fall in a raises the marginal cost for firms in the South which increases the price they charge. This ultimately leads to a reallocation of firms between the North and South. The aggregate number of firms will decrease in the steady-state equilibrium, but the share of

[3]The values chosen for the parameters are the following: $\bar{L} = 1000; \beta = 10; \gamma = .5; \delta^S = .2; f_E = 5000; \lambda = .75; w^S = .3; w^C = .2$

firms located in the North, ϕ^*, will increase, reducing the number of firms in the South.

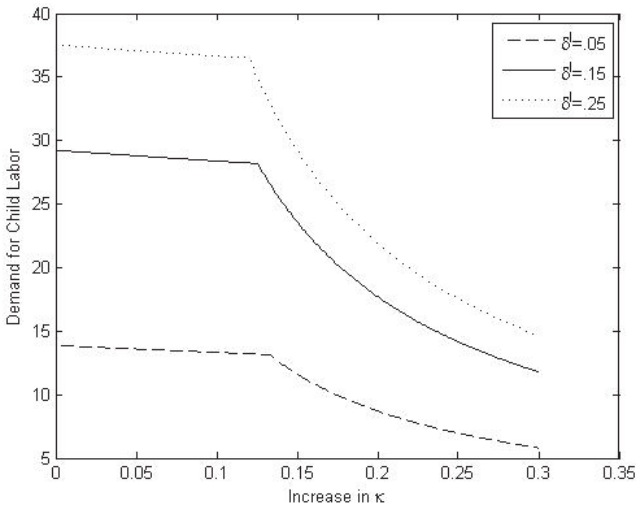

Figure 3: Increase in enforcement and the demand for child labor

The decrease in the number of firms in the South, as well as the reduction in each firm's demand for child labor, is what drives the reduction in the aggregate demand for child labor. An increase in child labor enforcement reduces welfare for consumers in both countries as it raises the price index for the differentiated goods and lowers the number of varieties. The reduction of welfare in the South can partly justify the surprising reluctance of officials to enforce child labor laws in developing countries.[4]

4.2 Increase in Market Size

A one-time increase in the population in either country raises the ex-ante value of all firms by increasing the expected profits earned each period. The increased competition for resources decreases the cutoff cost level in the North and forces high cost firms to exit. The price level falls and the total number of firms in the

[4]Basu (2005) and Estevez (2016) show that an increase in punishment can have a pathological reaction and increase the incidence of child labor. This result is driven from the supply-side as an increase in enforcement reduces household income and can increase the supply of child labor.

steady-state equilibrium increases. The increased number of Southern firms will employ a higher proportion of child labor and their output will also be higher. This increases the demand for child labor. The lower price level and the increase in total varieties leads to welfare increases for consumers in both the North and South.

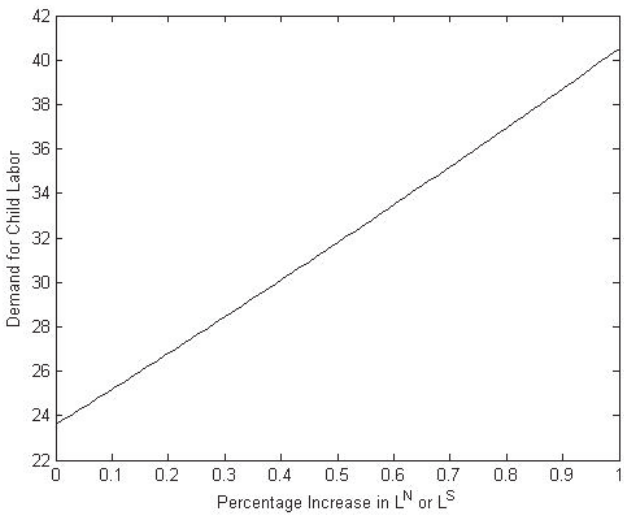

Figure 4: Increase in the population in the North/South and the demand for child labor

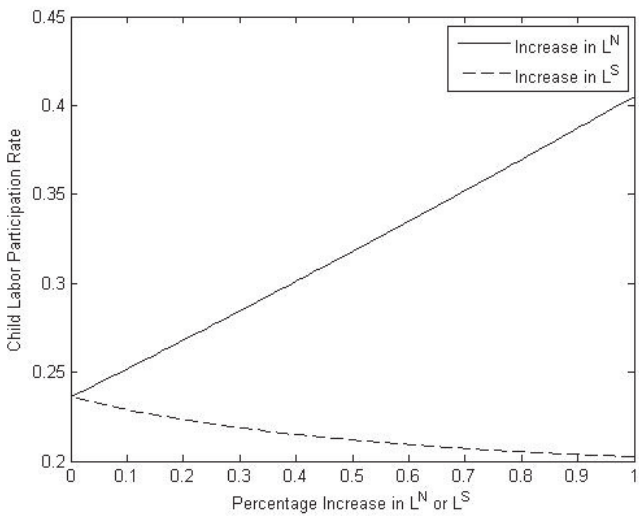

Figure 5: Increase in the population in the North/South and the child labor participation rate

4.3 Trade Costs

To discuss the effect of trade costs, we will assume that all firms face iceberg trade costs $\tau > 1$ when exporting their specific variety abroad. All firms in the South will export to the North as long as there exists at least one Northern firm that finds it profitable to export to the South. The profit-maximizing quantity, price, and profit from exporting for a firm in the South are equal to:

$$q_X^S = \frac{L^N}{2\gamma}\left(1 + c^* - \tau c^S\left(a^*\right)\right), \tag{46}$$

$$p_X^S = \frac{1}{2}\left(1 + c^* + \tau c^S\left(a^*\right)\right), \tag{47}$$

$$\pi_X^S = \frac{L^N}{4\gamma}\left(1 + c^* - \tau c^S\right)^2, \tag{48}$$

and their per-period profits are:

$$\pi^S = \frac{L^S}{4\gamma}\left(1 + c^* - c^S\left(a^*\right)\right) + \frac{L^N}{4\gamma}\left(1 + c^* - \tau c^S\left(a^*\right)\right). \tag{49}$$

