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Abstract

This paper studies how cross-country differences in labor market institutions shape the pattern of international trade, focusing on workers' skill acquisition. I develop a model in which workers undertake non-contractible activities to acquire firm-specific skills on the job. In the model, workers have more incentive to acquire firm-specific skills relative to general skills in a more protective labor market. When sectors are different in the dependence on these two types of skills, workers' skill acquisition turns labor laws into a source of comparative advantage. By embedding the model in an open-economy framework with heterogeneous firms, sectors with different levels of dependence on firm-specific skills, and countries with varying degrees of labor protection, I show that countries with more protective labor laws export relatively more in firm-specific skill-intensive sectors through both the intensive and extensive margins of trade. I then estimate returns to firm tenure for different U.S. manufacturing sectors over the period of 1974-1993, and use the estimates as sector proxies for firm-specific skill intensity to test the theoretical predictions. By implementing the Helpman-Melitz-Rubinstein (2008) framework to estimate sector-level gravity equations for 84 countries in 1995, I find supporting evidence for the predicted effects of labor market institutions on both margins of trade.

Keywords: Labor market institutions, heterogeneous firms, margins of trade, trade patterns, firm-specific skills

JEL Classification: F10, F12, F14, F16, L22, J24

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1 Introduction

Recent research in international trade shows that contracting and legal institutions of a country can shape its comparative advantage.[1] Labor market institutions, which also vary widely across countries, receive relatively less attention in the studies on international trade patterns. While there is an extensive strand of research examining how labor market regulations are linked to labor market outcomes, few have examined their effects on workers' investment decisions. Even less has been said about how such effects can in turn determine a country's comparative advantage.[2]

This paper fills this void by studying how cross-country differences in labor market institutions are related to the pattern of trade. In particular, I focus on the channel through which labor market institutions affect workers' on-the-job skill acquisition. The idea is that when labor laws become more protective, workers obtain a higher de facto bargaining power with respect to their employers, and thus have more incentive to acquire firm-specific skills relative to general skills on the job. Thus, countries with more protective labor laws have a comparative advantage in sectors for which firm-specific skills are more important. I test this hypothesis by estimating the gravity equation at the sector level, and find evidence that countries with more protective labor laws export relatively more in firm-specific skill-intensive sectors.

A simple model is constructed to highlight how protective labor laws, by enhancing workers' bargaining power, induce workers to acquire firm-specific skills. In the model, both general and firm-specific skills can enhance a worker's productivity. The level of general skills is exogenously given, whereas the level of firm-specific skills is determined by workers' on-the-job skill acquisition. The activities of skill acquisition are non-contractible, such that employers are unable to impose their preferred levels of investments on their workers. Thus, the combination of non-contractibility and relationship-specificity of investments results in ex-post bargaining over the division of joint surplus between the employer and the workers. Anticipating payoffs from ex-post bargaining, workers acquire firm-specific skills. Since workers are not the full residual claimants of the gains from investments, a hold-up problem arises, resulting in under-investment in firm-specific skills relative to the first-best level under complete contracts. In this environment, despite the associated well-known inefficiencies, stringent labor laws raise workers' bargaining power and can actually alleviate some of the under-investment problem. These effects of labor laws on firm productivity are more pronounced for more specific skill-intensive sectors, and therefore act as a potential source of comparative advantage.

I embed the model in an open-economy framework of trade in differentiated products based on Helpman, Melitz and Yeaple (2004). In the model, firms vary by productivity, sectors differ in their levels of dependence on firm-specific skills, and countries have different degrees of labor protection.

[1] This literature includes Levchenko (2007), Nunn (2007) and Costinot (2009), among others. See the section on related literature below for details.

[2] This small literature includes Saint-Paul (1997), Brügemann (2003) and Cuñat and Melitz (2010a; 2010b). See the literature review below for details.

Firms face both fixed and variable trade costs to export. With the presence of fixed trade costs and firm heterogeneity, only relatively more productive firms find it profitable to export. The model predicts that all else equal, when labor laws become more protective, firms in more specific skill-intensive sectors have a relative cost advantage in production. Thus, in countries where labor laws are more protective, the average volume of firms' exports (intensive margin) and the fraction of firms exporting (extensive margin) are both relatively higher in specific skill-intensive sectors.

I then extend Helpman, Melitz and Rubinstein's (2008) empirical framework to a multi-sector setting, and develop a two-stage regression framework to test the model's predictions. In particular, the first stage of the empirical framework is a Probit equation estimating the probability of countries' selecting into trade partners in a sector, whereas the second stage is a gravity equation augmented to take into account the extensive margin of trade.

