# International Trade and Forced Labor[a]

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**Abstract**

We explore the link between trade liberalization and forced labor theoretically and empirically. We provide a theoretical framework predicting that the net effect of trade on the use of forced labor depends on which sectors improve their relative terms of trade: (i) If forced-labor-intensive goods improve their relative terms of trade, then the use of cheap forced labor increases (forced labor demand channel); (ii) if free-labor-intensive goods improve their relative terms of trade, then the prevalence of forced labor decreases (free labor demand channel). Similarly, if openness to trade triggers anti-forced labor policies in the country (policy channel) or by trade partners (supply chains channel), then the prevalence of forced labor also decreases. These countervailing forces are consistent, on the one hand, with calls for import prohibitions on products made using forced labor and, on the other hand, with the hope that trade opportunities induce economic progress. Our empirical analysis provides causal evidence on these countervailing forces in a cross-country setting through an instrumental variable approach. We find that after accounting for the relation between trade and income and institutions, there is cross-country evidence for the forced labor demand channel: an increase in a country's openness raises the use of forced labor. But we also show that the forced labor demand channel is only present in trade with non-OECD countries, and provide evidence suggesting that supply chain transparency measures of developed countries decrease the use of forced labor. Our theoretical and empirical insights make a significant contribution to global debates on globalisation, international trade, the UN's Sustainable Development Goals (SDGS), ILO conventions and actions on forced labor, and domestic level legal developments designed to combat forced labor and modern slavery.

## 1 Introduction

Recent estimates suggest that 40.3 million people were victims of modern slavery in 2016. This estimation includes 25 million people in forced labor and 15 million people in forced marriage (ILO (2017a)). "In other words, on any given day in 2016, there were likely to be more than 25 million men, women, and children who were being forced to work against their will under threat... They were forced to work by private individuals and groups or by state authorities. In many cases, the products they made and the services they provided ended up in seemingly legitimate commercial channels."

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(ILO, 2017a, p. 9).[1] The role that international trade plays in this pervasive use of forced labor has recently drawn significant political attention. Anti-slavery policy proposals frequently demand that the negotiation of trade agreements explicitly prohibit the circulation of goods produced using forced labor.[2] Moreover, some countries have begun to respond to these demands. The United States Department of Labor maintains a list of goods and their source countries which it has reason to believe are produced by child labor or forced labor in violation of international standards, as required under the Trafficking Victims Protection Reauthorization Act of 2005 and subsequent reauthorizations. The list aims primarily to raise public awareness about forced labor and child labor around the world and to promote efforts to combat them; it is not intended to be punitive.[3] In 2001, U.S. Congressman Eliot Engel proposed legislation to require that all chocolate sold in the United States be marked as being free from slave and child labor.[4] The UK's 2015 Modern Slavery Act requires all companies with a high annual turnover file 'modern slavery statements' detailing the steps being taken to eradicate forced labour and slavery from supply chains. Despite the fact that no legislative initiative has been proposed yet, in 2016 the European Parliament asked for a legislative proposal on an effective traceability mechanism for goods produced through forced and child labor.[5] Through the induced changes in UK's trade, Brexit also raises concerns about UK's modern slavery policy.[6]

A key question remains, however, as to whether there is a causal link between international trade and the use of forced labor that justifies these demands. There are two opposite views in the debate on globalisation. On the one hand, there is the argument that trade openness increases the prevalence of forced labor, because it raises competitive pressures to reduce costs (ILO, 2005) or because the use of forced labor gives the country a competitive advantage in the export of this good (Neumayer and De Soysa, 2007). On the other hand, there is the view that trade openness

[1] For an example of how products produced with forced labour may spread worldwide see the case of China's cotton in Zenz (2020).

[2] For example, in its 2017 Report, the non-profit organisation GRAIN states: "Transnational supply chains have been an expanding economic actor since transnational corporations began outsourcing manufacturing to places where extremely low wages, low or non-existing labor safety standards and even slave labor prevailed or were tolerated. While they have existed since colonial times, supply chains have emerged forcefully in their modern fashion as a consequence of free trade agreements". "Trade agreements and negotiations are being used to institutionalise abuse and to facilitate it in countries where some labor protections still stand" (see https://grain.org/article/entries/5800-new-free-trade-agreements-normalising-the-brutality-of-transnational-supply-chains, accessed on 04/02/2021).

[3] See https://dol.gov/agencies/ilab/reports/child-labor/list-of-products, accessed on 04/02/2021.

[4] Opposed by the chocolate industry, the bill did not pass into law (see https://en.wikipedia.org/wiki/Harkin-Engel_Protocol, accessed on 04/02/2021).

[5] "This could pave the way for a complete ban on the importation into the EU of goods produced through modern forms of slavery... calling for a 'balanced and realistic proposal for legislation, including measures such as labelling child-labor-free products, giving trade preferences to countries that meet certain labor standards and imposing horizontal import prohibitions on products made using child labor'. The resolution further stresses that the objective of combating forced labor and child labor should be included in the trade and sustainable development chapters of EU trade agreements, and that EU trade strategy should promote the elimination of this type of work" (see https://europarl.europa.eu/legislative-train/theme-europe-as-a-stronger-global-actor/file-ban-on-import-of-goods-produced-using-modern-forms-of-slavery, accessed on 04/02/2021).

[6] "It is hard to see how the UK can take a lead on fighting slavery when Brexit has forced the prime minister to negotiate with economies driven by exploitation" (Aidan McQuade, Chief Executive of Anti-Slavery International, see https://theguardian.com/global-development/2017/sep/22/theresa-may-anti-slavery-crusader-craven-quest-trade-deals-brexit, accessed on 04/02/2021). "India has the largest numbers of people in slavery in the world, and many of those enslaved work in the supply chains of India's export-oriented sector. In other words, any trade deal that Britain would sign with India, under the current conditions that prevail there, would open the UK up as a major market for slavery-tainted goods" (Aidan McQuade, see https://news.trust.org/item/20161107134144-51h7z/, accessed on 04/02/2021).

decreases the prevalence of forced labor, because it provides the poor with sustained sources of income (Kara, 2012), because it leads to a harmonization of institutions and regulations (Sachs and Warner, 1995; Neumayer and De Soysa, 2007), or because globalisation increases information sharing about working conditions and consumers force producers to eradicate forced labor (ILO, 2005; Neumayer and De Soysa, 2007).[7] In spite of the relevance of this debate, the economic literature does not offer much guidance concerning the implications of the trade policies previously mentioned, nor the precise relationship between trade and forced labor. This study explores the link between trade liberalization and forced labor theoretically and empirically to assess the degree to which there is support for either of these two hypotheses.

Our first contribution is to provide a simple theoretical framework capturing the two opposite views in the debate on globalisation that we have described above. We provide a theoretical framework based on a standard textbook model of trade in which we embed forced labor. We assume that coercive labor relationships are sustained through the threat of force, but the use of forced labor is constrained in two ways. First, coercion is costly to employers, in particular, better institutions and regulations make coercion more costly. Second, there are 'transparency in supply chain' (TISC) measures adopted by trading partners. Our model generates two countervailing effects of trade openness on the prevalence of forced labor and predicts that the net effect depends on the relative terms of trade as well as on whether trade induces anti-forced labor policies. If forced-labor-intensive goods improve their relative terms of trade, then the use of cheap forced labor increases (forced labor demand channel); but if free-labor-intensive goods improve their relative terms of trade, then the prevalence of forced labor decreases (free labor demand channel). Similarly, if openness to trade triggers anti-forced labor policies in the country (policy channel) or by trade partners through TISC (supply chains channel), then the prevalence of forced labor also decreases.

In our model the use of forced labor distorts the allocation of labor. This implies that economies that rely on forced labor are inefficient. This important observation complements the argument that forced labor is undesirable because it is unethical or that it should be brought to an end, because it "is illegal in every country and rejected by all religious and political groups" (Bales, 2016, p. 116). Since our inefficient result is only based upon a misallocation of resources, it differs from the debate going back to Adam Smith on the incentives of coerced workers and whether these incentives lead to more or less productive workers (Weingast (2019) discusses Smith (1762-63; 1978)'s argument in modern terms; for recent contributions see e.g. the theoretical discussion in Acemoglu and Wolitzky (2011) or the empirical analysis in Markevich and Zhuravskaya (2018) and the literature reviewed in both papers).

Based on our theoretical framework, our second contribution is the empirical examination of various channels through which trade might affect forced labor. Since we uncover forces that go in opposite directions, the overall effect of trade on forced labor depends on the relative strengths of the effects and is an empirical question. Our empirical work addresses two objectives. First, it aims to understand whether the cross-country evidence suggests a link between trade and forced labor and, in particular, whether there is any evidence that increases in product demand accompanying a growth in trade exert upward pressure on forced labor. Second, we consider whether TISC shape this relationship.

The third contribution of the present study is to address the problem of the endogeneity of trade in the same way as in the literature on trade and income. The endogeneity problem of trade arises because the factors that determine trade may also influence forced labor and it is difficult to control for them in the empirical analysis.[8] From the outset it is not clear what the effects of endogeneity

[7] An extensive discussion of the arguments in the debate on globalisation and forced labor can be found in Neumayer and De Soysa (2007).

[8] For example, the analysis in Maskus (1997); Martin and Maskus (2001); Brown (2001); Brown et al. (1996), and

are. On the one hand, a high prevalence of forced labor may increase trade. This reverse causality problem would introduce a positive bias into the estimates. On the other hand, rich economies may trade more and have a lower prevalence of forced labor independently of trade. Latent factors like this may bias the estimates downwards. These problems could be solved and a causal link be established if we had an instrument for trade openness. To provide a plausible instrument we follow Frankel and Romer (1999) and use geography as an instrument for trade openness.[9] The main identification assumption in our approach is that trade which is driven by geography does not have an effect on forced labor, other than the effect through total trade.

The data suggest that trade and forced labor are unrelated. This result is consistent with the hypothesised forces of opposite signs cancelling each other out. However, as we show in our model, better outside options for workers reduce forced labor. If trade raises income by improving the workers value in the free-labor intensive sector, it would in turn be associated with declines in forced labor.[10] Similarly, the cost of coercion for producers, and the coerced workers' outside options, are also affected by the quality of institutions.[11] Our main empirical result shows that once we control for the positive link between trade and income, and between trade and institutions, countries that trade more increase the use of forced labor. This result provides evidence for the forced labor demand channel at a cross-country average. Anti-globalization advocates appear to be most concerned that trade-induced increases in product demand will increase the levels of forced labor through this mechanism. We find evidence that supports the validity of these concerns.[12]

In our theoretical framework we show that an increase in TISC can reduce the use of forced labor (supply chains channel). Our second empirical result provides evidence on the effect of this channel. To test whether there is a cross-country evidence of the TISC channel we consider trade partners, i.e. the destination of exports. As TISC were implemented almost exclusively by OECD countries, we assume that exports to OECD countries are subject to more controls than trade with non-OECD ones.[13] We find that trading with OECD countries, even in unskilled labor intensive goods, can reduce the use of forced labor through the TISC channel. Anti-slavery movements are concerned that the preponderance of developed economies in international trade increases the number of workers in forced labor.[14] In this sense, we provide evidence that attenuates these concerns. On the other hand, our findings also suggest that the TISC channel is not present on trade with non-OECD countries, where the forced labor demand channel mentioned in the previous paragraph remains unaltered: more openness increases the use of forced labor for this type of trade. As non-OECD

Busse (2002) suggests trade is determined by labor standards.

[9] See Frankel and Rose (2005) for a similar analysis on the effect of trade on the environment, and Edmonds and Pavcnik (2006) on trade and child labor.

[10] This link between trade and income is well established in a cross-country setting (Frankel and Romer (1999), Irwin and Tervio (2002)).

[11] The association between quality of institutions and international trade is also prominent in the literature, (e.g Dollar and Kraay, 2003; Levchenko, 2007). This would be the case, for example, if more exposure to international trade improved or damaged domestic institutions or regulations.

