DO INTERNATIONAL LABOR STANDARDS CONTRIBUTE TO THE PERSISTENCE
OF THE CHILD LABOR PROBLEM?

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ABSTRACT

In recent years, a number of governments and consumer groups in rich countries have tried to discourage
the use of child labor in poor countries through measures such as product boycotts and the imposition
of international labor standards. The purported objective of such measures is to reduce the incidence
of child labor in developing countries and thereby improve children's welfare. In this paper, we examine
the effects of such policies from a political-economy perspective. We show that these types of international
action on child labor tend to lower domestic political support within developing countries for banning
child labor. Hence, international labor standards and product boycotts may delay the ultimate eradication
of child labor.

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1 Introduction

The use of child labor in developing countries is a contentious political issue within industrialized countries. For example, consumer groups run publicity campaigns or product boycotts to put pressure on businesses that use child labor in developing countries. These campaigns protest the use of "sweatshop" labor by various corporations and promote "fair trade" labels for agricultural goods and handicrafts. At the level of governments and international organizations, there are calls for the imposition and strict enforcement of international labor standards. These measures could subject countries using child labor in export industries to severe trade sanctions. The issue of labor standards recently has become a major point of dispute between rich and poor countries in international trade negotiations.

For some time, economists have questioned the wisdom of measures like product boycotts and international labor standards. A recurring argument is that the ultimate cause of child labor is poverty. Given that boycotts and sanctions tend to lower the export earnings of developing countries at least in the short run, average income may fall even further, increasing the need of poor families to rely on child labor. In other words, even if international action succeeds in displacing children from export industries, more children may end up working.[1]

While raising serious concerns, this argument alone does not imply that trade policies are ineffective at reducing child labor in the long term. Countries that have eradicated child labor usually have done so primarily through imposing and strictly enforcing policies such as minimum-age laws for employment and compulsory schooling. This observation suggests that the ultimate solution for the child labor problem lies in domestic political action within developing countries. So, if we want to assess the long-run effect of trade policies aimed at reducing child labor, we need to ask how such policies affect the likelihood of further political reform within developing countries. Even if trade policies have detrimental short-run effects, they could still be worthwhile options if, by triggering

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[1]See for example Edmonds (2008), who reports evidence for a case involving the Bangladeshi garment industry. Similarly, Basu and Zarghamee (2008) argues from a theoretical perspective that boycotts and trade sanctions may increase child labor.

domestic political action, they contribute to the long-run eradication of child labor.

At first sight, policies such as trade sanctions and product boycotts might seem to improve the prospect for political reform in developing countries. Given that such policies reduce the wages of working children, they diminish the importance of child labor as a source of income for families. Thus, such policies might be thought to weaken the opposition to measures such as a complete ban on child labor or strictly enforced compulsory schooling. Put differently, international trade policies might nudge developing countries towards adopting measures that erase child labor entirely.

This paper shows that this intuition, however plausible, is likely to be wrong. We build on the analysis of the political economy of child-labor laws in Doepke and Zilibotti (2005). In that paper, we argue that opposition to child-labor regulation stems not only from employers who benefit from an abundant supply of cheap labor, but also from poor families for whom child labor is a necessary source of financial support. In contrast, the constituency in favor of child-labor regulation consists of unskilled workers who compete with children in the labor market, but who do not depend on child labor themselves, because their own children go to school.

From the perspective of this theory, if we want to evaluate the long-run impact of policy interventions we must assess how trade-policy measures imposed by foreign countries change the substitution relationships between adult and child labor, and how they affect the incentives for education. To do so, we assume that the local government can choose between a *laissez faire* (LF) policy, under which child labor is legal, and a *child-labor ban* (B), under which child labor is ruled out in all sectors. The international community has the option of imposing *international labor standards* (IS) on the country, which prevents the use of child labor in the export sector, but not in firms producing for the domestic market. The focus of our analysis is to determine how workers' political preferences regarding a child-labor ban depend on whether the international community imposes international labor standards.

Our main finding is that that the imposition of IS generally lowers domestic po-

litical support for the introduction of the ban B, and may prevent the ultimate eradication of child labor. Imposing IS reduces competition between unskilled adults and children in the labor market, thereby weakening the incentives for adult workers to support a child-labor ban.

In our model, children supply unskilled labor and thus are potential competitors of adult unskilled workers. However, there are different types of unskilled labor, and adults have a comparative advantage in the most physically demanding tasks. We envision the export sector in our model economy as a manufacturing sector in which children and adults carry out similar tasks, and thus compete with each other in the labor market. As long as children work in the export sector, unskilled workers have an incentive to support a ban of child labor, because the ban would reduce competition and raise adult wages.

If now IS are imposed on the country, children are displaced from the export sector and have to work in the domestic sector. We interpret the domestic sector as representing mostly traditional, family-based agriculture. In this sector, there are unskilled tasks (such as heavy field work) in which adults have a comparative advantage, and others (such as tending small animals) in which adults and children are equally efficient. Once IS are in place, adults and children specialize in the unskilled tasks in which they have a comparative advantage. As a consequence, adult and child workers in the domestic sector are not in direct competition, but rather are complementary to each other. As a consequence, unskilled workers may no longer have an incentive to support a ban of child labor.

Whether the softening of competition between adults and children resulting from the imposition of IS is enough to prevent a ban on child labor depends on the exact substitution relationships between adult and child labor. However, in our model the direction of the effect is clear cut: as long as IS are binding, imposing them always reduces unskilled workers' financial incentives for supporting a child labor ban.

A second channel through which IS can affect the political economy of child-labor regulation derives from the effect on education. If IS were to induce more parents to educate their children, fewer families would be economically dependent on child labor, which could strengthen the constituency in favor of a child-labor

ban in the long run. While this possibility does arise in our analysis, it is unlikely that the effect would be strong enough to revert the direct financial incentives. Moreover, our theory abstracts from income effects that would play against the increase in education. The recent empirical literature argues that such income effects are important, and that measures (such as IS) that worsen poverty in families relying on child labor are unlikely to induce these families to send more of their children to school.

To summarize, we find that the imposition of IS generally lowers domestic political support for a child labor ban, and in this way may contribute to the persistence of the child-labor problem. For developing countries where political support for a child-labor ban is low to begin with, this problem may seem less relevant. But even in countries that were able to eradicate child labor, political support for banning child labor grew only gradually over time. In Doepke and Zilibotti (2005), we interpret the growth in support as driven by technological change that gradually increases the demand for skilled labor, which, in turn, induces more and more parents to educate their children, broadening the coalition in favor of child-labor regulation.

To capture the dynamic effects of imposing IS in such a context, we simulate a quantitative version of our model in which technological change increases the demand for skilled workers in the export sector. The economy starts out in an equilibrium in which political support for child labor regulation is weak. If there is no international intervention, the increase in the return to education ultimately triggers a ban on child labor. If, in contrast, IS are imposed on the economy, sufficient political support for B never materializes. Hence, IS lead to more child labor (and lower unskilled wages) in the long run.

There is a sizeable literature on international labor standards.[2] A major part of this literature focuses on possible rationalizations for imposing restrictions on the use of child labor in developing countries. One reason why rich countries (i.e., countries where few or no children are working) might want to impose labor standards on other countries is protectionism. If poor countries are no longer able to use child labor their labor costs increase, which could be beneficial for un-

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[2]The edited volume Basu et al. (2003) provides an excellent overview of this literature.

skilled workers in rich countries. Put differently, labor standards (e.g. laws regulating child labor) would rob labor-rich countries of comparative advantage by increasing their labor costs. However, the existing empirical evidence suggests that this channel is unlikely to be important, i.e., labor standards don't seem to have a large effect on comparative advantage (see for example Rodrik 1996).[3]

Another commonly cited justification for imposing international labor standards is humanitarian concern for the working children and their families (Brown, Deardorff, and Stern 2003). Harmonized standards may help poor countries avoid a race to the bottom in which countries attract business by lowering their labor standards (see for example the discussion in Basu 1999). By harmonizing labor standards poor countries may be able to restrict the global supply of unskilled labor, raise wages, and more generally, improve the welfare of labor-rich countries (see Brown, Deardorff, and Stern 1996).[4]

The humanitarian argument is called into question, though, by a number of theoretical and empirical studies showing that labor standards have unintended consequences and may fail to reduce the use of child labor. The typical channel is an income effect: instead of inducing poor families to send their children to school, punitive policies may impoverish families further, forcing them to send even more of their children to work to provide for their most basic needs.[5] Results of this kind have been demonstrated for a number of different policies that are aimed at addressing child labor.[6]

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[3]There is also a lack of direct evidence that the imposition of labor standards is motivated by protectionism. Krueger (1996) analyzes the support for labor standards in the U.S. Congress, and finds that legislators from districts with many unskilled workers are less likely to vote for them. If labor standards were imposed to protect unskilled workers in the United States, we would expect to observe the opposite.

[4]A similar argument has been made by Basu and Van (1998) as a rationale for domestic child-labor regulation in a closed economy.

[5]See Edmonds and Pavcnik (2005a) for a survey of the empirical literature that documents the link between poverty and child labor. Using micro data from Vietnam, Edmonds and Pavcnik (2005b) show that low prices for rice (which indicate low wages for child workers) are associated with higher child labor rates. If this result generalizes, punitive trade sanctions on exports of countries that use child labor are unlikely to reduce child labor. Consistent with this result, Edmonds and Pavcnik (2006) show that countries that trade more have less child labor. This finding arises mainly due to the positive association between trade and income: controlling for income, there is no robust link between trade and child labor.

[6]Jafarey and Lahiri (2002) focus on trade sanctions, Basu (2005) analyzes fines on the use of

Our work complements this literature by focusing on the political-economy implications of international sanctions. In particular, while the existing literature focuses on the short-run effects of these policies, the approach of this paper is to assess long-run implications through changes in local institutions. In this way, our paper is connected to a recent literature on the distributional implications of child labor regulation and on rising demand for human capital as a trigger of political reform in the course of development.[7]

In the next section, we introduce the model economy. In Section 2, we derive the economic implications of different political regimes, and examine the political incentives for the different groups to support each regime. Section 3.3 is concerned with the dynamic implications of the imposition of labor standards in an economy undergoing technical change that reduces the demand for child labor. Section 5 concludes. All proofs are contained in the mathematical appendix.