For the purpose of testing the theoretical predictions, I construct sectoral measures for the importance of firm-specific skills in production. To my knowledge, there has been no attempt by researchers to estimate them across sectors. To this end, I follow the labor economics literature on the effects of seniority on wages (Altonji and Shakotko, 1987; Topel, 1991; Altonji and Williams, 2005) in interpreting returns to firm tenure as evidence of the presence of firm-specific skills. Although there exist alternative explanations for an upward-sloping wage profile due to firm tenure, such as theories of incentive contracts to elicit workers' effort (Lazear, 1981), asymmetric information about workers' abilities (Katz and Gibbons, 1991) and wage compression due to search frictions in labor markets (Acemoglu and Pischke, 1999), I adopt the traditional view and associate high returns to firm tenure with the importance of firm-specific skills (Becker, 1964). As such, I estimate returns to firm tenure in each sector using a Panel Study of Income Dynamics (PSID) sample over 1974-1993. With the assumption that real wages are positively correlated with the underlying marginal product of labor, I use the estimated returns to tenure as sector proxies for specific skill intensity for 62 SIC 3-digit sectors (out of 118 total).

Finally, I estimate sector-level gravity equations to test the theoretical predictions. Following the existing empirical literature on comparative advantage,[3] I include in the gravity equation an interaction term between a country's index of labor protection and a sector proxy for specific skill intensity to capture the differential impacts of labor laws across sectors. Using OLS, I find a positive and significant coefficient on the interaction term, supporting the theoretical prediction about the intensive margin of trade. Then I implement the two-stage estimation procedure. The results from the first-stage estimation confirm that countries with more protective labor laws are more likely to export in specific skill-intensive sectors (the extensive margin). The second-stage gravity estimation, after correcting both the omitted variables and the selection biases, confirms the OLS findings about the intensive margin of trade. To ensure that my results are not driven by other sources of comparative advantage, I also control for countries' factor endowments, income

[3] This literature includes, among others, Romalis (2003), Levchenko (2007), Nunn (2007) and Manova (2010).

and contracting institutions in both selection and gravity equations. Moreover, an interaction term between a country's index of labor protection and a sectoral measure of volatility is included to control for the previously studied channel through which labor market institutions affect trade patterns. In sum, in addition to checking the robustness of my results, I find evidence supporting the existing theoretical predictions on trade patterns.

To preview the empirical findings, in Figure 2, I plot countries' export specialization in specific skill-intensive sectors against the degree of labor protection for the countries in my sample.[4] A positive relationship between the two suggests that countries with more protective labor laws have their exports biased toward specific skill-intensive sectors. The relationship is economically significant. An increase from the 25th to the 75th percentile in the index of labor protection is associated with an increase in specialization in specific skill-intensive sectors of about 0.4 standard deviation. Figure 3 confirms the robustness of this positive association by controlling for countries' relative factor abundance. Figure 4 illustrates a similar pattern among the OECD countries. For instance, controlling for factor endowment differences, Sweden, a country with protective labor laws, derives proportionally more of its exports from specific skill-intensive sectors than the U.S., a country with flexible labor laws.

1.1 Related Literature

This paper is related to several strands of literature. The first strand studies how labor market institutions affect workers' human capital investment decisions (Houseman, 1990; Estevez-Abe et al., 1999; Hassler et al. 2001; Belot et al., 2007). In particular, Estevez-Abe et al. (1999), among others in the literature on the "varieties of capitalism", postulate that workers have more incentive to invest in firm- and industry-specific skills instead of portable general skills in countries with more protective labor laws. They succinctly argue that in developed countries, there could be two equilibria, with one characterized by high levels of job turnovers, general skills and portable assets; whereas the other equilibrium characterized by high levels of job tenure, specific skills and specific assets. Consistent with this theoretical argument, Wasmer (2006) shows in a search theoretical framework that labor market rigidity induces workers to acquire firm-specific skills relative to general skills, despite ambiguous welfare effects. In his model, higher firing costs increase search frictions in the external labor market and therefore the average duration of the relationships between workers and their employer. The returns to specific skills are thus higher in equilibrium. Despite the similarity in the theoretical underpinning, this paper highlights how workers' investment decisions shape the pattern of trade. Adding to the existing literature, the current study also provides indirect evidence based on trade data to support the hypothesis that labor market rigidity is associated

[4] A country's export specialization in firm-specific skill intensive sectors is a weighted average of sector measures of specific skill intensity, with weights equal to respective sector shares in a country's total exports. See equation (14) for detail.

with more specific skills in a country's labor force, which was asserted but not verified empirically before.

Second, this paper is motivated by empirical studies that gauge the importance of firm-specific skills in production. In labor economics, empirical studies find positive and significant firm tenure effects on wages. (Kletzer, 1989; Topel, 1991; Jacobson et al., 1993; Buchinsky et al., 2008).[5] To the extent that wages are positively correlated with the marginal product of labor, the estimated effects of firm tenure on wages can be taken as indirect evidence of firm-specific skills.[6] Consistently, studies in organizational economics find that specialized non-patentable human capital are more important than specialized physical capital in determining vertical integration between upstream and downstream firms (Monteverde and Teece, 1982; Masten et al., 1989).[7] In addition to confirming firms' provision of incentives for specific-skill investments, these studies underscore the non-contractible aspect of firm-specific investments, which is a crucial assumption in my theoretical model.[8]