[12] However, the overall effect of trade on forced labor need not be positive. The change in the sign of the trade coefficient after the inclusion of the income and institutional effect highlights further the existence of the free labor demand and/or policy channel in which trade reduces the use of forced labor. Without controlling for these channels the effect of trade on forced labor is statistically insignificant.

[13] Anti-slavery movements, mostly based on OECD countries, also play a crucial role in slavery detection. See for example https://theguardian.com/global-development/2020/nov/20/uk-sourced-ppe-from-factories-secretly-using-north-korean-slave-labour, accessed on 04/02/2021.

[14] "...business and governments in G20 countries are importing products that are at risk of modern slavery on a significant scale" (Walk Free Foundation, 2018, p. 3). "...high-GDP countries have an obligation to take serious and urgent steps to address the risks they are importing. They owe this obligation both to consumers in their own countries and to victims along the supply chain, where products are being harvested, packed and shipped" (Walk Free Foundation, 2018, p. 4).

countries have not widely adopted TISC, these results highlight the potential benefits of increasing the TISC in international trade to achieve a reduction in forced labor.

We conclude this introduction by briefly commenting on the most related work on the relationship between trade and forced labor. Several works study the effects of coercion in a principal-agent framework (Chwe (1990); Acemoglu and Wolitzky (2011); Naidu and Yuchtman (2013)). Our formalisation of coercive labor relationships follows Acemoglu and Wolitzky (2011) in assuming that coercive labor relationships are based on the threat of force but abstracts from moral hazard issues.[15] Dippel, Greif and Trefler (2020) provide a model of 'legal coercion' in an agricultural economy where plantation owners lobby the government to enact coercive policies that reduce the value to working outside the formal sector, and workers can choose in which sector to work. Whereas this literature focuses on the effects of coercion, our analysis is centered in the amount for forced labor in the economy. On the empirical side, Landman and Silverman (2020), Danzer and Grundke (2020) and Neumayer and De Soysa (2007) study the effects of globalization forced labor. Landman and Silverman (2020) analyze the relationship between globalization and modern slavery at a cross-country level and find that economic measures of globalization and higher levels of democracy are significantly related to lower levels of slavery prevalence. Danzer and Grundke (2020) document how an exogenous labor demand shock triggered by a surge in the world market price of cotton increases coerced labor in Tajikistan. The closest paper to our empirical analysis is Neumayer and De Soysa (2007) which provides a cross-country analysis of the relationship between openness an forced labor using an instrumental variable approach. There are two main differences with the present work. First, while it uses measures of forced labor based on a coded dummy variable where country evidence of forced labor has been detected, we take advantage of the most recent cross-country measures of forced labor based on country's random samples (ILO (2017a)). Second, our instrument is different.[16] Importantly, contrary to our findings, trade openness maintains negative and significant coefficients across the majority of their estimations, suggesting that trade openness is associated with a lower use of forced labor.

The paper proceeds as follows. In Section 2 we introduce our model and theoretical predictions. In Section 3 we outline the empirical framework, describe the data and present the empirical findings. Section 4 concludes.

[15] Abstracting from the principal-agent relationship implies that forced laborers do not need to be induced to provide effort. The level of coercion needed only depends on the outside option of forced laborers and is, hence, contrary to Acemoglu and Wolitzky (2011), increasing in the outside option. Other predictions of our model, however, are in line with those in Acemoglu and Wolitzky (2011). For example, the two countervailing forces that we describe resemble Acemoglu and Wolitzky (2011)'s countervailing labor demand and outside option effects and our model also predicts that more productive employers will use more coercion.

[16] Neumayer and De Soysa (2007) use some variables of the gravity model of trade to instrument openness at an aggregate level (population size and size of land area, common language with at least one OECD country and the sum of bilateral investment treaties signed by a country). Our empirical strategy, following Frankel and Rose (2005), uses the gravity model by focusing directly on each bilateral trade arrangement. This is relevant, as the gravity model of trade refers to bilateral flows. It states that trade between a pair of countries is determined, positively, by country size (GDP, population, and land area) and, negatively, by distance between the countries in question (physical distance as well as cultural distance in the form of, e.g., different languages). Thus we construct an instrumental variable for openness by aggregating up across a country's partners the prediction of a gravity equation that explains trade with distance, population, language, land border, land area, and landlocked status. Their results suggest that the instruments are not particularly strong for their models.

## 2 Theoretical framework

Given our interest in the labor market we use a simple version of the specific factors (or Ricardo-Viner) model.[17] We embed forced labor in this standard model of trade and follow Acemoglu and Wolitzky (2011) in assuming that coercive labor relationships are sustained through the threat of force.[18]

### 2.1 The model

*The model of trade.*—We consider the so-called specific factors model with two goods and three factors. For illustrative purposes, we think of the two goods as, for example, garments, which are produced in a "traditional" sector and chemicals, which are made in a more "advanced" sector. Sectors are hence indexed by $i = A, T$. One of the three factors is labor, which is mobile and can move between the two sectors. The other two factors are sector specific capital. In both sectors the amount of capital is fixed and can be used only in the production of the good made in that sector.

The production of both goods requires capital and labor and is described through the production functions

$$y_i = f_i(K_i, L_i), \quad i = A, T, \tag{1}$$

where $y_i$ is the output produced using capital $K_i$ and labor $L_i$, given the technology available. We assume that (1) is twice differentiable, strictly increasing, strictly concave, and homogeneous of degree one in the inputs $L_i$ and $K_i$. We also postulate the Inada conditions $\lim_{L_i \to 0} \partial f_i / \partial L_i = +\infty$ and $\lim_{L_i \to +\infty} \partial f_i / \partial L_i = 0$.

As mentioned before, the amount of capital in each sector is fixed, while the amount of labor employed in each sector follows from the interaction between employers and workers which will be described later. For the moment we only note that, since labor is a mobile factor that can be used in either sector and since the labor employed cannot exceed the total labor supply, the following resource constraint must hold

$$L_A + L_T = L. \tag{2}$$

The product prices $P_A$ and $P_T$ are determined on world markets and hence exogenously given.

*Free labor and forced labor.*—Profit-maximizing employers match with workers. Employers in both sectors have incentives to rely on coercion, rather than to hire free labor paying wage $w$. The use of coercion, however, is constrained in two ways.

First, there are transparency in supply chain (TISC) measures adopted by trading partners. Trading partners in high income countries take measures, like inspections, in order to ensure that their supply chains are free of forced labor and other forms of unethical behavior.[19] To capture

[17] The specific factors model is a standard workhorse model of trade. Its name comes from the assumption that capital is sector specific and fixed. This captures Acemoglu and Wolitzky (2011, p. 569)'s observation that the "unequal access to assets for production is a key feature supporting coercive relationships such as serfdom, forced labor, or slavery." Our model can be interpreted as a short run version of the Heckscher-Ohlin model in which both factors of production are mobile across sectors. Allowing for capital mobility makes the model more complex but does not yield richer predictions concerning the effect of trade on forced labor, see Cristóbal-Campoamor and Dahm (2021).

[18] As explained in footnote 15 our formalisation of coercive labor relationships follows Acemoglu and Wolitzky (2011) closely but abstracts from moral hazard issues.

[19] For instance, following the revelation that five garment factories in Malaysia produced in "working in conditions that included indicators of forced labor", 17 out of 23 major apparel brands who had "recent or ongoing buying or licensing relationships with the five factories" took actions including "audits or assessments at four of the five facilities". See https://transparentem.com/projects/, accessed on 04/02/2021.

these measures, suppose that audits ensure that a proportion $\alpha_i$ of the workers in each sector must be hired as free labor. More frequent and broader inspections raise $\alpha$ and increase the share of free labor. To fix ideas, we assume that $0 \leq \alpha_T < \alpha_A \leq 1$, that is, supply chain transparency is lower in the traditional than in the advanced sector.[20]

Second, coercion is costly. Following Acemoglu and Wolitzky (2011) workers in coercive relationships decide whether they want to stay in the traditional sector or run away.[21] Slave holders use coercive tools denoted by $g$ (for "guns") to induce forced labor to stay. Coercion can be interpreted as force or the threat of force against the forced laborer or family members. It can also be interpreted as an effort to prevent forced laborers from escaping.[22]

Formally, we assume that employers exert a given level of coercion $g$ at a cost $\eta\chi(g)$, where $\chi(\cdot)$ is continuous, strictly increasing and convex with $\chi(0) = 0$ and $\chi'(0) = 0$. The parameter $\eta > 0$ captures the costs of coercion and depends on institutions, technology and regulation, including whether slavery is legal.[23]

If the forced laborer stays in the traditional sector she gets a (very small) payment $\underline{w} \geq 0$, which we interpret as subsistence.[24] If the forced laborer rejects, she receives her outside option $\overline{u}$ minus the level of guns $g$. The outside option $\overline{u}$ follows from a reduced-form matching model. When a forced laborer escapes, with probability $\gamma \in [0, 1)$ her escape is unsuccessful, and she is punished. With probability $1 - \gamma$ her escape is successful and she obtains wage $w \geq \underline{w}$ in the advanced sector.

For convenience we define the average labor costs in the two sectors as

$$h_i(w, \alpha_i, \eta) \quad = \quad \alpha_i w + (1 - \alpha_i) \left\{ \underline{w} + \eta\chi[g^*(w)] \right\}. \tag{3}$$

Under our assumptions $h_A(\cdot) > h_T(\cdot)$ holds.[25] TISC measures in one sector will raise these cost

[20] This might be because in this sector it is possible that workers are "forced to work inside clandestine factories" (Walk Free Foundation, 2018, p. 26) which are difficult to detect. Hammer and Plugor (2016) note that in the garment sector audits can be bypassed by subcontracting beyond declared manufacturers. Our illustration of the two sectors suggests that the production of garments is more prone to using forced labor than chemicals. This is not unreasonable. Both products appear among the highest-valued exported products in India and Malaysia (Central Intelligence Agency, 2020) but only the garment sector in both countries is on the Walk Free Foundation's list of (top five) products exported to G20 countries at risk of modern slavery (Walk Free Foundation, 2018).

[21] See also Genicot (2002) who argues that forced labor is a voluntary choice and that workers might opt for it because of a lack of suitable alternatives.

[22] Acemoglu and Wolitzky (2011, p. 556, footnote 3) describe coercive tools as "including the acquisition and use of actual guns by the employers as a threat against the workers or their families; the use of guards and enforcers to prevent workers from escaping or to force them to agree to employment terms favorable to employers; the confiscation of workers' identification documents; the setting up of a system of justice favorable to employers; investment in political ties to help employers in conflictual labor relations; and the use of paramilitaries, strikebreakers, and other nonstate armed groups to increase employer bargaining power in labor conflicts."

[23] We interpret $\eta$ as depending on domestic policies and hence assume it is the same in both sectors. It is straightforward to extend our analysis to the case in which the two sectors have different costs of coercion.

[24] A small subsistence payment is in line with the view that "economic exploitation is the main reason why some employers use coercion. In most cases, people in forced labour receive wages lower than the market rate, in some cases less than the subsistence minimum" (ILO, 2009, p. 31). Exploitation is enabled through "a whole series of manipulations by employers–such as wage deductions, debt manipulations, payment in kind, or simply the nonpayment of wages–that lead to the economic exploitation of workers and that are facilitated by weaknesses in the protection of wage payments. In the best of cases, forced laborers obtain reduced payment for their work or services; in the worst cases, they receive no payment at all" (Belser and Andrees, 2009, p. 5). We use the assumption that $\underline{w}$ is small in the proof of Proposition 1. Alternatively, we could follow ILO (2009) where in the calculation of the size of underpaid wages it is supposed that $\underline{w} = \lambda w$ with $\lambda \in (0, 1)$. A proportional reduction in wages would also allow to establish Proposition 1.