2   The Economic Environment

The model economy is populated by overlapping generations of people who live for two periods, first as children, and then as adults. Every adult has one child. Children may either work or go to school. Children who go to school do not work, and the educational cost is paid by their parents. We assume that it is less costly for skilled adults to educate their children, because some skills are transmitted directly within the family. The education cost for skilled families is denoted as p_S, and unskilled families face an education cost of $p_U > p_S$.

Adults can be either skilled or unskilled workers. The skill level is endogenous and is determined by an education investment made by parents. The education

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child labor, Basu and Zarghamee (2008) and Davies (2005) analyze consumer boycotts of products manufactured using child labor, and Basu, Chau, and Grote (2006) and Baland and Duprez (2007) examine the effectiveness of labels that certify certain products as free of child labor.

[7]See Krueger and Donahue (2005) and Doepke and Krueger (2006) for analyses of child labor regulation in economies with heterogeneous agents. Galor and Moav (2006) study how rising demand for human capital can lead to the introduction of publicly financed education, Doepke and Zilibotti (2005) and Dessy and Knowles (2008) analyze the political economy of child labor in a closed-economy setting, and Doepke and Tertilt (2009) link the demand for human capital to the expansion of women's rights.

technology has a stochastic return: children who do not go to school turn skilled with probability π_0, whereas for children who do go to school the probability is $\pi_1 > \pi_0$. We denote the education choice by $e \in \{0, 1\}$, where $e = 1$ corresponds to school and $e = 0$ to child labor. Parents are altruistic, and weigh the potential earnings from child labor against the additional utility their children can derive from being educated. The expected utility V_h of an adult of skill $h \in \{S, U\}$ is given by:

$$V_h = \max_{e \in \{0,1\}} \left\{ c + z \left(\pi_e V_S' + (1 - \pi_e) V_U' \right) \right\},$$

where the maximization is subject to the budget constraint

$$c + p_h e \leq w_h + (1 - e) w_C.$$

Here w_h is the wage for skill level h, w_C is the wage for working children, e denotes the education decision, and $z \in (0, 1)$ is the altruism factor. Note that when $e = 1$ the child implies a financial burden for the family, whereas when $e = 0$ the child brings a wage income to the family. For simplicity, we assume that children do not consume.

The production side consists of two sectors. The output of the domestic sector D is consumed locally, whereas the output of the export sector E is exported and exchanged one-for-one with an import good I. Goods D and I are perfect substitutes in consumption, which implies that the relative price of the two goods is equal to one.

Three types of labor inputs are used in production: skilled labor, heavy unskilled labor, and light unskilled labor. Skilled labor can be performed only by skilled adults. Skilled adults are also able to perform either type of unskilled labor. Heavy and light labor are distinguished by the importance of physical strength. Unskilled adults can perform both types of unskilled labor, whereas children are restricted to light unskilled labor.[8] The production function of the export sector E uses skilled adult labor S^E and light unskilled labor U_l^E:

$$Y^E = F^E \left(S^E, U_l^E \right).$$

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[8]The qualitative results would be unchanged if we assumed that children can also perform heavy labor, but have a comparative advantage at light labor.

The domestic sector D uses heavy unskilled labor U_h, light unskilled labor U_l, and land L:

$$Y^D = F^D \left(L, G \left(U_h^D, U_l^D \right) \right).$$

Here G is a function that aggregates the two labor inputs. We assume that F^E, F^D, and G exhibit constant returns to scale and decreasing marginal returns to each factor.

The model could be extended to employ also heavy unskilled labor in the export sector. However, our interpretation is that the export sector is industrialized, so that physical labor is provided mostly by machines. In contrast, the domestic sector is interpreted as traditional agriculture. Thus, heavy labor includes physically demanding work in the fields, whereas light labor in this sector includes tasks such as weeding and tending to small animals.

Working children are perfect substitutes for adults doing light unskilled work, but they are relatively less productive. In particular, $\lambda < 1$ denotes the physical efficiency of children relative to unskilled adults in providing light unskilled labor. The actual efficiency λ^E and λ^D in the two sectors can be constrained additionally through government policy. In a laissez faire (LF) equilibrium, we have $\lambda^E = \lambda^D = \lambda$. We consider two other policy options in addition to LF. One possibility is that the international community imposes international labor standards (IS) on the country. This means that foreign countries will not buy any export goods that have been produced using child labor. However, children can still be used in the domestic sector, over which the international community has no direct control. The IS policy therefore amounts to setting $\lambda^E = 0$, while we still have $\lambda^D = \lambda$. The final policy option is a domestic child labor ban (B). Since this policy is passed by the domestic government, it affects all sectors of the economy, and consequently amounts to setting $\lambda^E = \lambda^D = 0$.

We use $\theta_{U,D}$ and $\theta_{U,E}$ to denote the fraction of adult unskilled labor employed in light labor in the domestic and export sectors, respectively, with the remainder employed for heavy labor in the domestic sector. Similarly, $\theta_{C,E}$ denotes the fraction of child labor employed in the export sector, with the remainder employed in the domestic sector. Using this notation, for a given number of adult workers

N_S and N_U and child workers N_C, labor supply is given by:

$$S^E = N_S,$$
$$U_l^E = \theta_{U,E} N_U + \lambda^E \theta_{C,E} N_C,$$
$$U_l^D = \theta_{U,D} N_U + \lambda^D (1 - \theta_{C,E}) N_C,$$
$$U_h^D = (1 - \theta_{U,E} - \theta_{U,D}) N_U.$$

We also use U^D to denote the aggregate of unskilled labor supply in the domestic sector:

$$U^D = G\left((1 - \theta_{U,E} - \theta_{U,D}) N_U, \theta_{U,D} N_U + \lambda^D (1 - \theta_{C,E}) N_C\right).$$

Since we assume competitive production, under any policy regime wages are given by marginal products. However, the policy regimes still affect wages through restrictions on labor supply.

3 Wage Determination and Political Incentives under Alternative Policy Regimes

In this section we analyze political economy of child-labor regulation in our economy. The focal point of the analysis is how the imposition of IS affects the incentive of certain groups—in particular, unskilled workers—for supporting a child labor ban. We start by examining the impact of the different policies on wages. We will show that if the initial policy regime is LF, the introduction of a child labor ban raises unskilled wages, which gives unskilled workers a motive to support the ban. In contrast, if IS are already in place, the introduction of B leads to a smaller rise or even a decline in unskilled wages. This result suggests that the imposition of IS may lower the political support for B. However, political preferences depend not only on the impact effect, but also on the dynamic consequences of the different policies. We therefore also analyze how each policy affects wages, education, and labor supply in the long run.

3.1 Short-Run Wage Effects

Our first task is to examine how wages are determined in each policy regime for given total labor supply N_S, N_U, and N_C. We assume the labor supply of each group to be positive. We also focus on equilibria where both sectors are operated in equilibrium, where it is optimal for skilled workers to specialize in supplying skilled labor, and where adult unskilled workers supply both light and heavy labor.[9]

Proposition 1 (Wages under LF) *Under laissez faire ($\lambda^E = \lambda^D = \lambda$), the equilibrium wages w_S^{LF}, w_U^{LF}, and w_C^{LF} and labor allocations $\theta_{U,D}^{LF}$, $\theta_{U,E}^{LF}$ and $\theta_{C,E}^{LF}$ are characterized by the following conditions:*

$$w_S^{LF} = F_S^E \left(N_S, \theta_{U,E}^{LF} N_U + \lambda \theta_{C,E}^{LF} N_C\right),$$

$$w_U^{LF} = F_{U_l}^E \left(N_S, \theta_{U,E}^{LF} N_U + \lambda \theta_{C,E}^{LF} N_C\right)$$
$$= F_U^D \left(L, U^D\right) G_{U_h} \left((1 - \theta_{U,E}^{LF} - \theta_{U,D}^{LF}) N_U, \theta_{U,D}^{LF} N_U + \lambda(1 - \theta_{C,E}^{LF}) N_C\right)$$
$$= F_U^D \left(L, U^D\right) G_{U_l} \left((1 - \theta_{U,E}^{LF} - \theta_{U,D}^{LF}) N_U, \theta_{U,D}^{LF} N_U + \lambda(1 - \theta_{C,E}^{LF}) N_C\right),$$

$$w_C^{LF} = \lambda F_{U_l}^E \left(N_S, \theta_{U,E}^{LF} N_U + \lambda \theta_{C,E}^{LF} N_C\right)$$
$$= \lambda F_U^D \left(L, U^D\right) G_{U_l} \left((1 - \theta_{U,E}^{LF} - \theta_{U,D}^{LF}) N_U, \theta_{U,D}^{LF} N_U + \lambda(1 - \theta_{C,E}^{LF}) N_C\right).$$

Under laissez faire, all factors are allocated to the productive sector where they command the highest return. Given that light labor is essential in each sector and children can supply labor to either sector, the returns to light labor have to be equalized across sectors. The returns to light and heavy unskilled labor have to be equalized as well, given that we focus on equilibria where adults supply both types of unskilled labor. The equilibrium uniquely pins down the wages as well as the total supply of each type of labor. However, the allocation of unskilled adults and children between the two sectors is indeterminate.

We now turn to the wage structure under the imposition of international labor standards.

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[9]The analysis could be extended to additional cases. However, these cases would add substantially more notation without offering new insights. Later on, we will place assumptions on parameters that ensure that these conditions are met.