This paper complements a growing literature that studies the interaction between labor market institutions and international trade across countries (Brecher, 1974; Matusz, 1996; Davis, 1998; Davidson et al., 1999; Davidson and Matusz, 2006). In a series of papers, Helpman and Itskhoki (2009, 2010) and Helpman, Itskhoki and Redding (2008, 2010) examine theoretically how trade liberalization, depending on labor market rigidity, affects unemployment and wage inequality of the liberalizers differently. This paper adds to the literature that examines labor market institutions as a source of comparative advantage. In that literature, Saint-Paul (1997), Brügemann (2003) and Cuñat and Melitz (2010a) consider a world where sectors are different in the degree of sales uncertainty, which can arise from either demand or supply shocks. Common in these studies is the source of comparative advantage that arises from the interplay between different costs of labor reallocation across countries and varying needs for factor reallocation across sectors. I focus instead on a country's endogenous comparative advantage stemming from workers' skill acquisition in response to their countries' labor market institutions, in an environment where the importance of specific skills varies across industries.

Finally, this paper is related to the literature on contracting institutions as a source of compar-

[5] Within this literature, studies of layoffs through no fault of their own (for example, plant closings) show that laid-off employees typically earn 15 to 25 percent less on their next jobs. See Kletzer (1998) for a review of this literature. Although the economic significance of firm-specific skills in determining wage growth is still subject to debate, a recent paper by Buchinsky et al. (2004) employs Markov Chain Monte Carlo methods to account for workers' mobility decisions, and find that returns to job seniority in the U.S. are higher than those to general working experience, even higher than what was previously estimated by Topel (1991).

[6] Importantly, these results are not specific to the flexible U.S. labor market. For instance, Dustmann and Meghir (2005) find that in Germany, the returns to sector tenure are almost zero, while the returns to firm tenure are substantial, especially for the unskilled. This particular finding is consistent with the story that workers acquire more specific skills in protective labor markets.

[7] In particular, they find that in the automobile industry instead of vertical integration, the "quasi-integrated" organizational form with specialized tools owned by the owner and leased to the contractor is common among parts production firms.

[8] Malcomson (1997) summarizes the literature on the hold-up problem of human capital investment.

ative advantage. Levchenko (2007), Nunn (2007) and Costinot (2009a), among others, show both theoretically and empirically that countries with better contracting institutions or legal environment specialize in the sectors in which production relies more on contract enforcement (such as sectors that involve complex production technology or relationship-specific investments by suppliers). This paper contributes to this literature by showing empirically the effects of labor market institutions on trade patterns. In addition, it highlights their effects on the extensive margin of trade. On the theoretical front, it is similar to Antràs (2003; 2005), Antràs and Helpman (2004) and Acemoglu et al. (2007) in applying the property-rights approach on studying international trade.

2 The Closed-Economy Model

In this section, I solve for the firm-level equilibrium in a closed economy, taking demand for goods as given. The ultimate goal is to show how labor market institutions affect workers' skill acquisition, which in turn affect firm employment, price, revenue and profit. The open-economy model will be introduced in section 3.

2.1 Preferences

Consider a closed economy of $S+1$ sectors, with one sector producing homogeneous goods, and S sectors producing differentiated products. The homogeneous good is the numéraire.

Labor is the only factor of production. The economy is inhabited by a measure L of ex-ante identical and risk-neutral consumers/workers, who supply labor inelastically. For simplicity, each worker is endowed with $\overline{h}$ units of general skills to begin with. The level of general skills can be endogenized if needed.

Workers' preferences have two parts: Utility derived from consumption and disutility from skill acquisition. Utility from consumption is a standard Cobb-Douglas aggregate over consumption indices of the homogeneous-good, C_0, and all differentiated goods, C_s:

$$C = C_0^{1-\alpha}\left(\prod_{s=1}^{S} C_s^{b_s}\right), \qquad \text{where } \sum_{s=1}^{S} b_s = \alpha.$$

Consumers exhibit love of variety. The real consumption index of sector s is a constant-elasticity of substitution (CES) aggregate over consumption of all available varieties $\omega's$ from the set Ω_s (to be determined in equilibrium):

$$C_s = \left[\int_{\omega\in\Omega_s} c_s(\omega)^{\frac{\sigma-1}{\sigma}} d\omega\right]^{\frac{\sigma}{\sigma-1}}$$

where $c_s(\omega)$ represents consumption of variety ω in sector s. The elasticity of substitution between varieties, σ, is assumed to be bigger than 1 to capture a higher degree of substitutability between varieties within sectors than between sectors. For simplicity, σ is assumed to be the same across sectors. The demand function of variety ω in sector s is therefore

$$c_s(\omega) = D_s p_s(\omega)^{-\sigma}$$

where $p_s(\omega)$ is its price, $D_s = P_s^{\sigma-1} b_s Y$ captures the demand level for goods in sector s, with Y being the aggregate spending of the economy; the ideal price index of sector s is $P_s = \left[\int_{\omega \in \Omega_s} p_s(\omega)^{1-\sigma} d\omega\right]^{\frac{1}{1-\sigma}}$.