[25] Notice that we implicitly assume that the wage for free labor satisfies $w \in [\underline{w}, \overline{w})$, where we define $\overline{w}$ as the value for $w$ such that $w = \underline{w} + \eta\chi[g^*(w)]$, if such a value exists and $+\infty$ otherwise. Our assumptions on $\chi(\cdot)$ imply that $w > \underline{w} + \eta\chi[g^*(w)]$ for $w \in (\underline{w}, \overline{w})$ and that $\overline{w}$ is unique. The reason for assuming $w \in [\underline{w}, \overline{w})$ is that, on the one

(directly) in only one sector, while domestic policies that raise the cost of coercion $\eta$ increase average labor costs in both sectors.

Since both sectors combine free and forced labor, we measure forced labor as

$$S = (1 - \alpha_A)L_A + (1 - \alpha_T)L_T. \tag{4}$$

## 2.2 Analysis

*The equilibrium.*—A forced laborer will stay in the coercive relationship if and only if

$$\underline{w} \geq \overline{u} - g, \tag{5}$$

where

$$\overline{u} = \gamma\left(\overline{u} - g\right) + (1 - \gamma)\, w \quad \Leftrightarrow \quad \overline{u} = w - \frac{\gamma}{1 - \gamma} g. \tag{6}$$

This implies that the level of coercion required to deter forced laborers from running away is

$$g^* = (1 - \gamma)\left(w - \underline{w}\right). \tag{7}$$

Hence, coercion increases both with the likelihood that an escape is successful and with the gains from a successful escape. Further we have that

$$\overline{u}^* = (1 - \gamma)\, w + \gamma \underline{w}. \tag{8}$$

The forced laborer's outside option is the expected wage after an escape.[26]

Firms maximize profits, that is,

$$\max_{L_i} P_i f_i(K_i, L_i) - h_i(w) L_i, \tag{9}$$

where $h_i(w, \alpha_i, \eta)$ is defined in (3). The first-order-conditions are

$$P_i \frac{\partial f_i}{\partial L_i} = h_i(w, \alpha_i, \eta), \tag{10}$$

implying that in both sectors the value of the marginal product of labor must equal its price.[27]

Given the technologies of production and coercion (including $\underline{w}$), output prices $P_A$ and $P_T$, and the total labor supply $L$, conditions (2), (7), (8) and (10) must hold in equilibrium. Such an equilibrium determines the wage $w^*$, the level of coercion $g^*$, the outside option $\overline{u}^*$, free labor employed in the advanced sector $L_A^*$, forced labor $L_T^*$, and the output production level in the advanced sector $y_A^*$ as well as that in the traditional one $y_T^*$. Our first result establishes existence and uniqueness of an equilibrium with forced labor as well as the fact that it is inefficient.

**Proposition 1.** *There exists a unique equilibrium for the economy. This equilibrium is without specialization (that is, both goods are produced), (at least) the traditional sector coerces some workers into forced labor, and the allocation of labor to the two sectors is inefficient.*

*Proof.* See Appendix A.1. □

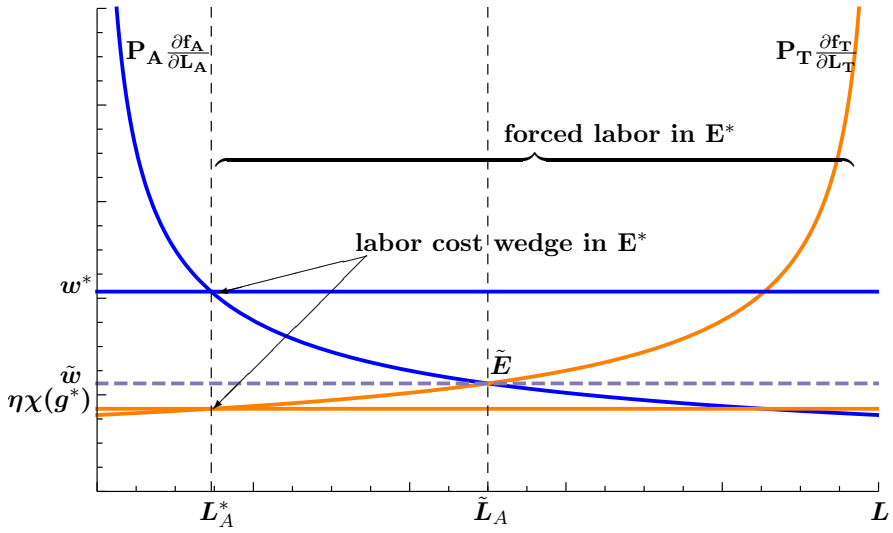


Figure 1: Equilibrium with and without forced labor

Figure 1 illustrates the equilibrium with coercion for the case in which the traditional sector relies completely on coercion, while the advanced sector only hires free labor, that is, $\alpha_A = 1 - \alpha_T = 1$. For simplicity we also assume that $\underline{w} = 0$. Figure 1 represents on the horizontal axis total labor supply $L$. Labor allocated to the advanced sector $L_A$ is measured from the left, while $L_T = L - L_A$ is measured from the right. The vertical axis shows the wage, the costs of coercion, and the value of the marginal product of labor.[28]

It is well known that in an economy without forced labor (that is, the traditional sector employs free labor at the current wage, rather than coerces workers) the equilibrium allocation of labor is such that the value of the marginal product of labor in each sector must equal its price. This is the case in which $\alpha_i = 1$ for $i = A, T$. Hence (10) yields the condition $P_A \partial f_A / \partial L_A = P_T \partial f_T / \partial L_T = w$ and implies that the allocation of labor is efficient. Figure 1 represents the equilibrium in an economy without forced labor by the pair $\tilde{E} = (\tilde{L}_A, \tilde{w})$. The allocation of free labor to the traditional sector follows implicitly as $\tilde{L}_T = L - \tilde{L}_A$.

The possibility of coercion drives a wedge between the labor costs in the two sectors, as now $h_A(\cdot) > h_T(\cdot)$ holds. The equilibrium with coercion is represented in Figure 1 by $E^* = (L_A^*, w^*)$. The wage $w^*$ in turn determines $h_A(w^*) = w^*$ and $h_T(w^*) = \eta\chi(g^*)$, since in Figure 1 we assume that $\alpha_A = 1 - \alpha_T = 1$. Labor is allocated to the traditional sector until the value of its marginal product equals coercion costs $\eta\chi(g^*)$, rather than the wage. This increased competition for workers results in a higher wage $w^*$ for free labor, compared to the wage $\tilde{w}$ in an economy without forced labor.

Notice that while the equilibrium of the economy without forced labor is efficient, the equilibrium of the economy with forced labor is not. As $P_A \partial f_A / \partial L_A > P_T \partial f_T / \partial L_T$, a unit of labor is

hand, $\underline{w}$ is interpreted as subsistence, and so lower wages are not possible. On the other hand, given our interest in forced labor, we suppose that there are incentives to use forced labor. Otherwise employers prefer to pay the wage for free labor, rather than using coercion. We discuss the case in which $w \geq \overline{w}$ in the context of Proposition 4.

[26] As in Acemoglu and Wolitzky (2011, p. 561) we can think of "$\overline{u} - g$ as the agent's 'extrinsic' outside option, influenced by the coercion of the producer, as opposed to $\overline{u}$, which could be thought of as the 'intrinsic' outside option, determined by factors outside the current coercive relationship."

[27] The concavity of the production function implies that the second-order-conditions hold.

[28] For simplicity in what follows we indicate coercion costs as $\eta\chi(g^*)$, rather than $\eta\chi[g^*(w^*)]$.

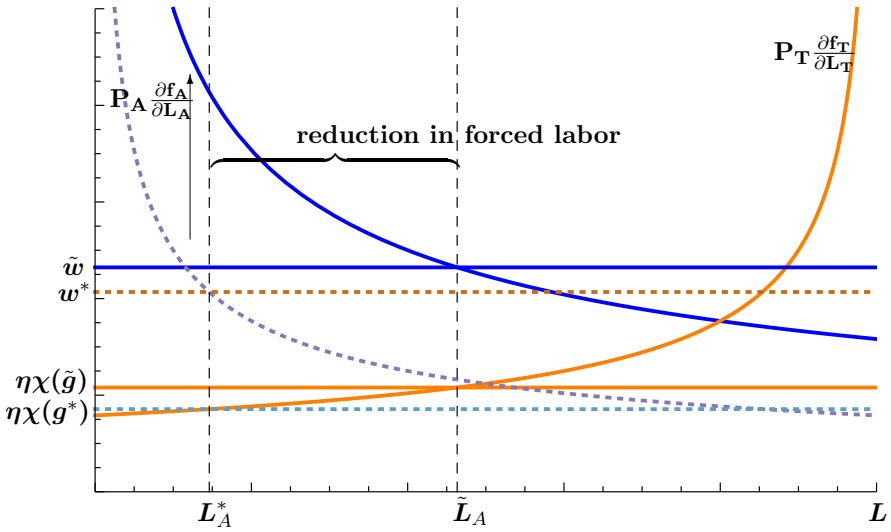


Figure 2: Free labor demand channel

more productive in the advanced sector than in the traditional one and a transfer of labor from the latter to the former increases the value of the goods produced in the economy.

*Trade liberalization and terms of trade.*—Trade liberalization affects output prices which leads to an adjustment both in labor costs and in the allocation of workers to the advanced and traditional sector. We show now that the effect of trade liberalization on forced labor depends crucially on whether relative output prices increase or decrease.

Consider first an increase in the output price of the advanced sector relative to the output price of the traditional sector. This increases the value of the marginal product of labor in the advanced sector. Figure 2 considers again the case in which $\underline{w} = 0$ and the traditional sector relies completely on coercion, while the advanced sector only hires free labor, that is, $\alpha_A = 1 - \alpha_T = 1$. It shows an upward shift in $P_A \partial f_A / \partial L_A$ and also how this alters the equilibrium from $E^* = (L_A^*, w^*)$ to $\tilde{E} = (\tilde{L}_A, \tilde{w})$. Labor is allocated to the advanced sector until the value of its marginal product equals the wage, which increases competition for workers and results in a higher wage $\tilde{w}$. By (7) and (8) the wage increase raises both the outside option of forced laborers and the level of coercion $\tilde{g}$ needed. As a result, coercion costs $\eta\chi(\tilde{g})$ increase, while the value of the marginal product of labor in the traditional sector remains the same. Therefore, the magnitude of forced labor must decrease. The next proposition returns to the general model described in Subsection 2.1 and states the following result.

**Proposition 2.** *[Free labor demand channel] Increasing exports produced in the advanced sector reduces the use of forced labour.*

*Proof.* See Appendix A.2. □

Notice that this result captures one of the arguments in the debate on globalisation mentioned in the Introduction, namely that trade openness decreases the prevalence of forced labor by creating opportunities for the poor to obtain sustained sources of income.