Proposition 2 (Wages under IS) *For the determination of equilibrium wages under IS ($\lambda^E = 0$, $\lambda^D = \lambda$) there are two possible cases.*

1. *The restriction of children to the domestic sector does not bind. This is the case if in the corresponding laissez-faire equilibrium the total supply of light labor by unskilled adults exceeds the use of light labor in the export sector:*

$$(\theta_{U,E}^{LF} + \theta_{U,D}^{LF})N_U \geq \theta_{U,E}^{LF}N_U + \lambda\theta_{C,E}^{LF}N_C. \tag{1}$$

Under this condition, wages under LF and IS are identical: $w_S^{IS} = w_S^{LF}$, $w_U^{IS} = w_U^{LF}$, and $w_C^{IS} = w_C^{LF}$.

2. *The constraint imposed by IS is binding:*

$$(\theta_{U,E}^{LF} + \theta_{U,D}^{LF})N_U < \theta_{U,E}^{LF}N_U + \lambda\theta_{C,E}^{LF}N_C. \tag{2}$$

In this case, we have $\theta_{U,D}^{IS} = 0$ (adults do not supply any light labor to the domestic sector), and the equilibrium wages satisfy the following conditions:

$$w_S^{IS} = F_S^E\left(N_S, \theta_{U,E}^{IS}N_U\right) < w_S^{LF},$$
$$w_U^{IS} = F_{U,l}^E\left(N_S, \theta_{U,E}^{IS}N_U\right) = F_U^D\left(L, U^D\right)G_{U,h}\left((1 - \theta_{U,E}^{IS})N_U, \lambda N_C\right) > w_U^{LF},$$
$$w_C^{IS} = \lambda F^D\left(L, U^D\right)G_{U,l}\left((1 - \theta_{U,E}^{IS})N_U, \lambda N_C\right) < w_C^{LF}.$$

In the first case, IS have no effect on wages, since the institutional constraint can be met by reshuffling unskilled adults and children across the two sectors. In the second case, the removal of children from the export sector will result in overemployment of light labor in the domestic sector. Relative to laissez faire, this implies that the children's wage has to decrease, whereas the wage for unskilled adults (who were previously competing with children in the export sector) has to rise.

Finally, consider the wage implications of a child-labor ban.

Proposition 3 (Wages under B) *Under a child-labor ban ($\lambda^E = \lambda^D = 0$) unskilled adults supply light labor to both sectors, so that $\theta_{U,E}^B, \theta_{U,D}^B > 0$. The equilibrium wages*

satisfy the following conditions:

$$w_S^B = F_S^E\left(N_S, \theta_{U,E}^B N_U\right),$$

$$w_U^B = F_{U,l}^E\left(N_S, \theta_{U,E}^B N_U\right)$$

$$= F_U^D\left(L, U^D\right)\ G_{U,h}\left((1 - \theta_{U,E}^B - \theta_{U,D}^B)N_U, \theta_{U,D}^B N_U\right)$$

$$= F_U^D\left(L, U^D\right)\ G_{U,l}\left((1 - \theta_{U,E}^B - \theta_{U,D}^B)N_U, \theta_{U,D}^B N_U\right),$$

$$w_C^B = 0.$$

Under a ban, unskilled adults have to supply all unskilled labor, and consequently the returns to unskilled labor are equalized across sectors and across light and heavy labor.

We can now determine the effect of unexpected changes in the policy regime. It is useful to distinguish between short- and long-run effects. The short-run effect of a policy change is calculated taking as given the total labor supply of each group in the current period.

Proposition 4 (Short-run Effects on Wages) *For a given supply of adult labor and given education decisions, the relative wages under LF, IS, and B depend on whether IS are binding. The two cases are:*

1. *Consider an equilibrium in which the condition for IS to be non-binding is satisfied:*

$$(\theta_{U,E}^{LF} + \theta_{U,D}^{LF})N_U \geq \theta_{U,E}^{LF}N_U + \lambda\theta_{C,E}^{LF}N_C.$$

   In this case, short-run wages compare as follows:

$$w_S^{LF} = w_S^{IS} > w_S^B,$$

$$w_U^{LF} = w_U^{IS} < w_U^B,$$

$$w_C^{LF} = w_C^{IS} > w_C^B = 0.$$

2. *Consider now the alternative case in which IS are binding:*

$$(\theta_{U,E}^{LF} + \theta_{U,D}^{LF})N_U < \theta_{U,E}^{LF}N_U + \lambda\theta_{C,E}^{LF}N_C.$$

Then the wages in each policy regime compare as follows:

$$w_S^{LF} > w_S^B, \quad w_S^{LF} > w_S^{IS}$$
$$w_U^{LF} < w_U^B, \quad w_U^{LF} < w_U^{IS}$$
$$w_C^{LF} > w_C^{IS} > w_C^B = 0.$$

Notice that if IS are binding, the comparison of adult wages between IS and B cannot be signed unambiguously. There are two counteracting effects on wages, and the sign of the overall change depends on which effect dominates. To understand these two effects in more detail, let us start by focusing on an economy in which IS are already in place, but are non-binding. In this case, the returns to light and heavy labor in the domestic sector are equalized. Consider now how wages will adjust if B is imposed. Given the removal of children from the domestic sector, adult unskilled labor has to be reshuffled in this sector to once again equalize the returns to light and heavy labor. Given the reduction in total unskilled labor supply in the sector and the presence of the fixed factor land, this implies an upshift in the unskilled wage. In response to this change, some unskilled labor will be reallocated from the export to the domestic sector, which accounts for the decline in the skilled wage.

Hence, the force that tends to increase the unskilled wage when B is introduced is the reduction in the total supply of unskilled labor, in the presence of the fixed factor land that is complementary to unskilled labor. We call this effect the *labor supply effect*, since it is driven by the aggregate decline in unskilled labor. If IS are binding, however, a second effect comes into play. In this case, under IS the return to light labor in the domestic sector (which is supplied entirely by children) is lower than the return to heavy labor. If B is introduced and children are removed from the labor market, adult unskilled labor has to be reassigned to light labor in the domestic sector. To equalize returns to light and heavy labor, the ratio of heavy to light labor supply has to increase in the domestic sector, which lowers the return to heavy labor. This *labor reallocation effect* tends to depress the unskilled wage.

Another way to understand the two effects is to realize that in the production structure adult and child labor can serve both as substitutes and as complements.

When adult and child labor are substitutes (such as when IS are non-binding and both adults and children perform the same light tasks in the domestic sector), only the labor supply effect is present, and the imposition of B unambiguously increases adult unskilled wages. In contrast, when IS are binding, adult and child labor are complementary in the domestic sector, because adults and children perform distinct tasks (heavy and light labor). If now B is introduced, the labor reallocation effect also arises and counteracts the labor supply effect.

Whether the labor supply effect or the labor reallocation effect dominates depends on the parameters of the production function and on labor supply. Generally, the labor supply effect tends to be large if the share of land in domestic production is large. The labor reallocation effect is large if under IS there is a big gap between the return to heavy and light (i.e., adult and child) labor in the domestic sector. The following proposition gives a condition under which $w_U^B < w_U^{IS}$ (i.e., the labor reallocation effect dominates the labor supply effect, so that imposing B on top of IS lowers unskilled wages) in the case of a nested Cobb Douglas-CES technology.

Proposition 5 (Condition for $w_U^B < w_U^{IS}$) *Consider the case in which the export technology is Cobb Douglas, and the domestic production function is a nested Cobb Douglas-CES technology:*

$$Y^E = S^{1-\gamma}(U_l^E)^\gamma,$$
$$Y^D = L^{1-\alpha}\left((1-b)(U_h^D)^\beta + b(U_l^D)^\beta\right)^{\frac{\alpha}{\beta}}.$$

Let $N_U^{D,IS}$ denote the total number of unskilled adults working in the domestic sector under IS, and N_C^{IS} is the corresponding number of child workers. If the condition:

$$(1-b)\left(1-b+b\left(\frac{N_C^{IS}}{N_U^{D,IS}}\right)^\beta\right)^{\frac{\alpha-\beta}{\beta}} > \left(\frac{(1-b)^{\frac{1}{1-\beta}} + b^{\frac{1}{1-\beta}}}{\left((1-b)^{\frac{1}{1-\beta}} + b^{\frac{1}{1-\beta}}\right)^\beta}\right)^{\frac{\alpha}{\beta}}$$

is satisfied, we have:

$$w_U^B < w_U^{IS},$$

that is, the imposition of B when IS are already in place will lower unskilled wages.

To see the intuition behind this result, consider the case $\alpha > \beta$. The condition in Proposition 5 will then be met if N_C^{IS} is sufficiently large relative to $N_U^{D,IS}$. Intuitively, if the supply of child labor is large under IS, there is a large wedge between the returns to light child labor and heavy adult labor. If now B is imposed, the child labor that complements adult labor is withdrawn, inducing a large labor reallocation effect. As a result, the equilibrium unskilled wage falls.

Ultimately, we want to know how the imposition of IS affects domestic political support for passing a full ban B. In our theory, the potential support for child-labor restrictions stems from unskilled workers who would like to raise their wages by restricting competition. Given Proposition 4, what we can say un-ambiguously is that the introduction of IS shrinks the potential wage gains for unskilled workers.

Corollary 1 *For given aggregate adult labor supply N_S and N_U, the change in the un-skilled wage following the introduction of B is smaller if the initial condition is IS com-pared to an initial condition of LF:*

$$w_U^B - w_U^{IS} \leq w_U^B - w_U^{LF}. \tag{3}$$

The inequality is strict if IS are binding, i.e., if (2) is satisfied. The right-hand side of (3) is always positive, whereas the left-hand side can be positive, zero, or negative.

Thus, if IS are binding, at the very least imposing IS reduces the potential wage gains from B for unskilled workers. If the left-hand side of (3) is negative, if IS are in place unskilled workers would in fact suffer lower wages from an introduction of B. These results suggest that imposing IS might lower domestic support for B.

Another factor that determines the political preferences of unskilled workers is the loss of child labor income in the families where children are working. The next proposition characterizes how the total income of such families depends on the policy regime.