If worker i exerts an effort level e_i to acquire skills, she incurs effort costs κe_i, measured in units of the homogeneous good. Therefore, given the ideal price index P of consumption and income w_i, her indirect utility is expressed as[9]

$$U_i = \frac{w_i - \kappa e_i}{P}.$$

2.2 Production Technologies and Market Structure

Production of the homogeneous goods requires only general knowledge. Technology is linear, with unit labor requirement of general skills equal 1. The product market of homogeneous goods is perfectly competitive, implying zero profits for the numéraire sector, and the wage of an employee equal to her level of general skills.

The markets for differentiated products are monopolistically competitive. A potential employer chooses a sector to enter and sets up a firm with no cost. The main conclusions of the paper are independent of the assumption of zero fixed costs.

The production function of a firm in sector s is

$$y_s = \epsilon f_s(a) l, \tag{1}$$

where l is firm employment, ϵ is an exogenous firm-specific productivity, which will be explained in detail below. The firm's endogenous labor productivity is

$$f_s(a) = a^{\lambda_s} \overline{h}^{(1-\lambda_s)},$$

where $\overline{h}$ stands for the fixed level of general skills acquired by workers before being matched with a firm; a represents the average level of workers' firm-specific skills acquired on the job. λ_s is constant for all firms in the same sector. $\lambda_s \in (0, 1)$ is increasing in the sector index s, such that $\lambda_s > \lambda_{s'}$ if $s > s'$ $\forall s, s' \in \{1, .., S\}$.

After setting up the firm, the employer hires workers by posting a contractible wage, w_1. Since there is a large number of ex-ante identical workers competing for jobs, w_1 adjusts across firms

[9] The assumption that disutility of effort is measured in the same units of nominal wages is implicitly made in the Shapiro-Stiglitz (1984) efficiency wage model, and more recently in Davis and Harrigan (2007).

and sectors, ensuring identical expected wages for all workers at the time of hiring, independent of which firms and sectors they join.

During firms' hiring, workers have two choices: join one of the differentiated-good firms, or stay out in the external labor market. If they choose to stay out, they expect to be employed by the homogeneous-good sector later. A worker who joins a differentiated-good firm receives w_1 and expects to exert effort to acquire specific skills. In practice, a lot of the firm-specific skills are difficult, if not impossible, to specify in contracts, and therefore cannot be verified by a third party. For this reason, investments in firm-specific skills are assumed to be observable but not contractible.[10] I take the assumption of contract incompleteness as a fact of life, and do not complicate the model by discussing its underpinnings. Furthermore, to focus on the main argument of the paper, I also assume the same degree of contract incompleteness across sectors. Relaxing this assumption does not affect the main conclusions of the model.

Because no enforceable contract can be written ex ante, the employer cannot impose her preferred level of investments on her employees. Under these circumstances, the employer and the workers bargain over the division of surplus after workers invest in specific skills. I adopt generalized Nash bargaining between the representative worker (e.g. a union leader) and the employer within the "right-to-manage" framework, with a given $\phi \in (0, 1)$ being the bargaining power of the workers. In the "right-to-manage" framework, the two parties in the firm bargain over wages, with the level of employment being chosen unilaterally by the employer before the bargaining stage.[11]

To abstract from issues related to coordination and incentive problems among workers, I assume that investment efforts of all workers are chosen by a representative worker in the firm. Developing a model that features multilateral bargaining between individual workers and the employer, such as those in Stole and Zwiebel (1996a and 1996b) and Acemoglu et al. (2007), can shed important light on the incentive and coordination issues among workers. I opt for a simpler set-up with bilateral bargaining to focus on the core of the paper – investment in firm-specific skills. This assumption can be rationalized based on real-world bargaining between the employer and the union representative, who represents the common interest of the union members in the firm.[12]

After the investment costs are incurred by both parties, the employer and the employees of a firm bargain over the division of expected surplus. At the time of bargaining, the employer's outside

[10] For instance, contract incompleteness of human capital investment has been used as an explanation for firm-provided training in studies by Balmaceda (2005) and Casas-Arce (2006).

[11] As discussed in Stole and Zwiebel (1996a and 1996b), firms have a strategic incentive to overemploy workers if the technology has decreasing returns to scale. However, as noted in these papers, unions internalize this effect with a single representative bargaining on other workers' positions. Thus, no incentive for overemployment arises. This statement is valid even if I relax the "right-to-manage" assumption.