Consider now an increase in the output price of the traditional sector relative to the output price of the advanced sector. This increases the value of the marginal product of labor in the traditional

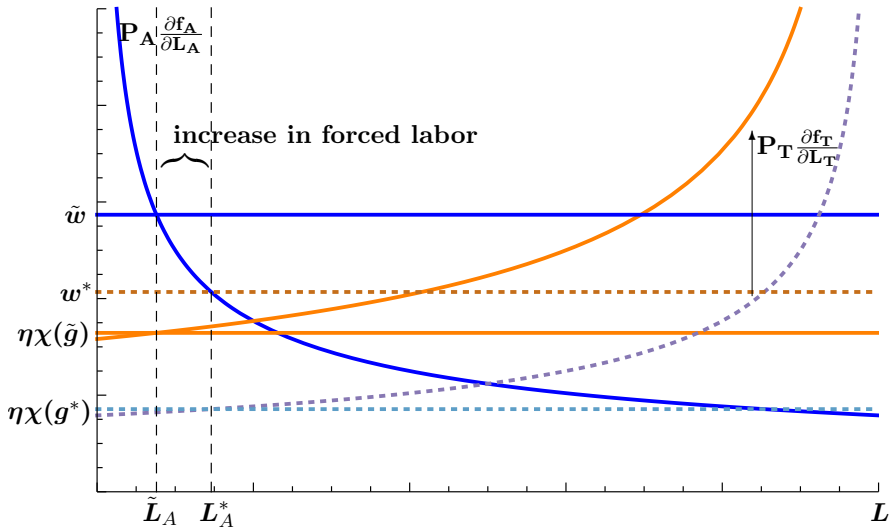


Figure 3: Forced labor demand channel

sector. Figure 3 considers again the case in which $\underline{w} = 0$ and the traditional sector relies completely on coercion, while the advanced sector only hires free labor, that is, $\alpha_A = 1 - \alpha_T = 1$. It shows an upward shift in $P_T \partial f_T / \partial L_T$ as well as the change in the equilibrium from $E^* = (L_A^*, w^*)$ to $\tilde{E} = (\tilde{L}_A, \tilde{w})$. Labor is allocated to the traditional sector until the value of its marginal product equals the cost of coercion $\eta\chi(\tilde{g})$. As a result, there is again increased competition for workers, resulting in a higher wage $\tilde{w}$, which by (7) and (8) raises both the outside option of forced laborers and the level of coercion $\tilde{g}$ needed. Since the wage increases, while the value of the marginal product of labor in the advanced sector remains the same, the prevalence of forced labor must increase. The next result drops the restriction $\alpha_A = 1 - \alpha_T = 1$ and shows that this *forced labor demand effect* is also general.[29]

**Proposition 3.** *[Forced labor demand channel] Increasing exports produced in the traditional sector increases the use of forced labour.*

*Proof.* See Appendix A.3. □

Notice that this result captures the other side of the argument in the debate on globalisation mentioned in the Introduction, namely that trade openness increases the prevalence of forced labor because the use of forced labor gives the country a competitive advantage in the export of this good.

*Trade liberalization and anti-forced labor policies.*—Trade liberalization might also affect anti-forced labor policies. Our model allows to distinguish between two types of policies, which also capture two arguments in the debate on globalisation mentioned in the Introduction. On the one hand, trade openness might lead to harmonization of institutions and regulations. Our model reflects this possibility through the parameter $\eta$ which we interpret as depending on institutions, including anti-slavery and anti-forced labor legislation that makes forced labor illegal as well as

[29] Notice that if instead of an increase in the output price there is an increase in the marginal product of labor in the traditional sector, then the same result is obtained and both forced labor and coercion increase. This is in line with Acemoglu and Wolitzky (2011, p. 557)'s model in which "more 'productive' employers will use more coercion, and thus a worker will be worse off when matched with a more productive firm."

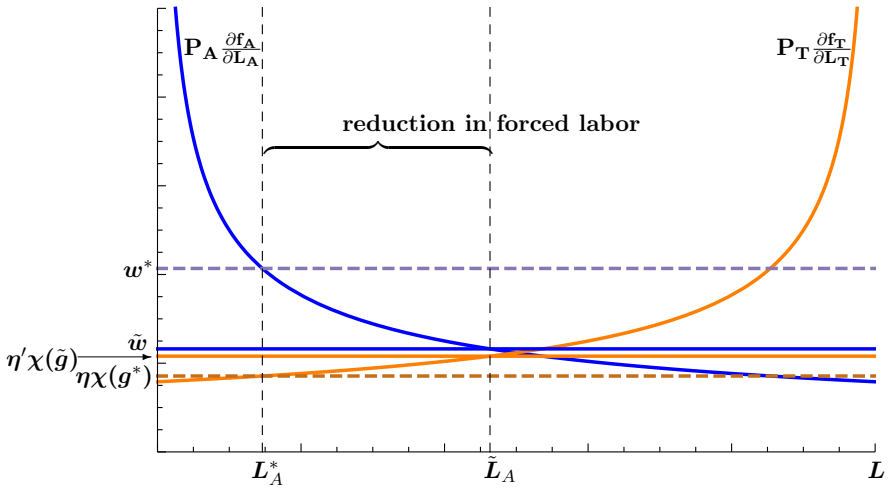


Figure 4: Effect of anti-forced labor legislation

state capacity to enforce legislation.[30] Trade openness might hence raise $\eta$ and thereby the average labor costs cost in both sectors. On the other hand, trade openness can also generate information about working conditions and trigger TISC of trading partners. Our model captures this possibility through the parameter $\alpha_i$ which we interpret as depending on the frequency and thoroughness of audits conducted.[31] Trade openness might hence raise $\alpha_i$ and thereby the average labor costs in the sector trading with these partners.

Consider first more stringent domestic anti-forced labor legislation or enforcement in the export country, that is, an increase from $\eta$ to $\eta' > \eta$. This raises the cost of coercion to $\eta'\chi(\tilde{g}) > \eta\chi(\tilde{g})$. Figure 4 considers again the case in which $\underline{w} = 0$ and the traditional sector relies completely on coercion, while the advanced sector only hires free labor, that is, $\alpha_A = 1 - \alpha_T = 1$. The figure shows an upward shift in $\eta$ as well as the change in the equilibrium from $E^* = (L_A^*, w^*)$ to $\tilde{E} = (\tilde{L}_A, \tilde{w})$. Labor is allocated to the traditional sector until the value of its marginal product equals the cost of coercion $\eta'\chi(\tilde{g})$. As a result, competition for workers and the wage $\tilde{w}$ decline as well as by (7) and (8) respectively the level of coercion $\tilde{g}$ and the outside option. Since the cost of coercion $\eta'\chi(\tilde{g})$ increases, while the value of the marginal product of labor in the traditional sector remains the same, the prevalence of forced labor must decline. The first part of Proposition 4 below shows that this effect is also general. This is so, because raising $\eta$ when the restriction $\alpha_A = 1 - \alpha_T = 1$ is dropped leads to more equal labor costs in the two sectors. Consequently the traditional sector loses more forced laborers than the advanced sector adds.

So far the analysis has implicitly assumed that the costs of forced labor are lower than paying free labor at the current wage. If $\eta$ rises beyond the level shown in Figure 4, it will quickly become cheaper to pay the wage, rather than using coercion. In such a situation, anti-forced labor legislation is successful and the economy will be in the efficient equilibrium $\tilde{E} = (\tilde{L}_A, \tilde{w})$ displayed in Figure 1. Notice, however, that even if more stringent anti-forced labor legislation or enforcement does not eliminate forced labor completely, it equalises labor costs in the two sectors. It hence corrects the

[30] "The weak capacity of the state to enact and enforce laws–and the resulting culture of impunity–has been repeatedly identified as the main cause of forced labor ..." (Belser and Andrees, 2009, p. 3).

[31] Bales (2012) describes the Rugmark Campaign. This campaign offers carpet makers a tag that guarantees that handmade rugs were not made by forced labor. To receive the tag producers have to cooperate with independent monitoring and major retailers have committed to only import carpets with the tag.

distortion in the allocation of labor partially and increases efficiency.

Consider now more stringent anti-forced labor legislation or enforcement of TISC in the import country. Suppose these measures happen in the traditional sector, so that $\alpha_T$ is raised. There is a direct and an indirect effect on the prevalence of forced labor. The direct effect is that the traditional sector needs to reduce the proportion of forced labor employed. In addition, there is an indirect effect that works in the same way as an increase in $\eta$: labor costs in the two sectors become more equal, the traditional sector loses more forced laborers than the advanced sector adds, and the prevalence of forced labor is reduced.[32]

**Proposition 4.** *[Anti-forced labor policy channel]*

1. *More stringent domestic anti-forced labor legislation and enforcement reduces the prevalence of forced labor in the export country.*

2. *More stringent anti-forced labor legislation and enforcement of TISC in the import country reduces the prevalence of forced labor in the export country.*

*Proof.* See Appendix A.4. □

To sum up, international trade increases or decreases the use of forced labor depending on the type of exports, but also the type of trading partner, as they might have different regulations and enforcement capacity. As the effect of trade is conditional on a number of observable factors, we turn now to study empirically the "trade-forced labor" link.

# 3 Empirical analysis

Propositions 2 and 3 deliver opposing effects of international trade on forced labor. Thus, whether international trade generates more opportunities in the free labor market or increases incentives to use forced labor is an empirical question, which we address by estimating the effect of exporting on a measure of forced labor. Proposition 4 offers ways to qualify this effect. Informed by this theoretical result, we study how institutions in the exporter and importer countries shape the effect of trade on forced labor.

## 3.1 Data

Appendix B describes our database in detail. As a measure of forced labor, we use the prevalence estimates constructed by Walk Free Foundation (2018), which provides cross-country information on 138 counties (listed in Appendix B) for the 2012-2016 period.[33] Despite being the most comprehensive source to study forced labor, this measure of forced labor comes with the shortcoming of including other forms of modern slavery, such as marriage and forced sexual exploitation. In Appendix C, we show that our results are robust to smaller samples for which we have more precise measures of forced labor.

Given the cross-country nature of our measure of forced labor, we follow Edmonds and Pavcnik (2006), who study the effect of trade on child labor in a similar setting. To capture the effect of exporting on forced labor, we focus on X/GDP, the ratio of exports to Gross Domestic Product

[32] In the case of TISC in the advanced sector, that is, an increase in $\alpha_A$, the direct and indirect effect go in opposite directions, because the traditional sector adds more forced laborers than the advanced sector loses. The direct effect is stronger than the indirect effect provided not many workers change the sector, see Appendix A.4.

[33] The measure is available for 167 countries. We focus our analysis on the 138 countries where we have complete data for the control variables.

(GDP), expressed in percentage terms, using data from UN Comtrade. To relate exports with our measure of forced labor, we take the average over the 2010-2015 period. During the discussion, we refer to this ratio as "trade openness".[34] Table 1 displays the descriptive statistics.

Table 1: Summary statistics

| Variable | N | Mean | S.D | Min | Max |
|---|---|---|---|---|---|
| Forced Labor (% of population) | 138 | 0.50 | 0.49 | 0.03 | 4.00 |
| X/GDP | 138 | 28.38 | 18.95 | 2.82 | 133.24 |
| X/GDP with OECD | 138 | 15.27 | 13.12 | 0.63 | 73.30 |
| X/GDP with non-OECD | 138 | 13.10 | 11.07 | 0.49 | 94.56 |
| X/GDP based on geography | 138 | 8.95 | 7.95 | 0.53 | 50.53 |
| X/GDP based on geography with OECD | 138 | 9.75 | 9.98 | 0.73 | 55.03 |
| X/GDP based on geography with non-OECD | 138 | 3.71 | 3.45 | 0.17 | 22.47 |
| Real GDP per capita (thousands 2011 USD) | 138 | 19.76 | 21.57 | 0.72 | 144.58 |
| Political Terror Scale | 138 | 2.37 | 0.99 | 1.00 | 5.00 |
| Anti-slavery Policies | 138 | 43.38 | 14.93 | 2.50 | 75.24 |
| Latitude | 138 | 20.20 | 26.12 | -44.28 | 64.15 |
| Share of rural population | 138 | 40.44 | 22.25 | 0.00 | 88.81 |
| Latin America and the Caribbean | 138 | 0.16 | 0.37 | 0.00 | 1.00 |
| Subsaharan Africa | 138 | 0.26 | 0.44 | 0.00 | 1.00 |
| Middle East and North Africa | 138 | 0.09 | 0.29 | 0.00 | 1.00 |
| South Asia | 138 | 0.04 | 0.20 | 0.00 | 1.00 |
| East Asia and Pacific | 138 | 0.14 | 0.35 | 0.00 | 1.00 |
| | | | | | |
| *Unskilled exports* | | | | | |
| X-LT1/GDP with OECD | 137 | 1.52 | 3.53 | 0.00 | 31.25 |
| X-LT1/GDP with non-OECD | 137 | 0.44 | 0.85 | 0.00 | 7.17 |
| X-LT1/GDP based on geography with OECD | 137 | 0.17 | 0.25 | 0.00 | 1.67 |
| X-LT1/GDP based on geography with non-OECD | 137 | 0.05 | 0.04 | 0.00 | 0.31 |
| X-Pri/GDP with OECD | 138 | 1.70 | 2.57 | 0.00 | 17.23 |
| X-Pri/GDP with non-OECD | 138 | 1.45 | 1.77 | 0.00 | 10.91 |
| X-Pri/GDP based on geography with OECD | 138 | 0.37 | 0.47 | 0.01 | 2.92 |
| X-Pri/GDP based on geography with non-OECD | 138 | 0.20 | 0.14 | 0.00 | 0.80 |
| X-RB/GDP with OECD | 137 | 0.70 | 0.93 | 0.00 | 3.98 |
| X-RB/GDP with non-OECD | 137 | 0.81 | 1.01 | 0.00 | 6.73 |
| X-RB/GDP based on geography with OECD | 137 | 0.21 | 0.37 | 0.00 | 2.57 |
| X-RB/GDP based on geography with non-OECD | 137 | 0.16 | 0.15 | 0.01 | 0.99 |

For the case of X-LT1 and X-RB Angola did not report the commodities classified in these categories to the United Nations.