Proposition 6 (Short-run Effects on Family Income) *For families whose children receive education, family income is given by the adult wage, which is characterized in Proposition 4 above. For unskilled families with working children, family income is given by $w_U + w_C$. If the elasticities of substitution between skilled and unskilled labor in the export sector and between land and aggregate unskilled labor in the domestic sector are each at least one, incomes across policy regimes compare as follows:*

1. *If Condition (1) for IS to be non-binding is satisfied, we have:*

$$w_U^{LF} + w_C^{LF} = w_U^{IS} + w_C^{IS} > w_U^B + w_C^B.$$

2. *Alternatively, if Condition (2) is satisfied, we have:*

$$w_U^{LF} + w_C^{LF} > w_U^B + w_C^B$$

and

$$w_U^{IS} + w_C^{IS} > w_U^B + w_C^B.$$

The comparison of family income between LF and IS is ambiguous, i.e., depending on parameters, income can go up or down when IS are imposed.

The restriction on the elasticities of substitution in the production technologies ensures that the unskilled wage decreases less than one-for-one with unskilled labor supply. In this case, when IS or B are imposed the reduction in child labor income is not compensated by higher adult wages, so that income declines in families with working children. Important examples that satisfy the conditions are the setup in which both production functions are Cobb Douglas, and the nested Cobb Douglas-CES setup considered in Proposition 5. For family income to increase if child labor is restricted, substitution between unskilled labor and the other factor (skilled labor or land) would have to be highly inelastic (close to Leontieff) in at least one of the sectors. In our view, therefore, the empirically plausible case is represented in the conditions and conclusions of Proposition 6.

Proposition 6 suggests that the constituency that may favor the introduction of IS or B consists of unskilled workers with children in school, whereas those with

working children would suffer from these policies. Thus, for a full analysis of political incentives we also have to examine how education decisions are made. Further, people's political preferences will depend not only on their own wages, but also on the wages that their children will earn in the future. Therefore, we need to characterize the dynamic equilibria of the economy.

3.2 Long-Run Wage Effects

In this section, we analyze the long-run (i.e., steady state) implications of each policy. We focus on economies in which, in steady state, all skilled and some of the unskilled adults educate their children. This implies that all unskilled parents are indifferent between educating and not educating.[10] The following Bellman equations characterize steady-state utilities and wages:

$$V_U = w_U - p_U + z\left(\pi_1 V_S + (1 - \pi_1) V_U\right)$$
$$= w_U + w_C + z\left(\pi_0 V_S + (1 - \pi_1) V_U\right),$$
$$V_S = w_S - p_S + z\left(\pi_1 V_S + (1 - \pi_1) V_U\right).$$

These equations are the Bellman equations for skilled and unskilled workers. There is a unique premium for skilled labor that makes unskilled workers just indifferent between educating their children and sending them to work. The steady state wages have to satisfy:

$$p_U + w_C = z(\pi_1 - \pi_0)(w_S - w_U + p_U - p_S). \tag{4}$$

Intuitively, since unskilled workers are indifferent, we can evaluate the utility of an unskilled worker under the assumption that their descendants will always choose to educate their children. When we now compare the utility of workers who educate their children to the utility of those who don't, discounted expected utility from the grandchildren's generation onwards is independent of the first

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[10]In Doepke and Zilibotti (2009) we assume heterogeneity in the taste for schooling across workers in each skill group. In that case, generically, unskilled workers are no longer indifferent between educating and not educating their children. This alternative specification generates the same qualitative predictions as the model considered here.

generation's education choice. Thus, the indifference condition equates the opportunity cost of education (direct cost and forgone child-labor income) to the short-run return, i.e., the additional wage premium and the reduction in education cost that accrues in the next (the children's) generation.

Let μ denote the fraction of unskilled parents who educate their children. The laws of motion for the population are:

$$N_S' = \pi_1(N_S + \mu N_U) + \pi_0(1 - \mu)N_U,$$
$$N_U' = (1 - \pi_1)(N_S + \mu N_U) + (1 - \pi_0)(1 - \mu)N_U,$$

which implies the following steady-state values for the number of adult workers (with population size normalized to one):

$$N_U = \frac{1 - \pi_1}{1 - (1 - \mu)(\pi_1 - \pi_0)}$$

$$N_S = \frac{\pi_1 - (1 - \mu)(\pi_1 - \pi_0)}{1 - (1 - \mu)(\pi_1 - \pi_0)}.$$

N_S is strictly increasing and N_U is strictly decreasing in μ. Moreover, writing wages as a function of μ through the impact on labor supply, the left-hand side of (4) is strictly increasing in μ and the right-hand side is strictly decreasing, because a larger supply of skilled labor increases the return to (unskilled) child labor and lowers the skill premium. Thus, if a solution for (4) exists, it is unique. We restrict attention to parameters such that under LF, the steady-state μ is interior, i.e., $0 < \mu^{LF} < 1$.

We now consider how steady-state labor supply and wages vary across regimes.

Proposition 7 (Steady State Comparison) *In steady state, the wages across policy regimes compare as follows:*

$$w_S^{LF} \geq w_S^{IS} > w_S^B,$$
$$w_U^{LF} \leq w_U^{IS} < w_U^B,$$
$$w_C^{LF} \geq w_C^{IS} > w_C^B = 0.$$

All inequalities are strict if IS are binding, i.e., if:

$$(\theta_{U,E}^{LF} + \theta_{U,D}^{LF})N_U < \theta_{U,E}^{LF} N_U + \lambda \theta_{C,E}^{LF} N_C.$$

Note that even though the skill premium is highest under LF, lowest under B, and at an intermediate level under IS, this does not imply that the fractions of unskilled parents educating their children in each regime necessarily satisfy $\mu^{LF} \leq \mu^{IS} < \mu^{B}$. The reason is that even without a change in μ, when IS or B are imposed adult wages move in the required direction through the direct effect of the withdrawal of child labor. Whether μ moves up or down when IS or B are imposed depends on parameters. Generally, if the direct cost of education makes up most of the opportunity cost of education, the change in the left-hand side of the indifference condition (4) caused by a switch in the policy regime will be small. In that case, it is possible that we observe $\mu^{IS} < \mu^{LF}$ or even $\mu^{B} < \mu^{LF}$.

3.3   Summary of Political-Economy Implications

To arrive at a full assessment of the political economy of banning child labor, we now combine our results on the short- and long-run implications of the different policies. We want to determine how the prevailing policy regime (LF or IS) affects the political incentives for introducing B. We therefore consider economies that start out in a steady state either with LF or IS, and then (unexpectedly) introduce B. By comparing outcomes on the transition path after B is introduced to the outcome without a policy change, we can see who gains and who loses from the introduction of B.

As in Doepke and Zilibotti (2005), we focus on the political preferences of unskilled workers, because this group forms the natural constituency in favor of a child-labor ban. Indeed, historically labor unions have been the main force campaigning for the introduction of child-labor laws. Unskilled workers tend to support a ban if their own children are not working (so that they are not economically dependent on child-labor income), and if introducing B promises a sizeable rise in unskilled wages. Next, then, we need to assess how the prevailing policy

regime determines how many unskilled workers educate their children and how the passing of a ban affects wages.

If a ban on child labor is imposed, in the first period we will observe the short-run wage effects described in Section 3.1. Since we assume that the economy starts out in a steady state and that the ban is introduced after education decisions are made in the impact period, the skill composition of the population is unchanged in the period after the ban is introduced. Hence, in the second period of the transition path wages will be the same as in the first. From the third period onward, the economy attains the new steady state as described in Section 3.2.

Although the wage dynamics are relatively simple, the impact of future wage changes on the total expected utility of workers, and hence on their political preferences, is in general ambiguous. This is because there is social mobility (i.e., all parents have both skilled and unskilled descendants with positive probability), which implies that all adults care about both skilled and unskilled future wages. In the following discussion, we focus on the case in which political preferences are dominated by the short-run wage effects, i.e., people's preferences are determined by the effect of policies on their own wages, rather than the effects on the wages of their children, grandchildren and so on. We believe this is the relevant case, because a period in the model corresponds to a generation in reality, implying that the short run in fact is rather long (notice that the initial wage effect persists for two periods/generations).[11] In the numerical analysis of Section 3.3, we do take explicit account of future wage changes, and find that political preferences are indeed dominated by the short-run effects.

There are two distinct channels through which the imposition of IS affects the political economy of child-labor legislation. First, the existing policy regime determines the wage changes that would result from passing a child-labor ban B. Here our main finding is that imposing IS unambiguously lowers the potential wage gains that adult unskilled workers can realize if they campaign for the introduction of B. If light and heavy labor are highly complementary in the domestic sector, imposing B once IS are in place can even lower adult unskilled wages,

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[11]Technically, short-run wage effects dominate political preferences if the altruism factor z is sufficiently small. In the simulated example presented in Section 3.3, we use z=0.3, and political incentives are indeed aligned with the short run wage effects.

removing those workers' incentive for supporting B. To the extent that unskilled workers are the main constituency that has to be mobilized in favor of a child-labor ban, the imposition of IS thus lowers the likelihood of B being introduced.[12]

The second channel works through the effects of the existing policy regime on the skill composition of the population. Political support for B generally will derive from unskilled workers whose own children are in school, whereas unskilled workers who depend on the income of their working children tend to oppose a child-labor ban. There is one scenario under which imposing IS on a country may increase the likelihood of passing a ban. The first requirement is that even under IS, introducing B would lead to wage gains for unskilled workers. The second requirement is that $\mu^{IS} > \mu^{LF}$, so that under IS relatively more workers educate their children. Under these conditions, if IS are in place there is a larger constituency that stands to realize wage gains from the introduction of B (even though their wage gains would be smaller compared to an initial policy regime of LF).[13]

To summarize, as far as the short-run reaction of wages is concerned, imposing IS generally reduces the likelihood that a ban will be introduced. In contrast, the effect of IS on the skill composition of the population is ambiguous: under certain circumstances IS may make the introduction of B more likely. But in our view this positive effect is unlikely to be empirically relevant, because we have made some simplifying assumptions that bias the results in favor of generating a positive effect of IS on education. In our model, the decision of whether to educate a child depends only on the skill premium and the opportunity cost of education, but not on total family income. In a richer model (incorporating for example financial frictions, subsistence consumption constraints, or strongly di-

---

[12]As documented by Doepke and Zilibotti (2005), working-class unions usually were the main force behind the introduction of child-labor restrictions in industrialized countries, which is consistent with our emphasis on the preferences of unskilled workers. However, it should be pointed out that if under IS the introduction of B would lower unskilled wages, it would necessarily raise skilled wages, which creates a potential alternative constituency for B.