[12] Allowing decentralized bargaining between a single worker and her employer would substantially complicate the model. Along these lines, Acemoglu et al. (2007) and Helpman and Itskhoki (2010) employ the Shapley value concept to solve for workers' bargaining power in an incomplete-contract setting. They show that workers' bargaining power is higher in sectors with lower elasticities of substitution between varieties.

option is normalized to 0.[13] Without loss of generality, production itself is assumed to require no effort by the workers. Concurrently, the homogeneous-good sector hires workers who remain in the external labor market.[14] A worker with $\overline{h}$ units of general skills in the differentiated-good firm can quit and supply labor in the competitive homogeneous-good sector. With the ability to produce $\overline{h}$ units of homogeneous goods, each worker's outside option at the time of bargaining is $\overline{h}$.

2.3 Labor Regulations and Implied Workers' Bargaining Power

Following Blanchard and Giavazzi (2003) and Spector (2004), I use the parameter for workers' bargaining power ϕ, admittedly in an abstract fashion, to represent the degree of a country's labor protection in the model.[15] A higher ϕ is associated with more protective (regulated) labor laws. Intuitively, when labor laws become more protective, workers can bargain for a larger ex-post share of surplus from the joint relationship. To mention a few real-world examples, ϕ can capture any labor regulations that increase workers' primitive bargaining power with respect to the employer, ranging from the existence and the nature of extension agreements, to closed-shop arrangements and rules on the right to strike (Blanchard and Giavazzi, 2003). To focus on cross-country differences in labor laws, I assume identical bargaining power of workers across all firms in the differentiated-good sector in an economy.

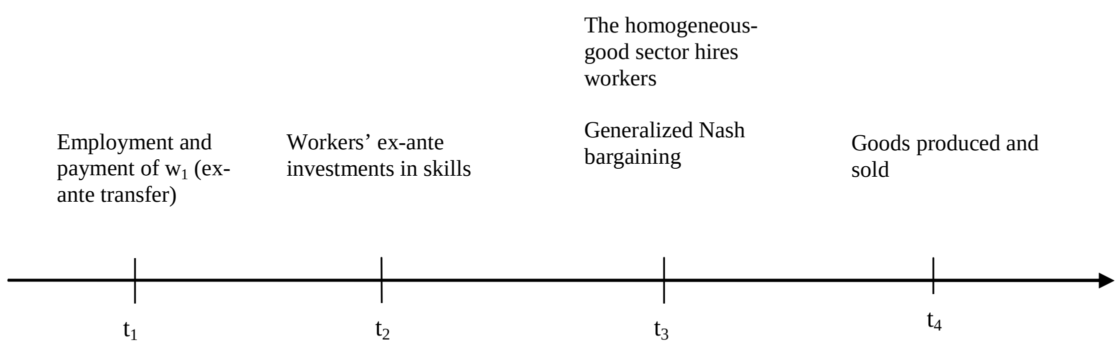

Figure 1: Timing of Events

2.4 Timing of Events

The timing of events is summarized as follows (see also Figure 1). There is no discounting between t_1 and t_4.

[13] A posssible interpretation is that workers have spent time acquired skills but did not produce anything yet at the time of bargaining.

[14] The assumption that the homogeneous-good sector hires workers later than the differentiated-goods firms is not crucial for the main conclusions of the paper. Having this assumption allows me to highlight the ex-post relative returns to both types of skills. If I assume instead that this sector employs workers at exactly the same time as the differentiated-goods firms, the solutions of w_1 will be different. Nevertheless, since ex-ante transfers do not affect workers' incentives to invest, the main insights of the model are unchanged.

[15] See also Griffith et al. (2007) for a discussion.

At t_1, the firm posts a contractible wage w_1 to hire workers. Job seekers can either join a differentiated-good firm or stay out in the external labor market.

At t_2, workers in differentiated-good firms acquire specific skills, in anticipation of a share ϕ of the ex-post surplus from sales, together with the outside options that depend only on general skills.

At t_3, after workers' investments, agents in a differentiated-good firm bargain over the division of expected surplus. The homogeneous-good sector hires workers, pays each of them $\overline{h}$. The labor market clears.

At t_4, if both parties in the firm agreed to continue the relationship at t_3, workers produce goods using their acquired skills effortlessly. Ex-post surplus S from sales (revenue minus the outside options of both parties) is divided between the employer and the employees, according to labor laws, with ϕS and $(1-\phi) S$ going to the workers and the employer, respectively. The homogeneous-good sector produces and sells an amount $\overline{h} l_0$ of goods. All goods markets clear.

2.5 Firm-level Equilibrium

2.5.1 Preliminaries

I solve the model backward in time from t_4. Given firm exogenous productivity ϵ, firm outcomes are all identical in symmetric equilibrium. Thus, in this section, I focus on a single firm and suppress both firm (ω) and sector (s) subscripts.

Given downward-sloping demand for each variety, the price and firm revenue of a variety (as a function of y) are expressed as follows:

$$p = D^{1-\eta} y^{\eta-1}; \qquad R = D^{1-\eta} y^{\eta}, \tag{2}$$

where $\eta = 1 - 1/\sigma < 1$ and D is the demand level for goods in a given sector (to be solved in equilibrium). Since each firm is infinitesimal, D is taken as given by agents in each firm.