### 3.2 Estimating equation

We begin our analysis estimating

[34] Our results remain similar if considering the more common definition of "trade openness" (exports plus imports over GDP) as in, for example, Edmonds and Pavcnik (2006) or Neumayer and De Soysa (2007). We restrict openness to just exports because it is a more natural counterpart of our theory.

$$\ln(\mathrm{FL}_i) = \beta_0 + \beta_1 \ln(\mathrm{X}_i/\mathrm{GDP}_i) + \epsilon_i, \tag{11}$$

where $\ln(\mathrm{FL}_i)$ is the log of the percentage of the population under forced labor in country $j$. $\beta_1$ represents the percentage change in the forced labor rate associated with a percentage point increase in the ratio of exports to GDP. The sign would indicate whether the effect of trade creates job opportunities to coerced workers or whether it exacerbates the demand for forced labour. Figure 5 plots this regression.

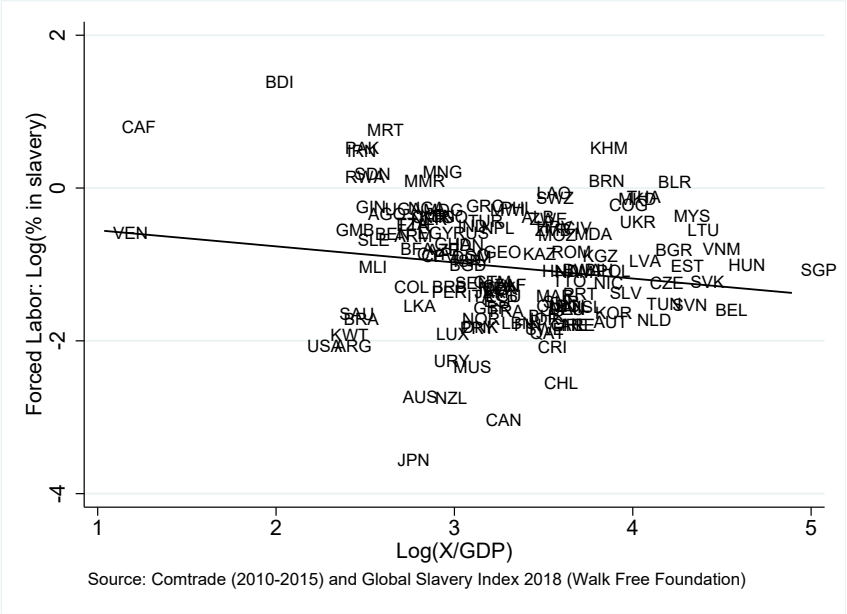


Figure 5: Forced Labor and Openness

Two features of this relationship stand out. First, more open economies exhibit less use of forced labor. Second, for any given level of X/GDP, there is considerable heterogeneity in the use of forced labor. In fact, trade openness only explains 3% of the total cross-country variation in forced labor. Thus, while the raw data suggest a negative relationship between forced labor and trade openness, the overall relevance of trade as a determinant of forced labor appears as relatively minor.

Clearly, estimating (11) requires controlling for other correlates of forced labour. For example, income per capita explains 37% of the cross-country variation in forced labor.[35] For this reason, we control for the log of GDP per capita (ln(Income)).[36] Furthermore, our theory suggests that the effect of international trade on forced labour is mediated by the quality of institutions and regulations. For this reason, we include measures on Anti-slavery Policies and the Political Terror Scale. After these inclusions, (11) becomes:

$$\begin{aligned}\ln(\mathrm{FL}_i) = \beta_0 + \beta_1 \ln(\mathrm{X}_i/\mathrm{GDP}_i) + \gamma_1 \ln(\mathrm{Income}_i) + \\ \gamma_2(\text{Anti-slavery-Pol})_i + \gamma_3(\text{Political-Terror})_i + \epsilon_i.\end{aligned} \tag{12}$$

[35] In contrast to the study on child labor in Edmonds and Pavcnik (2006), a second order polynomial of income does not increase the explanatory power of forced labor.

[36] GDP is from Penn World Tables 9.1 and is in purchasing power parity (PPP) terms (deflated with the chain index). We use real GDP on the expenditure side, intended to measure standard of living across countries (Feenstra et al. (2015))

Comparing the estimations of $\beta_1$ using (11) and (12) gives a measure of how much of the association between trade and forced labor in (11) is driven by the association between trade and income and institutions.

To test whether there is a cross-country evidence of the TISC effect uncovered by Proposition 4, we will distinguish between types of trade partners, i.e. the destination of exports. TISC have been adopted widely in OECD countries and are uncommon in non-OECD ones.[37] As a consequence, we assume that exports to OECD countries are subject to more stringent controls (higher $\alpha$'s, see Proposition 4) than exports to non-OECD countries. To explore the differential effect of a tighter regulation, we expand (11)-(12) to

$$\begin{aligned}\ln(\mathrm{FL}_i) = \beta_0 + \beta_1 \ln(\mathrm{X}_i^{\text{OECD}}/\mathrm{GDP}_i) + \beta_2 \ln(\mathrm{X}_i^{\text{non-OECD}}/\mathrm{GDP}_i) + \gamma_1 \ln(\mathrm{Income}_i) + \\ \gamma_2(\text{Anti-slavery-Pol})_i + \gamma_3(\text{Political-Terror})_i + \epsilon_i.\end{aligned} \tag{13}$$

In this specification, $\beta_1$ and $\beta_2$ have the interpretation of being the percentage change in the forced labor rate associated with a percentage point increase in the ratio of exports to GDP addressed to different types of partners, and thus subject to different TISC measures, after controlling for any effect of trade on income and institutions. As we control for countries' differences in institutions and regulation, we interpret these effects as driven by the TISC.

### 3.3 IV approach

We mitigate potential problems of endogeneity in the relationship between trade openness and forced labour by using geography as an instrument for trade openness. Following Frankel and Romer (1999), we construct a measure of trade based on geography using information on bilateral trade flows from Comtrade (United Nations) and geographical determinants of bilateral trade characteristics from the CEPII database. More specifically, we regress a measure of the log of bilateral trade between countries $i$ and $j$ (defined as $(\mathrm{X}_{ij})/(\mathrm{NGDP}_i)$) on the log of distance between the two countries, the log of country $j$'s population, the log of the product of the areas of the two countries, and indicators for whether the two countries share a border and landlocked status.[38] We conduct this regression for years 2010 to 2015 separately, yielding almost identical coefficients and $R^2$. For example, for year 2011, we obtain the following regression equation[39]

$$\begin{aligned}\ln(\mathrm{X}_{ij}/\mathrm{NGDP}_i) = \underset{(0.34)}{-8.63^{***}} - \underset{(0.03)}{1.43^{***}} \ln \text{ distance}_{ij} + \underset{(0.01)}{0.95^{***}} \ln \text{ population}_j \\ \underset{(0.01)}{-0.12^{***}} \ln(\text{area}_i * \text{area}_j) + \underset{(0.16)}{1.36^{***}} \text{common border}_{ij} - \underset{(0.05)}{1.23^{***}} \text{landlocked}_{ij} \quad .\end{aligned}$$

Trade based on geography for country $i$ is then created by exponentiating the predicted values for bilateral exports relative to GDP from the above equation and summing the predicted values for country $i$ across its trading partners. The correlation between the constructed trade based on geography and the actual trade is 0.44.

[37] Using Walk Free Foundation (2018) data on TISC by country, we note that 23 out of 34 OECD countries adopted at least one TISC. In the case of non-OECD countries, the implementation of TISC is less common (12 out of 104 countries).

[38] NGDP is nominal GDP which is used in the present case, because trade flows are also nominal.

[39] Robust standard errors are reported in parenthesis. The regressions were based on a maximum of 10,074 observations for 2011, and a minimum of 9,310 for 2015. The $R^2$ oscillated between 0.43 (2011) to 0.45 (2014).

The exclusion restriction implied by our instrumental variable regression is that geography-based trade has no relationship to forced labor except through its effect on total trade flows. This assumption might be potentially violated if a country's geography has an independent impact on forced labor. In our empirical work, we consider this concern by including relevant control variables in the specifications.[40] On the one hand, we include a country's latitude as a control. This is because the geographic characteristics of a country may be correlated with the quality of institutions or public health and hence influence outcomes (Hall and Jones, 1999; Acemoglu, Johnson and Robinson, 2001; Rodríguez and Rodrik, 2000; Easterly and Levine, 2003). On the other hand, we control for the location of the country by including indicators for whether a country is located in East Asia and Pacific, South Asia, Sub-Saharan Africa, Latin America and the Caribbean, Middle East and North Africa. The reason for this is that there is important variation in the prevalence of forced labor in various regions of the world. In addition, these regions also differ in other unobserved characteristics that could be correlated with geography. Lastly, we control for the share of the population that is rural, which is a proxy for the extent of agriculture. This is because the extent of agriculture is potentially correlated with geography and could have an impact on forced labor via the country's industry structure.

To investigate whether the effect of trade on forced labor depends on the regulations imposed by different trade partners, we construct two instruments by repeating the above methodology for OECD and non-OECD countries.

### 3.4 Empirical findings

We report the estimation of (11) and (12) in Table 2. As in Figure 5, the OLS estimation without controls suggests a negative and significant correlation between forced labor and trade openness (column 1). A percentage point increase in X/GDP is associated with a -0.21 percentage point reduction in the forced labor rate. However, this relationship becomes statistically insignificant in the IV specification (column 2) and positive (and significant) once we control for income and quality of institutions (columns 3-5) and include additional country characteristics (Latitude, Rural and Regional dummies, column 5).

[40] We consider the same controls as Edmonds and Pavcnik (2006) in their analysis on child labor.