[13]Although we have not specified a political mechanism that translates voters' preferences and the composition of the population into a particular political outcome, there are a number of political mechanisms (such as majority voting) that would imply a specific threshold $\bar{\mu}$ that needs to be passed for political support for B to be sufficient. If we have $\mu^{LF} < \bar{\mu} < \mu^{IS}$, imposing IS could be the nudge that leads to the ultimate adoption of B.

minishing marginal utility), additional income effects would arise. The empirical literature (see the discussion in the introduction) suggests that families on the margin between education and child labor often are financially constrained. In such families, child-labor income derived from some of the children can be crucial for sending other children to school. Given that IS lower child-labor income, after IS are imposed such families may no longer be able to afford educating any of the children, even though IS lowers the opportunity cost of education. Thus, a richer modeling framework including income effects would reinforce our overall argument that imposing labor standards or trade sanctions lowers the prospects for comprehensive child-labor regulation.

4 Technological Change and the Dynamic Effects of International Labor Standards

So far, we have focused on the political economy of child-labor regulation in a stationary environment, i.e., the parameters of the production technologies were assumed to be constant over time. The argument could be made that imposing IS on a stationary economy with high child labor rates in the steady state cannot do any harm. If the parameters of the economy were such that there was sufficient political support for a child-labor ban, the country would have introduced B already. If, in contrast, LF prevails in steady state and child labor rates are positive, political support for B evidently is insufficient even before the introduction of IS. Imposing IS on a stationary economy, then, should not affect the adoption of B.

In this section, we demonstrate that this argument breaks down if the economy undergoes technological change that increases the demand for skilled labor. We provide a dynamic simulation of an economy that initially is in a steady state where there is insufficient support for the introduction of B, and where a substantial fraction of children are working. Over time, however, the productivity of the export sector increases relative to the domestic sector's. This change increases the demand for skilled labor. Thus, a larger fraction of unskilled workers choose to educate their children, which swells the constituency that stands to gain from

the introduction of a child-labor ban. We show that in this environment, the imposition of IS on the country can prevent the ultimate eradication of child labor.

Parameter	Interpretation	Value
L	Amount of land	1
α	Total share of labor in D sector	0.8
β	Relative share of light labor in D sector	0.066
γ	Share of light labor in E sector	0.25
π_1	Fraction of educated children becoming skilled adults	0.7
π_0	Fraction of working children becoming skilled adults	0
z	Altruism factor	0.3
p_S	Cost of education for skilled parents	0.025
p_U	Cost of education for unskilled parents	0.075
$A_{E,0}$	Initial productivity of E sector	2.5
g	Growth rate of productivity of E sector	0.0075

Table 1: Parameter Values for Simulated Economy

Table 1 summarizes the parameter values that were used for the simulation. Both production functions are assumed to take the Cobb-Douglas form:

$$F^E\left(S^E, U_l^E\right) = A_E \left(S^E\right)^{1-\gamma} \left(U_l^E\right)^{\gamma},$$
$$F^D\left(L, G(U_h^D, U_l^D)\right) = L^{1-\alpha}\left((U_h^D)^{1-\beta}(U_l^D)^{\beta}\right)^{\alpha}.$$

The productivity of the export sector increases at a constant rate every period:

$$A_{E,t+1} = (1+g)A_{E,t}.$$

The initial conditions for the economy (i.e., the numbers of skilled and unskilled adults in the initial period, $N_{S,0}$ and $N_{U,0}$) were chosen as the steady-state values corresponding to the initial productivity of the export sector $A_{E,0}$.

We assume that introducing B in the country requires the support of a majority of the unskilled adults. As in Doepke and Zilibotti (2005), the interpretation of
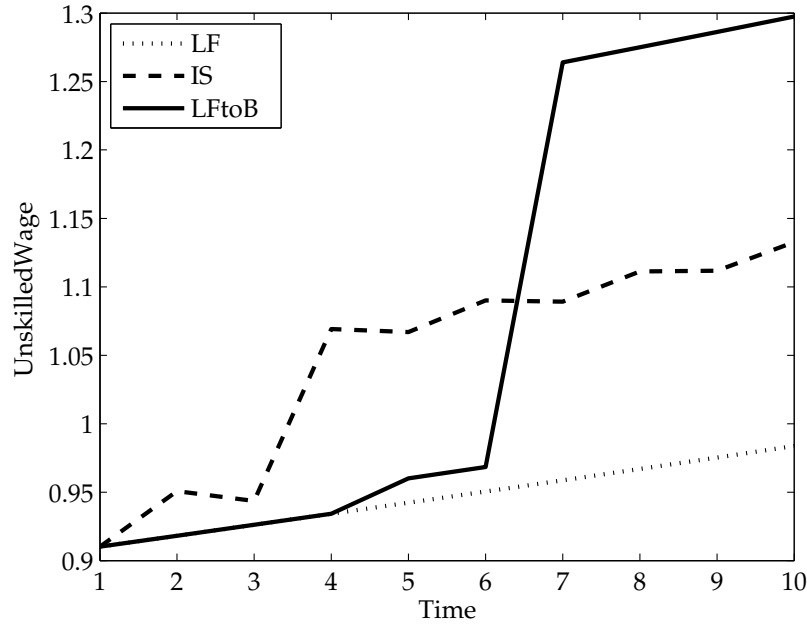
23

Figure 1: Unskilled Adult Wages under Different Policies

this assumption is that B is passed once labor unions (who represent unskilled workers) campaign for the eradication of child labor.[14] In the initial period, the preferences of the different types of workers (taking account of the full dynastic utility as a function of current and future wages) line up as in our theoretical analysis above: skilled workers as well as unskilled workers with working children oppose B, whereas unskilled workers whose children receive education favor the introduction of B.

In the initial period, about 45 percent of unskilled parents educate their children, which implies that there is insufficient political support for the introduction of B. Over time, however, the rising productivity of the export sector (which is intensive in skilled labor) induces more and more unskilled parents educate their children, which increases the constituency that stands to gain from B. In period 5, for the first time more than 50 percent of unskilled parents educate their children. These workers can increase their utility by forcing the introduction of B, and con-

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[14]It is possible to construct similar examples in which B is passed once a majority of all adults support the reform.
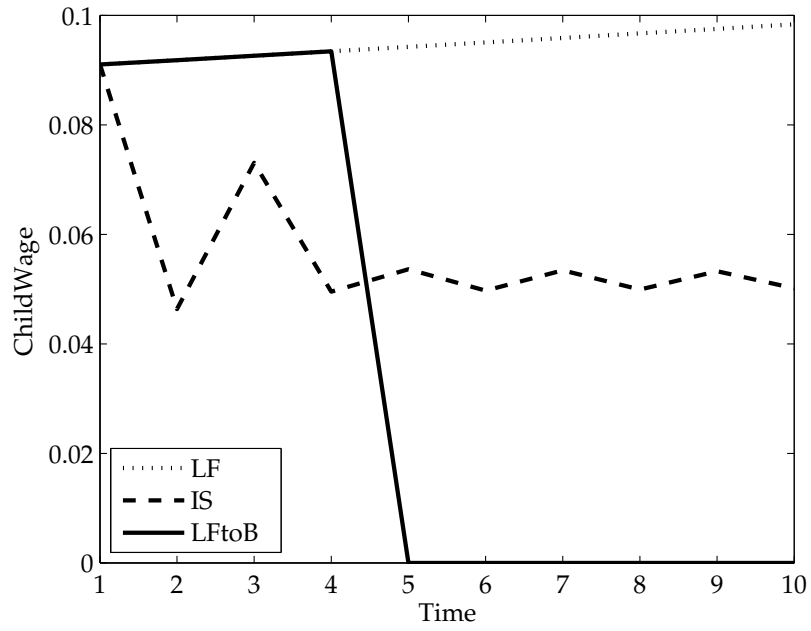
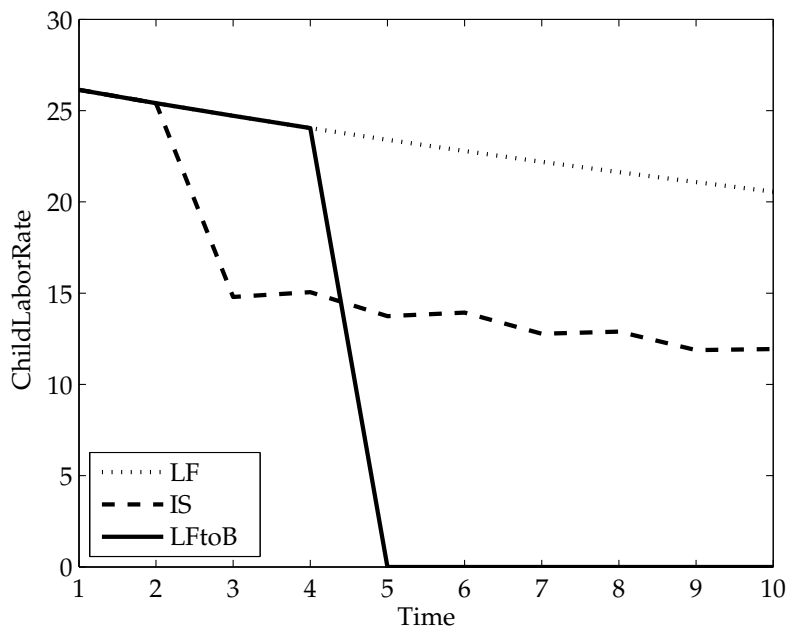Figure 2: Children's Wages under Different Policies

Figure 3: Child Labor Rate under Different Policies

sequently from period 5 onward, child labor is banned.[15]

Figures 1 to 3 display the implications of technological change and the introduction of B for the wages of unskilled adults, the wages of children, and the child labor rate. Under LF (dotted line), unskilled and child wages rise slowly over time (due to technological progress), and the child labor rate declines (due to increasing education). The introduction of B in period 5 (solid line, "LF to B") immediately reduces child wages and the child labor rate to zero. In periods 5 and 6, there is a moderate increase in unskilled wages. From period 7 onward, unskilled wages increase by a larger amount. This second increase results from a bigger supply of skilled labor: the elimination of child labor reduces the opportunity cost of education, and therefore leads to a lower equilibrium skill premium.