With a worker's outside option equal to $\overline{h}$ and that of the employer normalized to 0, the ex-post surplus of a firm with l workers is

$$S(a) = R(a) - \overline{h} l.$$

2.5.2 Workers' Investment in Firm-specific Skills (at t_2)

Since investment in specific skills are non-contractible, workers invest optimally at t_2, anticipating payoffs from ex-post bargaining at t_3. Throughout the paper, I assume that firms do not invest in workers' human capital.[16]

To simplify algebra, I assume that the marginal cost of skill acquisition κ equals 1. Since each worker expects to obtain $\phi S(a)/l + \overline{h}$ ex post, the representative employee of the firm maximizes

[16] They do, however, indirectly pay for them in equilibrium through ex-ante transfers.

her expected payoffs for all workers by choosing the level of specific skills (a) as

$$\max_{a} \left\{\phi D^{1-\eta} \left[\epsilon f(a)\, l\right]^{\eta} + (1-\phi)\, \overline{h} l - al\right\}.$$

With l chosen by the employer ex ante, the first order condition delivers the optimal investment level in specific skills and endogenous labor productivity as follows:

$$\begin{aligned} a^*(\phi,\lambda) &= \left[\phi\lambda\eta B \left(\epsilon\overline{h}^{1-\lambda}\right)^{\eta}\right]^{\frac{1}{1-\lambda\eta}}; \\ f^*(\phi,\lambda) &= \left[(\phi\lambda\eta B\epsilon^{\eta})^{\lambda}\, \overline{h}^{1-\lambda}\right]^{\frac{1}{1-\lambda\eta}}, \end{aligned} \tag{3}$$

where $B = (D/l)^{1-\eta}$. Each worker expects to receive a smaller share of firm revenue when the firm gets bigger. Because the marginal revenue is decreasing in labor, all else being equal, workers have less incentive to acquire skills in larger firms. When workers anticipate a higher share of firm revenue ϕ, they exert more effort to acquire specific skills in the interest of their employer. With incomplete contracting, there would be under-investments in specific skills. Consider for a moment that human capital investments are contractible, such that the employer can impose her preferred levels of investments on the workers. The first-best investment level (a^c) under complete contracting would imply $a^*/a^c = \phi^{\frac{\lambda}{1-\lambda\eta}} < 1$.[17] Thus, workers always underinvest from the perspective of the employers when contracts are incomplete.[18] Notice that the degree of underinvestment is increasing in the intensity of specific-skills in production (increasing in λ).[19]

These effects of labor regulations on endogenous firm productivity is summarized as follows:

Lemma 1 Let $\varsigma_{\phi}(\phi,\lambda) \equiv \partial \ln f^*(\phi,\lambda)/\partial \ln \phi$ be the elasticity of $f^*(\phi,\lambda)$ with respect to ϕ, and $\varsigma_{\lambda} \equiv \partial \ln f^*(\phi,\lambda)/\partial \ln \lambda$ be the elasticity of $f^*(\phi,\lambda)$ with respect to λ. I have that:
i) $\varsigma_{\phi}(\phi,\lambda) > 0$;
ii) $\partial\varsigma_{\phi}(\phi,\lambda)/\partial\lambda > 0$ and $\partial\varsigma_{\lambda}(\phi,\lambda)/\partial\phi > 0$.

Proof: See Appendix.

Part (i) of this lemma highlights that all else equal, higher bargaining power of workers enhances labor productivity. In the current model in which workers are the only party investing in human capital, workers' anticipation of higher ex-post payoffs encourages specific skill acquisition, which in turn enhances firm productivity.

[17] The first-best maximization problem for the workers is $\max_a R(a)/l - a$.

[18] This is a standard one-sided hold-up result, when workers are not the full residual claimants of the gains from their investments. In reality, ϕ is never close to 1. Also, this simple model does not include capital as a factor of production. With capital as a factor of production, an employer would require some surplus to cover her sunk investment costs.

[19] The focus of this paper is on comparative advantage due to labor regulations. The current discussion about ϕ has no normative implications for optimal labor laws. For welfare analysis for countries under different labor laws, see a review by Nickell (1997).

More importantly, part (ii) of the lemma captures the main determinant of institutional comparative advantage in the paper. Similar to Costinot (2009b), the second part of Lemma 1 specifies that labor productivity $f^*(\phi, \lambda)$ is log-supermodular in both arguments. In other words, the positive effect of granting workers bargaining power is larger for firm-specific skill-intensive sectors, which potentially mitigates the costs of employment protection. This insight is consistent with Roberts and Van den Steen (2000), who postulate that it is optimal for an employer to grant her employees a larger share of equity or role in governance when non-contractible human-capital are more important for production.