Table 2: Forced Labor and X/GDP

| | (1) OLS | (2) IV | (3) OLS | (4) IV | (5) IV |
|---|---|---|---|---|---|
| L(X/GDP) | -0.211* | -0.129 | 0.233** | 0.724** | 0.561** |
| | (0.120) | (0.297) | (0.097) | (0.284) | (0.279) |
| L(Income) | | | -0.270*** | -0.298*** | -0.219** |
| | | | (0.050) | (0.055) | (0.088) |
| Political Terror Scale | | | 0.218*** | 0.314*** | 0.393*** |
| | | | (0.059) | (0.080) | (0.086) |
| Anti-slavery Policies | | | -0.012*** | -0.016*** | -0.026*** |
| | | | (0.005) | (0.005) | (0.006) |
| Latitude | | | | | 0.001 |
| | | | | | (0.003) |
| Rural | | | | | 0.004 |
| | | | | | (0.004) |
| Regional dummies | No | No | No | No | Yes |
| Observations | 138 | 138 | 138 | 138 | 138 |
| $R^2$ | 0.027 | 0.023 | 0.478 | 0.364 | 0.574 |
| F-stat on excluded inst. | | 24.18 | | 18.52 | 13.91 |
| First stage $R^2$ | | 0.17 | | 0.33 | 0.40 |

Standard errors in parentheses

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

Reassuringly, our estimations suggest that higher income is associated with less forced labor (i.e. the coefficient on L(Income) is negative and significant). Similarly, institutional enforcement, captured by Political Terror (a measure of general state coercion and restriction of physical integrity rights) and Anti-slavery Policies, is negatively associated with the use forced labor.[41] Conditional on income and institutions, our results suggest a positive and statistically significant association between trade and forced labor. The trade openness elasticity of forced labor ranges from 0.2 and 0.7. Taken together, our results show that engaging in international trade may reduce the use of forced labour through its impact on income or via changes in regulations. Once income and regulations are taken into account, we provide evidence suggesting that international trade enhances the use of forced labor.

As discussed above, this effect might be affected by the institutions of trading partners. To investigate this possibility, we distinguish between exports to OECD and non-OECD countries. Table 3 reports the results.

[41]The Political Terror Scale ranges from 1 to 5, where a greater value is associated with higher levels of state repression.

Table 3: Forced Labor and X/GDP by partner

| | (1) OLS | (2) IV | (3) OLS | (4) IV | (5) OLS | (6) IV | (7) IV | (8) IV | (9) IV |
|---|---|---|---|---|---|---|---|---|---|
| L(X/GDP with OECD) | -0.319*** | -0.344*** | -0.023 | 0.097 | 0.026 | -0.148 | | | |
| | (0.064) | (0.132) | (0.078) | (0.125) | (0.074) | (0.126) | | | |
| L(X/GDP with non-OECD) | 0.181* | 0.798*** | 0.079 | 0.496** | 0.107 | 0.544*** | | | |
| | (0.108) | (0.292) | (0.087) | (0.243) | (0.068) | (0.209) | | | |
| L(X-LT/GDP with OECD) | | | | | | | -0.105** | | |
| | | | | | | | (0.052) | | |
| L(X-LT/GDP with non-OECD) | | | | | | | 0.214*** | | |
| | | | | | | | (0.071) | | |
| L(X-Pri/GDP with OECD) | | | | | | | | -0.160** | |
| | | | | | | | | (0.068) | |
| L(X-Pri/GDP with non-OECD) | | | | | | | | 0.198** | |
| | | | | | | | | (0.100) | |
| L(X-RB/GDP with OECD) | | | | | | | | | -0.074 |
| | | | | | | | | | (0.052) |
| L(X-RB/GDP with non-OECD) | | | | | | | | | 0.251** |
| | | | | | | | | | (0.115) |
| L(Income) | | | -0.382*** | -0.414*** | -0.199** | -0.132 | -0.261*** | -0.183 | -0.159* |
| | | | (0.062) | (0.078) | (0.085) | (0.103) | (0.097) | (0.118) | (0.096) |
| Political Terror Scale | | | 0.212*** | 0.290*** | 0.290*** | 0.319*** | 0.262*** | 0.293*** | 0.315*** |
| | | | (0.060) | (0.071) | (0.064) | (0.071) | (0.063) | (0.066) | (0.074) |
| Anti-slavery Policies | | | -0.013*** | -0.017*** | -0.024*** | -0.021*** | -0.023*** | -0.018*** | -0.022*** |
| | | | (0.005) | (0.005) | (0.005) | (0.007) | (0.006) | (0.006) | (0.007) |
| Latitude | | | | | 0.002 | 0.008** | 0.003 | 0.004 | 0.009** |
| | | | | | (0.004) | (0.004) | (0.003) | (0.004) | (0.004) |
| Rural | | | | | 0.006 | 0.003 | 0.005 | 0.005 | 0.003 |
| | | | | | (0.004) | (0.004) | (0.004) | (0.004) | (0.004) |
| Regional dummies | No | No | No | No | Yes | Yes | Yes | Yes | Yes |
| Observations | 138 | 138 | 138 | 138 | 138 | 138 | 137 | 138 | 137 |
| $R^2$ | 0.139 | -0.203 | 0.474 | 0.389 | 0.653 | 0.524 | 0.528 | 0.568 | 0.516 |
| F-stat on excluded inst. (OECD eq.) | | 112.60 | | 30.72 | | 35.78 | 25.62 | 13.47 | 28.16 |
| First stage $R^2$ (OECD eq.) | | 0.59 | | 0.62 | | 0.68 | 0.57 | 0.44 | 0.63 |
| F-stat on excluded inst. (non-OECD eq.) | | 10.04 | | 8.76 | | 8.94 | 28.08 | 10.93 | 10.52 |
| First stage $R^2$ (non-OECD eq.) | | 0.14 | | 0.18 | | 0.31 | 0.42 | 0.43 | 0.43 |

Standard errors in parentheses
* p<0.1, ** p<0.05, *** p<0.01

Several interesting findings emerge from this additional analysis. First, in the regressions without controls, the association between forced labor and trade with OECD countries is negative and statistically significant (columns 1-2). Second, conditional on income and institutions, the coefficient on trade with OECD becomes statistically insignificant (columns 3-4). This is also the case after including our additional controls such as latitude, the share of rural population and regional indicators (column 5-6). In contrast, trading with non-OECD countries appears as positive and significant in most specifications. The implied elasticity of forced labor for trade with non-OECD countries is in the ballpark of the ones obtained using total trade.

These results indicate that the forced labor demand channel, i.e. the incremental effect of trade on forced labor, that we evidenced for the aggregate openness estimates on Table 2 is driven by openness with non-OECD countries. Moreover, we saw that more trade with OECD countries has no effect on forced labor after accounting for income and institutions.

A potential limitation of our analysis is that the measure of trade involves all products. However, the relationship between trade and forced labor is likely to be more salient for unskilled labor-intensive goods produced in relatively poor countries. In fact, the products appearing the most frequently in the 2016 US Department of Labor list of goods produced using forced labor (Walk Free Foundation, 2018, p. 103) are either labor-intensive or primary goods.[42] For this reason, we turn our focus to labor-intensive products (denoted by X-LT, e.g. textile, garment, footwear), primary exports (denoted by X-Pri, e.g. cotton, rice, cattle, wood, fish), and labour-intensive manufactures for which their competitive advantage is based on the local availability of natural resources (denoted by X-RB, e.g. prepared meats/fruits, beverages, wood products, vegetable oils). We express each category of unskilled-labor intensive exports as a share of GDP, and construct our instruments following the procedure described in Section 3.3. Columns 7-9 report the results for the specification with the full set of controls.

We find that unskilled-labor intensive exports to OECD are negatively and significantly associated with forced labor in the majority of the specifications (columns 7-8). Also, the coefficients of unskilled-labour intensive exports with non-OECD countries appear as positive and significant. These results suggest that trading with OECD countries, even in unskilled labor intensive goods, can reduce the use of forced labor. This is consistent with the TISC channel established in Proposition 4. In this sense, we provide evidence attenuating concerns about trade enhancing the use of forced labor: the positive association is confined to non-OECD countries that appear as having lighter TISC regulations.

# 4 Conclusions

In this paper we explore the link between trade liberalization and forced labor theoretically and empirically. We provide a theoretical framework predicting that the net effect of trade on the use of forced labor depends on which sectors improve their relative terms of trade: forced-labor-intensive goods or free-labor-intensive goods. Similarly, we show that if openness to trade triggers anti-forced labor policies in the country (policy channel) or by trade partners (supply chains channel), then the prevalence of forced labor also decreases. These countervailing forces are consistent, on one hand, with calls for import prohibitions on products made using forced labor and, on the other hand, with the hope that trade opportunities induce economic progress. Our empirical analysis provides causal evidence on these countervailing forces in a cross-country setting through an instrumental variable approach. We find that after accounting for the relation between trade and income and

[42]These products include cotton, bricks, garments, cattle and sugarcane, gold, carpets, coal, fish, rice, timber, Brazil nuts/chestnuts, cocoa and diamonds.

institutions, there is a cross-country evidence of the forced labor demand channel: an increases in country's openness increases the use of forced labor. In this sense, our findings provide support for the demands of anti-slavery activists: international trade can increase the use of forced labor. However, as trade is associated with higher income and better institutions, when considering trade at an aggregate level we cannot conclude that the forced labor demand channel dominates the other channels through which trade may reduce the use of forced labor.

We also show that the effect of trade on forced labor depends on the type of trade-partner and export goods considered. On the one hand, the detrimental effect of trade is only present through trade with non-OECD countries. This effect is present before and after accounting for the link between trade and income/institutions. From this we conclude that the forced labor demand channel dominates in this type of trade: more openness with non-OECD countries increases the use of forced labor. On the other hand, we do not find a positive relationship between trade with OECD countries and forced labor. Moreover, when involving unskilled labor-intensive exports, trade with OECD partners is negatively associated with the use of forced labor. This reflects the TISC measures of developed countries, that is, the higher quality of labor-standards that OECD countries impose on their trading partners. These results are suggestive that anti-slavery pressures, mostly focused on OECD countries, might be effective in mitigating the potentially pro-slavery effect of international trade. The case of the United Kingdom presents a fascinating example of a country that has just left an OECD-dominated trading bloc (the European Union), has a national level anti-slavery law (the 2015 Modern Slavery Act), and seeks to craft new trade agreements with both OECD and non-OECD countries. Our findings here suggest that the UK government will continue to be influenced by its own domestic anti-slavery policy, embed EU and other OECD anti-slavery policies, and may lead by example by including anti-slavery measures in its new non-OECD trade agreements.

This work provides the first cross-country analysis showing a significant effect of international trade on forced labor using the best data available. As we explain, "best" does not mean "accurate". The limitations of our analysis reveal how important it is to generate more reliable and disaggregated measures of forced labor. This is a challenge that requires joint efforts between countries and multilateral organizations. Our results show that investments in this direction may be worthwhile to get a deeper understanding of the problem and to inform policy.

# A Appendix: Proofs

## A.1 Proof of Proposition 1

Conditions (10) can be rewritten as

$$\frac{\partial f_i}{\partial L_i} = \frac{h_i(w)}{P_i}. \tag{14}$$

Since $\partial f_i/\partial L_i$ is differentiable and strictly decreasing in $L_i$, it has an inverse function $b_i$, which is strictly decreasing and differentiable at any interior point. Hence

$$L_i = b_i\left[\frac{h_i(w)}{P_i}\right]. \tag{15}$$

Consider the function

$$\Lambda(w) = L - \Sigma_{i\in\{A,T\}} b_i\left[\frac{h_i(w)}{P_i}\right]. \tag{16}$$

Under our assumptions $\Lambda(w)$ is continuous. Also, for $w = \underline{w}$ we have that $b_i(\cdot) > L$, since $\underline{w}$ is assumed to be close to zero. Hence $\Lambda(\underline{w}) < 0$. On the other hand, for $w \to \infty$, $b_i(\cdot) \to 0$, so that $\Lambda(w) > 0$. We can apply Bolzano's Theorem and conclude that there exists $w > \underline{w}$ such that $\Lambda(w) = 0$. This implies that (2) holds and hence an equilibrium exists. Moreover, by the properties of $h_i(\cdot)$ and $b_i(\cdot)$ we have that $\Lambda(w)$ is strictly increasing. Thus the equilibrium is unique. Since $w > \underline{w}$, by (7) $g^*(w) > 0$ and $h_A(\alpha_A, \eta, w) > h_T(\alpha_T, \eta, w) > 0$. This implies that the equilibrium is inefficient. In addition, the right hand sides of (15) are strictly positive. Therefore $L_i > 0$ and hence $(1-\alpha_T)L_T > 0$ as well as $y_i > 0$ for $i = A, T$.