So, even though the economy starts out in LF with a relatively high child labor rate, if left to its own devices the country ultimately bans child labor. The abolishment of child labor leads to a substantial rise in education and a large improvement in the living standards of unskilled workers.

Let us compare this outcome to an alternative scenario in which the international community imposes IS before the threshold for the introduction of B is reached. Figures 1 to 3 display outcomes if IS are imposed in period 2 (dashed line, "IS"). In the short term, this intervention reduces child wages, increases unskilled adult wages, and lowers the child labor rate. Compared to the outcome under LF up until period 4, the IS policy may be deemed successful in terms of fighting child labor and improving the wages of unskilled workers. However, in period 5 (when B would be introduced if IS were not in place) there is little political support for introducing B. In fact, introducing B in the economy that already has IS in place would reduce unskilled wages in the short term. Thus, once IS are in place, the economy no longer introduces B.

Comparing the outcome under IS (dashed line) to the one under the endogenous introduction of B (solid line), we see that IS in fact lead to more child labor and

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[15]For simplicity, and consistent with our theoretical analysis above, we assume that the introduction of B in period 5 is unanticipated. Education decisions therefore change only from period 6 onward. Under perfect foresight of future policies, the overall dynamics and the effects of imposing IS would be qualitatively unchanged, but there would be additional anticipation effects.

lower unskilled wages in the long run. If the economy were left alone, child labor would be eliminated from period 5 onward. If IS are imposed, the child labor rate declines only gradually, and remains above 10 percent throughout the entire transition. In addition, the endogenous introduction of B yields a long-run rise in the unskilled wage that is almost twice the increase caused by the imposition of IS. Thus, the simulation shows that the imposition of IS can prevent the ultimate eradication of child labor and can lead to lower living standards for unskilled workers.

5   Conclusions

Our analysis raises serious doubts about the effectiveness of international labor standards and trade sanctions in addressing the child-labor problem in developing countries. We find that these measures not only reduce the income and welfare of developing countries in the short run, but also have the potential to lower the prospects for the ultimate eradication of child labor through domestic political action.

Given these findings, a natural question is whether there are alternative policies that the international community could implement to fight child labor. As a theoretical exercise, it is easy to come up with policy proposals that would be more productive than the international labor standards considered in our model. For example, a policy could punish developing countries for the use of child labor anywhere in the economy, not just in the export sector. Even more effectively, one could construct a policy that punishes the use of child labor in the domestic sector, while leaving child labor unconstrained in the export sector. In our model, this would place children in the sector where they compete directly with adults, increasing the incentives of unskilled workers to vote for a ban on child labor.

These alternative policy proposals, however, may not be feasible or even desirable to put into practice. The use of child labor would have to be strictly monitored, for example, in the informal sector or in family farming. Ensuring compliance at this level would be very difficult, especially if developing countries

chose not to cooperate. Equally significant is the issue of welfare. Even if child labor could be wiped out by tight monitoring in every sector and by punishing its use where detected, families in developing countries would experience large income losses. The compensating benefits could not be guaranteed unless the now-unemployed children were re-engaged in worthwhile ways, schooling in particular. Social policies targeting the poor, then, may well be a necessary complement to ending the use of child labor.

An important caveat is that our analysis focuses on conditions that give rise to majority support for a child-labor ban among unskilled workers. Implicitly, we assume that the working class has enough political influence to make their views pivotal. This assumption is grounded in the observation that in developed countries, labor unions were often the main campaigners for child labor laws. Further, in many countries with widespread child labor we observe that unions representing unskilled workers oppose child-labor regulation. For instance, Weiner (1991) argues that in India there is no political pressure from trade unions to ban child labor, since the ban would be unpopular among the majority of poor workers. But political institutions differ across countries, and in many developing countries unions are weak. In these countries, even if a majority of workers would benefit from a child-labor ban, the local business lobby may be able to prevent regulation through its influence on the political process. In this scenario, international pressure may strengthen the case of groups that favor a ban. Even then, our analysis suggests that the external pressure should not specifically target labor in the export sector.

For the international community, a more productive approach might be to move away from sanctions to policies that promote alternatives to child labor.[16] Recently, some developing countries have had real success with programs that reward parents for keeping their children in school (the most prominent examples are PROGRESA in Mexico and Bolsa Escola/Bolsa Familia in Brazil). Programs

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[16]It is useful to keep in mind that abolishing child labor is not an end in itself, but has to be justified with the welfare implications for families and their children. Since we believe that child labor is harmful mostly because it keeps children out of school, policies should focus on the ultimate objective of increasing education rather than exclusively on the sole aim of lowering child labor. See Doepke and Krueger (2006) for a comprehensive discussion of child-labor regulation and related policies from a welfare perspective.

like these are inducing more families to educate their children rather than relying on child labor, strengthening the constituency that stands to gain from child labor laws. Moreover, policies promoting education do not lead to a displacement of working children into low-productivity tasks that are complementary to adult labor, as do international labor standards and trade sanctions. Our earlier research (Doepke and Zilibotti 2005) also suggests that fertility is an important determinant of child labor. Large families typically are opposed to banning child labor, as these are more dependent on child labor income. Policies promoting conscientious family planning also can build the constituency favoring child-labor regulation. A reworking of international policy measures along these lines should improve the prospects for reducing child labor in developing countries.

A Mathematical Appendix

Proof of Proposition 1: Profit maximization implies that wages equal marginal products in each sector. The wage for skilled labor is therefore given by:

$$w_S^{LF} = F_S^E \left(N_S, \theta_{U,E}^{LF} N_U + \lambda \theta_{C,E}^{LF} N_C \right).$$

Given that we assume that unskilled workers supply both types of unskilled labor, the returns to light and heavy labor have to be equalized, both within and across sectors. The unskilled wage therefore satisfies:

$$
\begin{aligned}
w_U^{LF} &= F_{U_l}^E \left(N_S, \theta_{U,E}^{LF} N_U + \lambda \theta_{C,E}^{LF} N_C \right) \\
&= F_U^D \left(L, U^D \right) \, G_{U_h} \left((1 - \theta_{U,E}^{LF} - \theta_{U,D}^{LF}) N_U, \theta_{U,D}^{LF} N_U + \lambda (1 - \theta_{C,E}^{LF}) N_C \right) \\
&= F_U^D \left(L, U^D \right) \, G_{U_l} \left((1 - \theta_{U,E}^{LF} - \theta_{U,D}^{LF}) N_U, \theta_{U,D}^{LF} N_U + \lambda (1 - \theta_{C,E}^{LF}) N_C \right).
\end{aligned}
$$

Finally, given that the use of child labor is unrestricted, the children's wages are given by λ (the children's relative productivity) times the unskilled wage.

$$
\begin{aligned}
w_C^{LF} &= \lambda F_{U_l}^E \left(N_S, \theta_{U,E}^{LF} N_U + \lambda \theta_{C,E}^{LF} N_C \right) \\
&= \lambda \, F_U^D \left(L, U^D \right) \, G_{U_l} \left((1 - \theta_{U,E}^{LF} - \theta_{U,D}^{LF}) N_U, \theta_{U,D}^{LF} N_U + \lambda (1 - \theta_{C,E}^{LF}) N_C \right).
\end{aligned}
$$

$\square$

Proof of Proposition 2: Consider first the case in which IS are non-binding, i.e., Condition (1) is satisfied. We need to show that we can find choices for $\theta_{U,D}^{IS}$, $\theta_{U,E}^{IS}$, and $\theta_{C,E}^{IS}$ that satisfy the IS restriction and give rise to the same structure of labor supply as the laissez-faire choices $\theta_{U,D}^{LF}$, $\theta_{U,E}^{LF}$, and $\theta_{C,E}^{LF}$. Given that IS are imposed, we must have $\theta_{C,E}^{IS} = 0$. To keep the supply of unskilled labor in the export sector constant, we set:

$$\theta_{U,E}^{IS} = \frac{\theta_{U,E}^{LF} N_U + \lambda \theta_{C,E}^{LF} N_C}{N_U}.$$

Condition (1) ensures that

$$\theta_{U,E}^{IS} \leq 1,$$

implying that the choice is feasible. To keep the supply of heavy labor in the domestic sector constant, we set:

$$\theta_{U,D}^{IS} = \theta_{U,E}^{LF} + \theta_{U,D}^{LF} - \theta_{U,E}^{IS}.$$

Condition (1) ensures that

$$\theta_{U,D}^{IS} \geq 0,$$

implying that the choice is feasible. The resulting supply of light unskilled labor in the

domestic sector is:

$$
\begin{aligned}
\theta_{U,D}^{IS} N_U + \lambda N_C &= \left(\theta_{U,E}^{LF} + \theta_{U,D}^{LF} - \theta_{U,E}^{IS} \right) N_U + \lambda N_C \\
&= \left(\theta_{U,E}^{LF} + \theta_{U,D}^{LF} - \left(\frac{\theta_{U,E}^{LF} N_U + \lambda \theta_{C,E}^{LF} N_C}{N_U} \right) \right) N_U + \lambda N_C \\
&= \theta_{U,D}^{LF} N_U + (1 - \theta_{C,E}^{LF}) \lambda N_C.
\end{aligned}
$$

Thus, labor supply is once again identical to LF, implying that all wages are the same as well.