The log-supermodularity of $f^*(\phi, \lambda)$ provides general implications. Consider a world with two countries: i and k, which are identical in all aspects beside that labor laws are more protective in i than k, i.e. $\phi_i > \phi_k$. To show different impacts of labor protection across sectors, consider the ratio of firm labor productivity between two countries for a given sector:

$$\frac{f^*(\phi_i, \lambda)}{f^*(\phi_k, \lambda)} = \left(\frac{\phi_i}{\phi_k}\right)^{\frac{\lambda}{1-\lambda\eta}}.$$

This ratio is increasing in λ as long as $\phi_i > \phi_k$. Intuitively, through endogenous workers' skill acquisition, the model delivers an upward-sloping technology schedule (in λ) that captures comparative advantage of the two countries. This schedule is close in spirit to the exogenous technology schedule in Dornbusch, Fischer and Samuelson's (1977) two-country Ricardian trade model with a continuum of industries.

At t_3, since the Nash-bargaining outcomes are always efficient, both parties agree to produce jointly. At t_4, workers produce goods effortlessly with the acquired skills.

2.5.3 Firm Employment Decision (t_1)

Now let us go back to period t_1. Anticipating a payoff of $(1-\phi)\, S(a^*)$ at t_4, the employer hires workers by offering a contractible wage, w_1. The employer chooses the level of employment l to maximize the expected net surplus $(1-\phi)\left[R(a^*, \epsilon) - \overline{h}l\right] - w_1 l$.

At t_1, the outside options for workers are determined by the (expected) employment opportunities in the homogeneous-good sector. Since the wage of each unit of general skills equals 1, a worker endowed with $\overline{h}$ units of general skills expects an ex post outside option of $\overline{h}$. On the other hand, joining a firm with productivity ϵ gives her an up-front payment $w_1(\epsilon)$ plus expected future payoffs equal to $\phi R(a^*) + (1-\phi)\overline{h}$ minus costs of investment. Hence, the ex-ante participation constraint for a worker joining the firm at t_1 is

$$w_1(\epsilon) + \phi R(a^*, \epsilon)/l + (1-\phi)\overline{h} - a^* \geq \overline{h}.$$

Inelastic supply of ex-ante identical workers implies that $w_1(\epsilon)$ will adjust until the participation constraint binds. $w_1(\epsilon)$ is then pinned down as

$$w_1(\epsilon) = -\phi\left[R(a^*,\epsilon)/l - a^* - \overline{h}\right] + (1-\phi)\,a^*.$$

A higher ϵ implies higher ex-post payoffs for the workers, and therefore lower ex-ante transfers to the workers.[20] The term inside the square brackets is negative because of the concavity of $R(a^*,\epsilon)$. Workers are assumed to be not credit-constrained, so that a negative w_1 (i.e., a positive transfer from the workers to the employer) is feasible. Substituting w_1 into the firm's objective function yields[21]

$$\widetilde{\pi}(a^*,\epsilon) \equiv \max_l \left\{R(a^*,\epsilon) - \left(a^* + \overline{h}\right) l\right\}.$$

With $f^*(\phi,\lambda)$ solved in (3), I can solve for firm price, output, revenue and the employer's net surplus as follows (see derivation in appendix):

$$p(\phi,\lambda,\epsilon) = \frac{\Theta(\phi,\lambda)}{\epsilon\eta}; \qquad y(\phi,\lambda,\epsilon) = D\left(\frac{\Theta(\phi,\lambda)}{\epsilon\eta}\right)^{-\sigma} \tag{4}$$

$$R(\phi,\lambda,\epsilon) = D\left(\frac{\Theta(\phi,\lambda)}{\epsilon\eta}\right)^{1-\sigma}; \tag{5}$$

$$\widetilde{\pi}(\phi,\lambda,\epsilon) = D\left(\frac{\Theta(\phi,\lambda)}{\epsilon\eta}\right)^{1-\sigma}\frac{(1-\phi\lambda\eta)(1-\eta)}{1-\lambda\eta} \tag{6}$$

where

$$\Theta(\phi,\lambda) = \widetilde{\lambda}\left(\frac{1-\lambda\eta}{1-\phi\lambda\eta}\right)^{1-\lambda}\left(\frac{1}{\phi}\right)^{\lambda}; \qquad \widetilde{\lambda} = (1-\lambda)^{-(1-\lambda)}\lambda^{-\lambda}.$$

These firm values take the familiar functional forms. Because $\eta < 1$, price is a standard mark-up over marginal cost $\Theta(\phi,\lambda)/\epsilon$. The firm-specific exogenous productivity ϵ is negatively correlated with prices. Sector-level demand A and firm-level productivity ϵ are positively related to firm output, revenue and employers' net surplus. A higher ϕ induces workers to exert more effort for skill acquisition, thus enhancing firm productivity. These effects are stronger in sectors for which firm-specific skills are more important (see Appendix A for proofs).[22] Notice that all firm-level

[20] To show that shirking is never an equilibrium outcome, consider the situation when a worker shirks, and invest in no skills at all. The expected "life-time" income of a shirker is equal to w_1 plus her outside option at t_3, which will become $\overline{h}$, i.e. $U_{shirk} = \left(w_1(\epsilon) + \overline{h}\right)/P$. For a worker who exerts optimal efforts to acquire skills, she will get $U_{opt.} = \left[w_1(\epsilon) + \phi R(a^*,h^*,\epsilon)/l + (1-\phi)\,\overline{h} - a^*\right]/P$. Since $R(a^*,\epsilon)$ exhibits decreasing returns to scale with respect to a, the optimal choice of a^* guarantees that $R(a^*,\epsilon) - a^* > 0$. Thus, $U_{opt.} \geq U_{shirk}$ and shirking is always an off-equilibrium outcome.