## A.2 Proof of Proposition 2

The following Lemma is useful in the proofs of Propositions 2 and 3.

**Lemma 1.** *Let $B_i = \alpha_i + (1-\alpha_i)\eta\frac{\partial\chi}{\partial g^*}\frac{\partial g^*}{\partial w}$ for $i = A, T$. We have that*

$$\frac{\partial L_i}{\partial P_i} = \frac{-\frac{\partial f_i}{\partial L_i}B_j}{P_i\frac{\partial^2 f_i}{\partial (L_i)^2}B_j + P_j\frac{\partial^2 f_j}{\partial (L_j)^2}B_i} > 0 \quad \textit{and} \quad \frac{\partial L_j}{\partial P_i} = -\frac{\partial L_i}{\partial P_i} < 0 \quad \textit{for} \quad i = A, T. \tag{17}$$

*Proof.* Consider condition (2). Since the conditions of the implicit function theorem are fulfilled, we can write $L_i$ as a function of $L_j$ and differentiate with respect to $L_j$. This yields

$$\frac{dL_i}{dL_j} = -1. \tag{18}$$

Consider condition (10) and notice that the conditions of the implicit function theorem are satisfied. Differentiating (10) with respect to $P_k$, where $k = i, j$, and rearranging, we obtain

$$\frac{\partial w}{\partial P_k} = \frac{\frac{dP_i}{dP_k}\frac{\partial f_i}{\partial L_i} + P_i\frac{\partial^2 f_i}{\partial (L_i)^2}\frac{\partial L_i}{\partial P_k}}{B_i}, \tag{19}$$

where $dP_i/dP_k \in \{0, 1\}$. By symmetry we obtain a similar expression for sector $j$. Equalizing these expressions and assuming that $k = i$ yields the expression for $\partial L_i/\partial P_i$ in (17), where the strict inequality follows from the fact that under our assumptions all terms are strictly positive with the exception of the second order partial derivatives, which are strictly negative. Using (18) the expression for $\partial L_j/\partial P_i$ follows. □

We are now in a position to prove Proposition 2. Differentiating (4) with respect to $P_A$ and using the second expression in (17) yields

$$\frac{\partial S}{\partial P_A} = (1-\alpha_A)\frac{\partial L_A}{\partial P_A} + (1-\alpha_T)\frac{\partial L_T}{\partial P_A} = -(\alpha_A - \alpha_T)\frac{\partial L_A}{\partial P_A} < 0, \tag{20}$$

as $\alpha_A > \alpha_T$ under our assumptions and $\partial L_A/\partial P_A > 0$ by Lemma 1.

### A.3 Proof of Proposition 3

Differentiating (4) with respect to $P_T$ yields

$$\frac{\partial S}{\partial P_T} = (1-\alpha_A)\frac{\partial L_A}{\partial P_T} + (1-\alpha_T)\frac{\partial L_T}{\partial P_T} = (\alpha_A - \alpha_T)\frac{\partial L_T}{\partial P_T} > 0, \tag{21}$$

where we have used that $\alpha_A > \alpha_T$ under our assumptions and $\partial L_T/\partial P_T = -\partial L_A/\partial P_T > 0$ by Lemma 1 in Appendix A.2.

### A.4 Proof of Proposition 4

Consider the first part of the proposition. Consider condition (10) and notice that the conditions of the implicit function theorem are satisfied. Differentiating (10) with respect to $\eta$ we obtain

$$P_i \frac{\partial^2 f_i}{\partial (L_i)^2}\frac{\partial L_i}{\partial \eta} = \alpha_i \frac{\partial w}{\partial \eta} + (1-\alpha_i)\left\{\chi[g^*(w)] + \eta \frac{\partial \chi}{\partial g^*}\frac{\partial g^*}{\partial w}\frac{\partial w}{\partial \eta}\right\}. \tag{22}$$

Rearranging yields

$$\frac{\partial w}{\partial \eta} = \frac{P_i \frac{\partial^2 f_i}{\partial (L_i)^2}\frac{\partial L_i}{\partial \eta} - (1-\alpha_i)\chi[g^*(w)]}{B_i}, \tag{23}$$

where $B_i$ is defined in Lemma 1 in Appendix A.2. Equating (23) for both sectors and solving for $\partial L_i/\partial \eta$ yields

$$\frac{\partial L_i}{\partial \eta} = \frac{(\alpha_j - \alpha_i)\chi[g^*(w)]}{P_i \frac{\partial^2 f_i}{\partial (L_i)^2} B_j + P_j \frac{\partial^2 f_j}{\partial (L_j)^2} B_i} < 0 \Leftrightarrow \alpha_j > \alpha_i, \tag{24}$$

where the strict inequality follows from the fact that all terms are strictly positive with the exception of the second order partial derivatives, which are strictly negative. It follows that $\partial L_A/\partial \eta = -\partial L_T/\partial \eta > 0$. Hence from (23) we obtain that $\partial w/\partial \eta < 0$. Differentiating (4) with respect to $\eta$ yields

$$\frac{\partial S}{\partial \eta} = (1-\alpha_A)\frac{\partial L_A}{\partial \eta} + (1-\alpha_T)\frac{\partial L_T}{\partial \eta} = -(\alpha_A - \alpha_T)\frac{\partial L_A}{\partial \eta} < 0, \tag{25}$$

Consider the second part of the proposition. We prove a more general statement that covers increases in $\alpha$ in both sectors. Differentiating (10) with respect to $\alpha_k$, where $k = i, j$, and rearranging, we obtain

$$\frac{\partial w}{\partial \alpha_k} = \frac{P_i \frac{\partial^2 f_i}{\partial (L_i)^2}\frac{\partial L_i}{\partial \alpha_k} + \frac{d\alpha_i}{d\alpha_k}\{\underline{w} + \eta\chi[g^*(w)] - w\}}{B_i}, \tag{26}$$

where $d\alpha_i/d\alpha_k \in \{0, 1\}$. By symmetry we obtain a similar expression for sector $j$. Equalizing these expressions assuming that $k = i$ and using (18) yields

$$\frac{\partial L_i}{\partial \alpha_i} = \frac{B_j\{w - \underline{w} - \eta\chi[g^*(w)]\}}{P_i \frac{\partial^2 f_i}{\partial (L_i)^2} B_j + P_j \frac{\partial^2 f_j}{\partial (L_j)^2} B_i} < 0, \tag{27}$$

and $\partial L_j/\partial \alpha_i = -\partial L_i/\partial \alpha_i > 0$, where again the strict inequalities follow from the fact that all terms are strictly positive with the exception of the second order partial derivatives, which are strictly negative. Notice that this and (26) imply that $\partial w/\partial \alpha_i < 0$. Differentiating (4) with respect to $\alpha_i$ yields

$$\frac{\partial S}{\partial \alpha_i} = -L_i + (1-\alpha_i)\frac{\partial L_i}{\partial \alpha_i} + (1-\alpha_j)\frac{\partial L_j}{\partial \alpha_i} = -L_i + (\alpha_j - \alpha_i)\frac{\partial L_i}{\partial \alpha_i}. \tag{28}$$

Hence, $\partial S/\partial \alpha_T < 0$ and $\partial S/\partial \alpha_A < 0$ if and only if $\partial L_A/\partial \alpha_A > -L_A/(\alpha_A - \alpha_T)$. The latter condition implies that an increase in $\alpha_A$ reduces the prevalence of forced labor if and only if the share of the workers in the advanced sector is sufficiently inelastic with respect to changes in $\alpha_A$, that is,

$$\frac{\partial L_A}{\partial \alpha_A}\frac{\alpha_A}{L_A} > -\frac{\alpha_A}{\alpha_A - \alpha_T}. \tag{29}$$

# B Appendix: Data description

*Forced Labor*: We use the prevalence estimates of modern slavery from Walk Free Foundation (2018), defined as "the average number of persons in modern slavery at a given point in time during 2012-2016" (Walk Free Foundation, 2018, p. 167). "The regional estimates produced in ILO (2017a) form the starting point for the national level estimates presented here for 167 countries. These national estimates were calculated using individual and country-level risk factors of modern slavery. The analysis draws on data from nationally representative surveys implemented through the Gallup World Poll, including a module on modern slavery in 48 countries, and data from the Global Slavery Index Vulnerability Model. The final set of risk factors were selected from an exhaustive list of variables to optimally predict confirmed cases of forced labor and forced marriage. The model was then used to generate average predicted probabilities of modern slavery by country. The regional totals in the 2017 Global Estimate were then apportioned based on each country's average predicted probability of modern slavery. A final calculation accounting for state imposed forced labor was performed to reach the final estimated prevalence of all forms of modern slavery" (Walk Free Foundation, 2018, p. 8).
X/GDP: Exports as a share of GDP, 2010-2015 (Source: Comtrade, United Nations).
*Income per capita*: Expenditure-side real GDP at current PPPs (2011 USD) (Source: Penn World Tables 9.1).
*Bilateral Trade*: Bilateral exports and imports in thousands current US$, 2010-2015 (Source: Comtrade, United Nations).
*Nominal GDP (NGDP)*: Nominal GDP in thousands current US$, 2010-2015 (Source: WDI).
*Geographical variables*: Bilateral distance, landlocked status, indicators for common border, common language (Source: CEPII).
*Political Terror Scale*: We use the Political Terror Scale average scores for years 2010-2016 based on Amnesty International's annual human rights reports. For six countries where this measure is missing we use the Political Terror Scale average scores based on the US Department of State. (Source: Political Terror Scale).
*Anti-slavery Polices*: This index provides a comparative assessment of the legal, policy, and programmatic actions that 181 governments are taking to respond to modern slavery. This is based on data collected on 104 indicators for each country (Source: Walk Free Foundation (2018)).
*Latitude*: A country's distance from equator (Source: CEPII).
*Rural and total population*: Rural population as a percent of total population, and total population (Source: WDI).
*Regional dummies*: based on the ILO (2017a) regions.

*Countries in the database*: Albania (ALB), Algeria (DZA), Angola (AGO), Argentina (ARG), Armenia (ARM), Australia (AUS), Austria (AUT), Azerbaijan (AZE), Bahrain (BHR), Bangladesh (BGD), Barbados (BRB), Belarus (BLR), Belgium (BEL), Benin (BEN), Bolivia (BOL), Bosnia and Herzegovina (BIH), Botswana (BWA), Brazil (BRA), Brunei (BRN), Bulgaria (BGR), Burkina Faso (BFA), Burundi (BDI), Cabo Verde (CPV), Cambodia (KHM), Cameroon (CMR), Canada (CAN), Central African Republic (CAF), Chile (CHL), China (CHN), Colombia (COL), Congo, Rep. (COG), Costa Rica (CRI), Cote d'Ivoire (CIV), Croatia (HRV), Cyprus (CYP), Czech Republic (CZE), Denmark (DNK), Dominican Republic (DOM), Ecuador (ECU), Egypt, Arab Rep. (EGY), El Salvador (SLV), Estonia (EST), Ethiopia (excludes Eritrea) (ETH), Finland (FIN), France (FRA), Georgia (GEO), Germany (DEU), Ghana (GHA), Greece (GRC), Guatemala (GTM), Guinea (GIN), Honduras (HND), Hungary (HUN), Iceland (ISL), India (IND), Indonesia (IDN), Iran, Islamic Rep. (IRN), Ireland (IRL), Israel (ISR), Italy (ITA), Jamaica (JAM), Japan

(JPN), Jordan (JOR), Kazakhstan (KAZ), Kenya (KEN), Korea, Rep. (KOR), Kuwait (KWT), Kyrgyz Republic (KGZ), Lao PDR (LAO), Latvia (LVA), Lebanon (LBN), Lesotho (LSO), Lithuania (LTU), Luxembourg (LUX), Macedonia, FYR (MKD), Madagascar (MDG), Malawi (MWI), Malaysia (MYS), Mali (MLI), Mauritania (MRT), Mauritius (MUS), Mexico (MEX), Moldova (MDA), Mongolia (MNG), Morocco (MAR), Mozambique (MOZ), Myanmar (MMR), Namibia (NAM), Nepal (NPL), Netherlands (NLD), New Zealand (NZL), Nicaragua (NIC), Niger (NER), Nigeria (NGA), Norway (NOR), Oman (OMN), Pakistan (PAK), Panama (PAN), Paraguay (PRY), Peru (PER), Philippines (PHL), Poland (POL), Portugal (PRT), Qatar (QAT), Romania (ROU), Russian Federation (RUS), Rwanda (RWA), Saudi Arabia (SAU), Senegal (SEN), Sierra Leone (SLE), Singapore (SGP), Slovak Republic (SVK), Slovenia (SVN), South Africa (ZAF), Spain (ESP), Sri Lanka (LKA), Sudan (SDN), Suriname (SUR), Swaziland (SWZ), Sweden (SWE), Switzerland (CHE), Tanzania (TZA), Thailand (THA), The Gambia (GMB), Togo (TGO), Trinidad and Tobago (TTO), Tunisia (TUN), Turkey (TUR), Uganda (UGA), Ukraine (UKR), United Arab Emirates (ARE), United Kingdom (GBR), United States (USA), Uruguay (URY), Venezuela (VEN), Vietnam (VNM), Zambia (ZMB), Zimbabwe (ZWE).