Now consider the case where IS are binding, i.e., Condition (2) holds. The condition implies that the supply of light labor in the domestic sector rises above what is supplied under LF. Thus, wages can no longer be equalized, so that no adults will supply light labor to the domestic sector, implying $\theta_{U,D}^{IS} = 0$. Condition (2) also implies that:

$$
N_U < \left(\theta_{U,E}^{LF} + \theta_{U,D}^{LF} \right) N_U + \theta_{U,E}^{LF} N_U + \lambda \theta_{C,E}^{LF}
$$

Thus, total unskilled labor supplied to the export sector and to heavy labor in the domestic sector has to decline relative to LF. The ratios of skilled to unskilled labor supply in the export sector and of light to heavy labor in the domestic sector therefore rise compared to LF, which gives rise to the wage comparisons stated in the proposition:

$$
\begin{aligned}
w_S^{IS} &= F_S^E \left(N_S, \theta_{U,E}^{IS} N_U \right) < w_S^{LF}, \\
w_U^{IS} &= F_{U,l}^E \left(N_S, \theta_{U,E}^{IS} N_U \right) = F_U^D \left(L, U^D \right) G_{U,h} \left((1 - \theta_{U,E}^{IS}) N_U, \lambda N_C \right) > w_U^{LF}, \\
w_C^{IS} &= \lambda F^D \left(L, U^D \right) G_{U,l} \left((1 - \theta_{U,E}^{IS}) N_U, \lambda N_C \right) < w_C^{LF}.
\end{aligned}
$$

$\square$

Proof of Proposition 3: Under a child-labor ban the total supply of unskilled labor declines unambiguously. To equalize wages across sectors, the supply of unskilled labor then also has to decline in each sector individually. The ratios of skilled to unskilled labor supply in the export sector and of land to unskilled labor supply in the domestic sector therefore rise compared to LF, which gives rise to the wage comparisons stated in the proposition:

$$
\begin{aligned}
w_S^B &= F_S^E \left(N_S, \theta_{U,E}^B N_U \right), \\
w_U^B &= F_{U,l}^E \left(N_S, \theta_{U,E}^B N_U \right) \\
&= F_U^D \left(L, U^D \right) G_{U,h} \left((1 - \theta_{U,E}^B - \theta_{U,D}^B) N_U, \theta_{U,D}^B N_U \right) \\
&= F_U^D \left(L, U^D \right) G_{U,l} \left((1 - \theta_{U,E}^B - \theta_{U,D}^B) N_U, \theta_{U,D}^B N_U \right), \\
w_C^B &= 0.
\end{aligned}
$$

$\square$

Proof of Proposition 4: The results are implied by Propositions 2 and 3. $\square$

Proof of Proposition 5: Consider the case in which the export technology is Cobb Douglas, and the domestic production function is a nested Cobb Douglas-CES technology:

$$Y^E = S^{1-\gamma}(U_l^E)^\gamma,$$

$$Y^D = L^{1-\alpha}\left((1-b)(U_h^D)^\beta + b(U_l^D)^\beta\right)^{\frac{\alpha}{\beta}}.$$

We now want to compare wages for unskilled workers under IS and B. For signing the wage effects, it is sufficient to focus on the determination of wages in the domestic sector. In particular, we are going to ask what happens to adult unskilled wages in the domestic sector after removing the children and keeping constant the number of unskilled adults in the D sector. Even though the full equilibrium will generally also involve a reallocation of adult labor between the E and D sectors, this reallocation can only mitigate the wage effect with the labor allocation held constant, but cannot reverse it. Let $N_U^{D,IS}$ denote the total number of unskilled adults working in the domestic sector under IS, and N_C^{IS} is the corresponding number of child workers. If now B is imposed and adult labor allocated to the D sector does not change ($N_U^{D,B} = N_U^{D,IS}$), the constant adult labor will be allocated efficiently within the domestic sector:

$$\max_{U_l} \left\{(1-b)\left(N_U^{D,IS} - U_l\right)^\beta + b \cdot U_l^\beta\right\}$$

This implies:

$$U_l = \frac{b^{\frac{1}{1-\beta}}}{(1-b)^{\frac{1}{1-\beta}} + b^{\frac{1}{1-\beta}}} N_U^{D,IS},$$

$$U_h = \frac{(1-b)^{\frac{1}{1-\beta}}}{(1-b)^{\frac{1}{1-\beta}} + b^{\frac{1}{1-\beta}}} N_U^{D,IS}.$$

We can therefore rewrite the production function under B as:

$$Y^{D,B} = \Xi L^{1-\alpha}(N_U^{D,IS})^\alpha,$$

$$\Xi \equiv \left(\frac{(1-b)^{\frac{1}{1-\beta}} + b^{\frac{1}{1-\beta}}}{\left((1-b)^{\frac{1}{1-\beta}} + b^{\frac{1}{1-\beta}}\right)^\beta}\right)^{\frac{\alpha}{\beta}}.$$

The adult unskilled wage corresponding to this allocation is:

$$w_U^B = \alpha \Xi L^{1-\alpha}(N_U^{D,IS})^{\alpha-1}.$$

In contrast, under IS we have:

$$Y^D = L^{1-\alpha}\left((1-b)(N_U^{D,IS})^\beta + b \cdot (N_C^{IS})^\beta\right)^{\frac{\alpha}{\beta}},$$

$$w_U^{IS} = \alpha(1-b)L^{1-\alpha}\left((1-b)(N_U^{D,IS})^\beta + b \cdot (N_C^{IS})^\beta\right)^{\frac{\alpha-\beta}{\beta}}(N_U^{D,IS})^{\beta-1}.$$

The condition for B to lower the unskilled wage therefore is:

$$w_U^{IS} > w_U^B$$

$$\alpha(1-b)L^{1-\alpha}\left((1-b)(N_U^{D,IS})^\beta + b \cdot (N_C^{IS})^\beta\right)^{\frac{\alpha-\beta}{\beta}}(N_U^{D,IS})^{\beta-1} > \alpha \cdot \Xi \cdot L^{1-\alpha}(N_U^{D,IS})^{\alpha-1}$$

$$(1-b)\left(1-b+b\left(\frac{N_C^{IS}}{N_U^{D,IS}}\right)^\beta\right)^{\frac{\alpha-\beta}{\beta}} > \Xi,$$

which is the condition stated in the proposition. □

Proof of Corollary 1: The result follows from the wage comparisons in Proposition 4. □

Proof of Proposition 6: Given the assumption of constant returns, the production functions can be rewritten as follows:

$$F^E\left(S^E, U_l^E\right) = U_l^E f_E\left(\frac{S^E}{U_l^E}\right) \equiv U_l^E F\left(\frac{S^E}{U_l^E}, 1\right),$$

$$F^D\left(L, U^D\right) = U^D f_D\left(\frac{L}{U^D}\right) \equiv U^D F\left(\frac{L}{U^D}, 1\right),$$

$$G(U_h^D, U_l^D) = U_l^D g\left(\frac{U_h^D}{U_l^D}\right) \equiv U_l^D G\left(\frac{U_h^D}{U_l^D}, 1\right).$$

Using this notation, the restrictions on substitution elasticities are given by:

$$-\frac{f_E'(x)(f_E(x) - x f_E'(x))}{x f_E''(x) f_E(x)} \geq 1, \tag{5}$$

$$-\frac{f_D'(x)(f_D(x) - x f_D'(x))}{x f_D''(x) f_D(x)} \geq 1. \tag{6}$$

for all $x > 0$.

We start by focusing on the comparison of LF and IS. We need to establish:

$$w_U^B + w_C^B < w_U^{LF} + w_C^{LF}.$$

Let $\nu_{U,E}^{LF}$ and $\nu_{U,E}^{LF}$ denote the fractions of total unskilled labor (including adult and child labor) devoted to the export sector and light labor in the domestic sector under LF. These

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fractions are given by:

$$\nu_{U,E}^{LF} = \frac{\theta_{U,E}^{LF} N_U + \lambda \theta_{C,E}^{LF} N_C}{N_U + \lambda N_C}$$

$$\nu_{U,D}^{LF} = \frac{\theta_{U,D}^{LF} N_U + \lambda(1 - \theta_{C,E}^{LF}) N_C}{N_U + \lambda N_C}$$

Also, total unskilled labor supply under LF is:

$$N_U + \lambda N_C = (1 + (1 - \mu)\lambda) N_U.$$

Since wages to unskilled labor are equalized across sectors and types of labor, the income of unskilled families under LF can be expressed in three different ways. For example, the equilibrium unskilled wage equals the marginal product of unskilled labor in the E sector. Defining:

$$x(\lambda) = \frac{N_S}{\nu_{U,E}^{LF}(1 + (1 - \mu)\lambda) N_U},$$

the total income I of families with working children under LF is given by:

$$w_U^{LF} + w_C^{LF} = I_l^E(\lambda) \equiv (1 + \lambda)\left(f_E\left(x(\lambda)\right) - x(\lambda) f_E'\left(x(\lambda)\right)\right).$$

Similarly, defining:

$$x(\lambda) = \frac{L}{G\left(\nu_{U,D}^{LF}(1 + (1 - \mu)\lambda) N_U, (1 - \nu_{U,E}^{LF} - \nu_{U,D}^{LF})(1 + (1 - \mu)\lambda) N_U\right)}$$

$$= \frac{L}{(1 + (1 - \mu)\lambda) G\left(\nu_{U,D}^{LF} N_U, (1 - \nu_{U,E}^{LF} - \nu_{U,D}^{LF}) N_U\right)},$$

$$y = \frac{1 - \nu_{U,E}^{LF} - \nu_{U,D}^{LF}}{\nu_{U,D}^{LF}},$$

income can also be linked to the return to heavy and light labor in the domestic sector:

$$I_h^D(\lambda) \equiv (1 + \lambda) g'(y)\left(f_D(x(\lambda)) - x(\lambda) f_D'(x(\lambda))\right),$$
$$I_l^D(\lambda) \equiv (1 + \lambda)\left(g(y) - y g'(y)\right)\left(f_D(x(\lambda)) - x(\lambda) f_D'(x(\lambda))\right).$$