Compared with the previous section when $\tau = 1$, the addition of trade costs decreases per-period profits and the value of firms in both regions. Northern firms are also segmented between those that export in addition to producing domestically and those that produce solely for the domestic market. The expected value for a firm in the North is equal to:

$$V_i = \frac{1}{4\gamma\left(\delta^{NI}\right)}\left[L^N \int_0^{c^*} \left(c^* - c_i\right)^2 \partial G\left(c_i\right) - L^S \int_0^{c^{NX*}} \left(c^* - \tau c_i - (\tau - 1)\right)^2 \partial G\left(c_i\right)\right]. \tag{50}$$

The cutoff cost level in the North is found by setting (50) equal to the fixed entry cost, noting the relationship between the c^* and c^{NX*} is the same as in (25). An increase in trade costs, τ, increases the cutoff cost level and decreases the export cutoff cost level.

Trade costs create a price wedge between differentiated goods in the North and South. Unlike their Northern counterparts, all firms in the South will export

and pass on a portion of their trade costs to consumers in the North. The price indices in both countries are equal to the following:

$$\bar{p}^N = \phi^* \left(\frac{3c^*}{4} + 1 \right) + (1 - \phi^*) \frac{1 + c^* + \tau c^S (a^*)}{2}, \tag{51}$$

$$\bar{p}^S = \phi^{NX} \left(\frac{3c^*}{4} + \tau \right) + (1 - \phi^*) \frac{1 + c^* + c^S (a^*)}{2}, \tag{52}$$

where ϕ^{NX} represents the share of firms located in the North that export relative to the total number of firms, M^T.

An interesting result is that while an increase in trade costs raises the price indices in both countries, the price index in the South increases by a much lower extent due to consumers in the South being able to shift consumption toward cheaper domestic varieties.

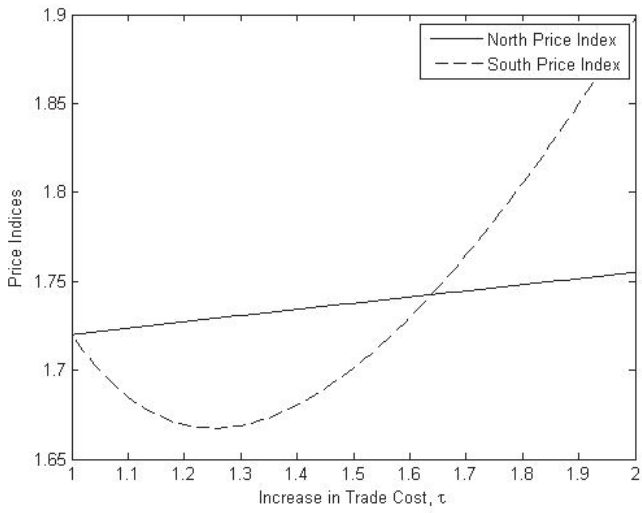

Figure 6: Iceberg trade costs and the price indices in the North/South

As trade costs increase, the total number of firms in both the North and South will decrease as well as the share of Northern firms that export to the South, ϕ^{NX}. Consumers in the South will consume a greater proportion of goods produced domestically as Northern goods become relatively more expensive. A rise in trade costs not only shifts the production of goods to the South relative to the North, but it also increases the absolute number of firms in the South.

The quantity produced by each firm also increases so the demand for child labor increases at an increasing rate.

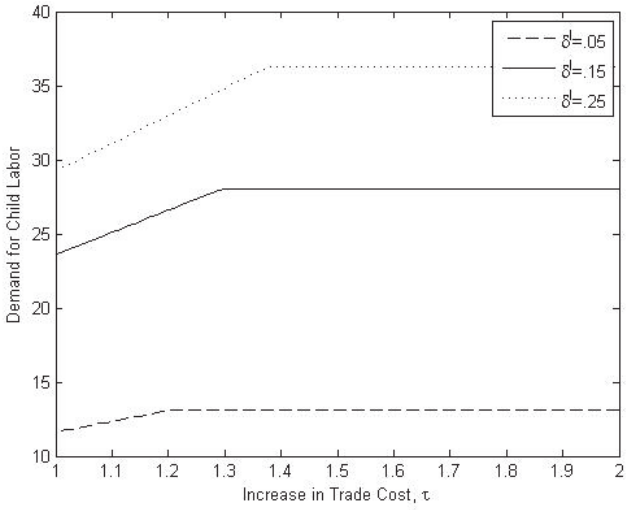

Figure 7: Iceberg trade costs and the demand for child labor

5 Conclusion

This paper examines how trade liberalization affects the demand for child labor in a North-South model of trade. Firms in the North are assumed to differ in their cost of producing a differentiated good which endogenizes the rate of innovation of new varieties, while the cost of Southern firms depends on their use of child labor in production. The rate of innovation in the North, along with the exogenous rate of imitation in the South, determines how the share of output is allocated between the North and South.

An increase in the market size in either the North or South or an increase in trade costs will increase the number of firms producing in the South and increase their output resulting in an increased demand for child labor. Reductions in trade costs can therefore help reduce the demand for child labor in the steady-state equilibrium by shifting the allocation of firms from the South to the North. Policies that reduce the demand for child labor results in lower welfare for consumers in both the North and South and can help explain why policies that

make the employment of child labor "riskier" are not fully enforced in least developed countries.

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