# C Appendix: Data Limitations

## C.1 Random Sample

The set of surveyed countries that was used to produce ILO (2017a) was treated as a random sample of the world and the global figure was estimated directly from that (that is, without first calculating national estimates).[43] However, the selection of the countries to be surveyed was not random as countries were selected for specific reasons. The countries were selected within the following framework according to (ILO, 2017a, p. 80):

1) belonging to the set of 143 countries covered by the World Poll conducted annually by Gallup Inc.;
2) survey interviewing carried out using face-to-face interviewing; and
3) consent of national authorities to the module on forced labor and forced marriage.

"Within this framework, the countries were selected such that the total set of national surveys included at least two countries per ILO broad sub-region and represented a substantial part of the sub-region population. The idea behind this selection procedure was to mimic as closely as possible a stratified random sample of countries where the strata are the 11 ILO broad sub-regions and the random selection scheme is probability proportional to size with size measured in terms of the working age population (15 years old and over). In practice, it was possible to implement the specified requirements in all sub-regions except the North America sub-region where no national surveys could be conducted. Also, in certain other sub-regions, substitution had to be made as the consent of some selected countries could not be obtained in time for the preparation of the fieldwork." (ILO, 2017b, p. 80).

Based on this limitation, we restrict the sample to the 45 countries where national representative surveys where conducted and we have complete data for the control variables.[44] An alternative to IV would be to just look at the relationship between openness based on geography and forced labor. This reduced form captures the exact source of variation in trade that we are using for identification.[45] In this case, we consider this reduced form analysis for the small sample of surveyed countries. We present the results in Table 4 below for the specification that includes all the control variables included in the main text.[46] The first column shows the results when X/GDP based on geography is used. More openness based on geography with OECD countries decreases the forced labor rate, whereas more openness based on geography with non-OECD increases it. Both coefficients are statistically significant. Finally, columns 2-4 show the same model but using unskilled-exports based on geography rather than openness. In this case, the results are similar. More unskilled-exports to OECD decreases the rate of forced labor in every unskilled category considered, and the coefficients are statistically significant. On the other hand, more unskilled-exports to non-OECD increases forced labor, but the effect is only significant for products related to the garment industry, X-LT. In sum, these results give support to the findings presented when the whole sample is considered.

[43] See the discussion of this issue at https://delta87.org/2018/12/symposium-modelling-modern-slavery-risk/, accessed on 04/02/2021.

[44] We lose three countries with modern slavery measure based on national surveys because of missing data on the regressors.

[45] We choose to follow convention in the main text and focus on IV results rather than the reduced forms to show the results, but in practice, this decision is not substantive to our main findings.

[46] For the regional dummies, we use 3 regions instead of 6, to reduce the number of regressors for this small sample. We also construct our instrument based on the data from these 45 countries.

Table 4: Forced Labor and X/GDP - Survey Countries

| | (1) OLS | (2) OLS | (3) OLS | (4) OLS |
|---|---|---|---|---|
| L(X/GDP based on geo with OECD) | -0.488** | | | |
| | (0.152) | | | |
| L(X/GDP based on geo with non-OECD) | 0.092** | | | |
| | (0.026) | | | |
| L(X-LT/GDP based on geo with OECD) | | -0.421*** | | |
| | | (0.084) | | |
| L(X-LT/GDP based on geo with non-OECD) | | 0.166* | | |
| | | (0.068) | | |
| L(X-Pri/GDP based on geo with OECD) | | | -0.397** | |
| | | | (0.118) | |
| L(X-Pri/GDP based on geo with non-OECD) | | | 0.047 | |
| | | | (0.113) | |
| L(X-RB/GDP based on geo with OECD) | | | | -0.290** |
| | | | | (0.065) |
| L(X-RB/GDP based on geo with non-OECD) | | | | 0.069 |
| | | | | (0.097) |
| L(Income) | -0.052 | -0.030 | -0.183* | -0.124 |
| | (0.082) | (0.066) | (0.066) | (0.064) |
| Political Terror Scale | 0.015 | 0.125 | 0.091 | 0.132* |
| | (0.035) | (0.062) | (0.058) | (0.051) |
| Anti-slavery Policies | -0.012 | -0.009 | -0.014 | -0.012 |
| | (0.006) | (0.007) | (0.008) | (0.008) |
| Latitude | 0.018** | 0.017** | 0.014** | 0.014** |
| | (0.005) | (0.004) | (0.005) | (0.005) |
| Rural | 0.004 | 0.004 | 0.002 | 0.002 |
| | (0.005) | (0.004) | (0.006) | (0.006) |
| Regional dummies | Yes | Yes | Yes | Yes |
| Observations | 45 | 45 | 45 | 45 |
| $R^2$ | 0.657 | 0.682 | 0.656 | 0.671 |

Standard errors in parentheses

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

## C.2 Forced Labor and Modern Slavery

While our study aims to shed light on the link between trade and forced labor, the measure of forced labor used includes people in forced marriage and forced sexual exploitation. To conduct a robustness check in this respect we apply the methodology used by Walk Free Foundation (2018) in their estimation of the modern slavery cross-country measure, but restrict it to forced labor in the private economy and state-imposed forced labor. We were not able to apply the complete methodology because not all the necessary data are accessible; hence, our constructed measure represents an approximation.[47]

We replicate the IV analysis of the main text using our constructed measure of forced labor (FL) on one hand, and the remaining forms of modern slavery (OMS) on the other. Table 5 presents the results for the specifications that include all the controls. The first column uses FL as dependent variable and shows a negative and a statistically insignificant relationship between openness with OECD countries and forced labor. On the other hand, the coefficient of openness with non-OECD countries is positive and statistically significant. These results are in line with the ones of presented in Table 3. On the other hand, when we consider OMS as dependent variable (column 5), neither form of trade has a statistically significant effect. Finally, similar results are obtained when we consider unskilled-exports (column 2-4 and 6-8). The effects of unskilled exports on OMS are not statistically significant (column 6-8), whereas unskilled-exports to non-OECD countries increases our measure of forced labor (column 2-4). On the other hand, unskilled exports to OECD reduces the use of forced labor for Primary products (column 3).

[47]The Global Slavery Index is based on 11 sub-regional measures taken from ILO (2017a) that are later disaggregated using the risk model of forced labor from Diego-Rosell and Joudo Larsen (2018). Since ILO (2017a) only made available 5 regional measures in the report, i.e. not the 11 sub-regions measures that formed the basis of the Global Slavery Index estimations, we were able to disaggregate these 5 aggregate regional measures using the risk model of Diego-Rosell and Joudo Larsen (2018).

Table 5: Forced Labor (FL)/ Other forms of Modern Slavery (OMS)

| | (FL) IV | (FL) IV | (FL) IV | (FL) IV | (OMS) IV | (OMS) IV | (OMS) IV | (OMS) IV |
|---|---|---|---|---|---|---|---|---|
| L(X/GDP with OECD) | -0.184 | | | | 0.265 | | | |
| | (0.234) | | | | (0.204) | | | |
| L(X/GDP with non-OECD) | 0.814** | | | | -0.061 | | | |
| | (0.351) | | | | (0.277) | | | |
| L(X-LT/GDP with OECD) | | -0.148 | | | | 0.147 | | |
| | | (0.109) | | | | (0.104) | | |
| L(X-LT/GDP with non-OECD) | | 0.335*** | | | | -0.020 | | |
| | | (0.120) | | | | (0.101) | | |
| L(X-Pri/GDP with OECD) | | | -0.239* | | | | 0.154 | |
| | | | (0.135) | | | | (0.106) | |
| L(X-Pri/GDP with non-OECD) | | | 0.260* | | | | 0.019 | |
| | | | (0.144) | | | | (0.110) | |
| L(X-RB/GDP with OECD) | | | | -0.072 | | | | 0.076 |
| | | | | (0.077) | | | | (0.072) |
| L(X-RB/GDP with non-OECD) | | | | 0.379*** | | | | 0.025 |
| | | | | (0.139) | | | | (0.123) |
| L(Income) | -0.380* | -0.645*** | -0.459** | -0.482*** | -0.118 | -0.082 | -0.034 | -0.083 |
| | (0.210) | (0.202) | (0.200) | (0.174) | (0.169) | (0.195) | (0.180) | (0.172) |
| Political Terror | 0.458*** | 0.409*** | 0.372*** | 0.479*** | 0.182 | 0.139 | 0.156 | 0.163 |
| | (0.104) | (0.091) | (0.100) | (0.119) | (0.125) | (0.112) | (0.118) | (0.131) |
| Anti-slavery Pol | -0.005 | -0.006 | -0.001 | -0.007 | -0.028*** | -0.030*** | -0.029*** | -0.030*** |
| | (0.009) | (0.009) | (0.009) | (0.010) | (0.006) | (0.007) | (0.007) | (0.007) |
| Latitude | 0.009 | 0.002 | 0.004 | 0.012* | 0.001 | 0.007 | 0.007 | 0.005 |
| | (0.007) | (0.005) | (0.005) | (0.006) | (0.005) | (0.005) | (0.006) | (0.006) |
| Rural | -0.006 | -0.007 | -0.004 | -0.010 | 0.009 | 0.002 | 0.009 | 0.008 |
| | (0.008) | (0.009) | (0.008) | (0.008) | (0.008) | (0.009) | (0.008) | (0.008) |
| Regional dummies | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 128 | 127 | 128 | 127 | 128 | 127 | 128 | 127 |
| $R^2$ | 0.349 | 0.365 | 0.312 | 0.331 | 0.515 | 0.492 | 0.457 | 0.484 |
| F-stat on excluded inst. (OECD eq.) | 31.76 | 19.18 | 8.43 | 26.13 | 31.76 | 19.18 | 8.43 | 26.13 |
| First stage $R^2$ (OECD eq.) | 0.69 | 0.57 | 0.38 | 0.66 | 0.69 | 0.57 | 0.38 | 0.66 |
| F-stat on excluded inst. (non-OECD eq.) | 8.13 | 22.83 | 10.56 | 9.26 | 8.13 | 22.83 | 10.56 | 9.26 |
| First stage $R^2$ (non-OECD eq.) | 0.28 | 0.42 | 0.43 | 0.45 | 0.28 | 0.42 | 0.43 | 0.45 |

Standard errors in parentheses
* p<0.1, ** p<0.05, *** p<0.01

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