Since wages are equalized across sectors, all these definitions are equivalent, and we have:

$$w_U^{LF} + w_C^{LF} = I_l^E(\lambda) = I_l^D(\lambda) = I_h^D(\lambda).$$

Moving the economy from LF to B amounts setting $\lambda = 0$. One feasible adjustment to this change (but not necessarily the optimal one) would reduce each use of unskilled labor (light labor in the export sector, and heavy and light labor in the domestic sector) in equal proportion. Given the definitions above, we can compute the incomes $I_l^E(0)$, $I_l^D(0)$, and

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$I_h^D(0)$ that would result from this adjustment using each use of unskilled labor to pin down the unskilled wage. Even though reducing labor proportionally is not necessarily optimal, the resulting income measures provide bounds for the true income under B. In particular, we have:

$$\min \left\{ I_l^E(0), I_l^D(0), I_h^D(0) \right\} \leq w_U^B + w_C^B \leq \max \left\{ I_l^E(0), I_l^D(0), I_h^D(0) \right\}.$$

Intuitively, taking the proportional reduction of labor supply in each use as a starting point, any reallocation of labor across uses can only increase the return to one use of unskilled labor at the expense of another. Since in equilibrium returns to each use of unskilled labor are equalized, the equilibrium return has to lie within the range spanned by the different returns. To establish the desired result, it therefore suffices to show that:

$$\max \left\{ I_l^E(0), I_l^D(0), I_h^D(0) \right\} < w_U^{LF} + w_C^{LF} = I_l^E(\lambda) = I_l^D(\lambda) = I_h^D(\lambda).$$

This relationship, in turn, can be established by showing that $I_l^E(\lambda)$, $I_l^D(\lambda)$, and $I_h^D(\lambda)$ are each strictly decreasing in λ. Consider, first, the use of unskilled labor in the export sector. We would like to show that

$$\frac{\partial I_l^E(\lambda)}{\partial \lambda} > 0.$$

Writing out this equation gives (here we write x for $x(\lambda)$ for more compact notation):

$$f_E(x) - x f_E'(x) + \frac{(1+\lambda)(1-\mu)}{1+(1-\mu)\lambda} x^2 f_E''(x) > 0.$$

Modifying the condition to be comparable to (5) gives:

$$-\frac{f_E'(x)\left(f_E(x) - x f_E'(x)\right)}{\frac{(1+\lambda)(1-\mu)}{1+(1-\mu)\lambda} x^2 f_E''(x) f_E'(x)} > 1.$$

The numerator is identical to that in (5), and in the denominator we have that:

$$\frac{(1+\lambda)(1-\mu)}{1+(1-\mu)\lambda} < 1$$

and $x f_E'(x) \leq f_E(x)$ due to the assumption of diminishing marginal products. The denominator is therefore strictly smaller in absolute value compared to that in (5). We therefore have:

$$-\frac{f_E'(x)\left(f_E(x) - x f_E'(x)\right)}{\frac{(1+\lambda)(1-\mu)}{1+(1-\mu)\lambda} x^2 f''(x) f'(x)} > -\frac{f'(x)\left(f_E(x) - x f_E'(x)\right)}{x f_E''(x) f_E(x)},$$

which together with (5) implies the desired inequality.

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Next, we would like to establish that:

$$\frac{\partial I_h^D(\lambda)}{\partial \lambda} > 0.$$

Writing out and modifying this inequality as above gives:

$$g'(y)\left(f_D(x) - xf_D'(x) + \frac{(1+\lambda)(1-\mu)}{1+(1-\mu)\lambda}x^2 f_D''(x)\right) > 0$$

$$-\frac{f_D'(x)(f_D(x) - xf_D'(x))}{\frac{(1+\lambda)(1-\mu)}{1+(1-\mu)\lambda}x^2 f_D''(x) f_D'(x)} > 1.$$

Parallel to the case above, this inequality is implied by (6). Following the same steps, we can also establish that:

$$\frac{\partial I_l^D(\lambda)}{\partial \lambda} > 0.$$

Taken together, these results show that

$$w_U^B + w_C^B < w_U^{LF} + w_C^{LF}.$$

We still need to determine the income of families with working children under IS relative to LF and B. If IS are nonbinding (i.e., Condition (1) is satisfied), wages and incomes are as under LF, and the previous result applies. Consider, therefore the case in which IS are binding (Condition (2) is satisfied). We would like to establish:

$$w_U^B + w_C^B < w_U^{IS} + w_C^{IS}.$$

If we have $w_U^B \leq w_U^{IS}$, the result follows immediately, because $w_C^B = 0 < w_C^{IS}$. Hence, from here on we will focus on the case $w_U^B > w_U^{IS}$. First, notice that the ratio of marginal products of heavy and light labor in the domestic sector is given by:

$$\frac{G_{U_h}(U_h^D, U_l^D)F_{U^D}^D(L, U^D)}{G_{U_l}(U_h^D, U_l^D)F_{U^D}^D(L, U^D)} = \frac{g'(y)}{g(y) - y(g'y)},$$

where:

$$y = \frac{U_h^D}{U_l^D}.$$

If IS are binding (which is the case we are considering here), the marginal product of heavy labor exceeds the marginal product of light labor in the domestic sector. In contrast, under B the returns are equalized. The labor input ratios y^{IS} and y^B under the two policies therefore satisfy:

$$\frac{g'(y^{IS})}{g(y^{IS}) - y^{IS}g'(y^{IS})} > 1 = \frac{g'(y^B)}{g(y^B) - y^B g'(y^B)}.$$

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This equation implies $y^B > y^{IS}$ because of the concavity of g. Next, consider the determination of the unskilled wage. Based on the return to heavy labor in the domestic sector, the unskilled wage is:

$$w_U = g'(y) \left(f_D(x) - f'_D(x) \right).$$

If $w_U^B > w_U^{IS}$ (the case that we consider here), we must have:

$$x^B > x^{IS}.$$

This is because the fact that $y^B > y^{IS}$ tends to lower the unskilled wage, which has to be offset by a higher input ratio of land versus aggregated unskilled labor.

Consider now the total income accruing to unskilled labor (provided by both adults and children) in the domestic sector, which is given by:

$$
\begin{aligned}
I_U^D &= U_h^D w_{U,l}^D + U_l^D w_{U,l}^D \\
&= U_h^D g'(y) \left(f_D(x) - x(f'_D(x)) \right) + U_l^D \left(g(y) - yg'(y) \right) \left(f_D(x) - x(f'_D(x)) \right) \\
&= U_l^D g(y) \left(f_D(x) - x(f'_D(x)) \right).
\end{aligned}
$$

The share of unskilled labor in total domestic output is given by:

$$
\begin{aligned}
\frac{I_U^D}{F(L, G(U_h^D, U_l^D))} &= \frac{U_l^D g(y) \left(f_D(x) - x(f'_D(x)) \right)}{U_l^D g(y) f(x)} \\
&= \frac{f_D(x) - x f'_D(x)}{f_D(x)}.
\end{aligned}
$$

We now would like to show that the share of unskilled labor in total domestic output is non-increasing in x. We thus need to show:

$$\frac{\partial \frac{f_D(x) - x f'_D(x)}{f_D(x)}}{\partial x} \leq 0.$$

Writing out this equation gives:

$$\frac{-x f''_D(x)}{f_D(x)} - \frac{f'_D(x)(f_D(x) - x f'_D(x))}{(f_D(x))^2} \leq 0.$$

This inequality can be rewritten as:

$$-\frac{f'_D(x)(f_D(x) - x f'_D(x))}{x f''_D(x) f_D(x)} \geq 1,$$

which is (6) and therefore satisfied.

Given that $x^B > x^{IS}$, the result implies that total unskilled income on the domestic sector has to be lower under B than under IS, since under B unskilled labor derives at

most an unchanged share of a smaller total amount of output. In the export sector, total unskilled income has to be smaller as well. The increase in the unskilled wage implies that less adult unskilled labor is employed in this sector under B compared to IS. Given our assumption of an elasticity of substitution between skilled and unskilled labor of at least one, the share of unskilled labor in the output of the export sector cannot be larger under B compared to IS, so that total income accruing to unskilled labor in the export sector has to decline once B is imposed.

To summarize, total income derived by unskilled families declines in both sectors and thus also in the aggregate. In addition, unskilled families with working children derive a relatively smaller share of total unskilled income under B compared to IS (because under IS their families supply more labor than do families with children in school, whereas under B all families supply one unit of adult labor only). These families therefore claim a smaller share of a smaller pie, implying that their income goes down once B is imposed:

$$w_U^B + w_C^B < w_U^{IS} + w_C^{IS},$$

□

Proof of Proposition 7: Consider first the comparison of wages under LF and IS. In either case, the indifference condition determining the skill premium is given by (4). If IS are non-binding, clearly wages are the same under LF and IS. Consider, therefore, the case in which IS are binding. First we would like to show that if IS are binding, the child wage has to be strictly smaller under IS than under LF. We show this by a contradiction argument. Assume, to the contrary, that $w_C^{LF} \leq w_C^{IS}$. Given that for a fixed adult labor supply we have $w_C^{LF} > w_C^{IS}$ (Proposition 4), this is only possible if $\mu^{LF} < \mu^{IS}$, i.e., if under IS unskilled labor is relatively more scarce. However, thus would also imply that $w_U^{LF} < w_U^{IS}$ and $w_S^{LF} > w_U^{IS}$. Comparing the indifference condition (4) across regimes, going from LF to IS we would observe an increase in the opportunity cost of education (left-hand side) but a decline in the return to education (right-hand side). Thus, $w_C^{LF} \leq w_C^{IS}$ implies that the indifference condition (4) cannot be satisfied for both LF and IS. We therefore obtain a contradiction, and conclude that $w_C^{LF} > w_C^{IS}$. Given this result, the indifference condition (4) implies that we must have $w_U^{LF} < w_U^{IS}$ and $w_S^{LF} > w_U^{IS}$.

Going from IS to B, the child wage is reduced to zero, $w_C^B = 0$. The left-hand side of the indifference condition (4) therefore decreases even further, implying that the skill premium has to drop as well, $w_U^{IS} < w_U^B$ and $w_S^{IS} > w_U^B$.   □

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