[21] One may wonder that since the employer's ex-post surplus is decreasing with ϕ, all else being equal, the employer should be worse off when the workers gain more bargaining power. However, with a constant ex-ante outside option $\overline{h}$ for the workers, ex-ante transfers to the workers $w_1(\epsilon)$ adjust in such a way so that all workers across firms and sectors receive the same "life-time" income. Hence, when a higher ϕ increases investments in specific skills and therefore joint surplus, the employer's net surplus increases one for one.

[22] Notice that the timing of the game is crucial for the results here. Since workers acquire specific skills after they receive the transfers, the amount of the transfers no longer matters for their investment incentives. Therefore, even though the employer's net surplus increases one for one, workers' incentives to invest does not decrease. In fact,

variables are independent of the level of general skills $\overline{h}$.[23]

In this model, workers invest only in firm-specific skills but not general skills. However, the model is general enough to incorporate non-contractible investment activities for both types of skills. The solutions to this extended model posit that higher workers' bargaining power alleviates the underinvestment problems for all human capital investments, more so for production that depends more on specific skills. The rationale is that since specific skills are not transferable across firms, the associated underinvestment problem is relatively more severe. If protective labor laws can alleviate the underinvestment problems for both types of skills, the effect would be greater for specific human-capital investments and for production that depends more on them. Since the extension does not change the main insights about comparative advantage, a simpler model is presented here.

3 The Multi-Country Open-Economy Model

In this section, I embed the closed-economy model in a multi-country open-economy framework, à la Helpman, Melitz and Yeaple (2004). The ultimate goal of this section is to derive sector-level gravity equations, which capture the impact of labor market institutions on both the intensive and extensive margins of trade. In the main text, I present only the partial-equilibrium version of the model by taking the measure of firms in each sector as given, following Helpman, Melitz and Rubinstein (2008) and Manova (2010). Readers are referred to the appendix for a general-equilibrium analysis of the model, similar to Chaney (2008).

3.1 The Environment

Consider an open economy with N countries. All goods are potentially traded across countries. While the homogeneous (numéraire) goods are assumed to be freely traded, differentiated-good firms face fixed and variable export costs. The variable cost takes the form of an "iceberg" transportation cost – for a unit of a variety shipped from country i to country j, only a fraction $1/\tau_{ij} < 1$ arrives in the destination. In addition, to export to country j, a firm in country i has to pay an up-front fixed cost f_{ij} in units of the numéraire.[24] For simplicity, I assume symmetric variable and fixed trade costs between any two trade partners, i.e. $\tau_{ij} = \tau_{ji}$ and $f_{ij} = f_{ji}$.

I consider only equilibria in which the numéraire good is produced in all countries.[25] Given that each worker is endowed with $\overline{h}_i$ of general skills, all workers' life-time incomes in country i

exactly the opposite happens: anticipating a larger share of firm surplus, workers have more incentives to invest, driving up the employer's (expected) surplus by adjusting the ex-ante incentive-neutral transfers.

[23] It happens that $\overline{h}$ is multiplied to l in both the employers' surplus and labor costs, which offset each other in these equations.

[24] Examples of the fixed export costs include costs for setting up a distribution network, research on the foreign markets, and so on.

[25] This condition will hold as long as the expenditure share of the numéraire $(1 - \alpha)$ is large enough, or trade costs for differentiated goods are high enough.

equal $\overline{h}_i$. To simplify notation, I denote country $i's$ nominal labor income by $w_i = \overline{h}_i$.

To derive an empirical specification to test the extensive margin of trade, I introduce heterogeneous firm productivity in the model, à la Melitz (2003). Upon setting up a firm, the employer draws costlessly an exogenous productivity parameter ϵ, which determines part of the firm's labor productivity. Once ϵ is drawn, it becomes common knowledge at the time of hiring. As in Helpman, Melitz and Yeaple (2004), firms in different sectors draw their $\epsilon's$ from a common Pareto distribution over bounded support $[1, \epsilon_H]$,[26] with the cumulative distribution function of ϵ equal to $\Pr(\epsilon < \epsilon') = G(\epsilon) = \left(1 - \epsilon^{-\xi}\right) / \left(1 - \epsilon_H^{-\xi}\right)$, where ξ is a measure of the dispersion of $\epsilon's$ across firms. ξ is assumed to be bigger than $\sigma - 1$.[27] A smaller ξ represents a higher concentration of $\epsilon's$ around the lower bound, which is normalized to 1.

3.2 Sectoral Export Thresholds for a Foreign Market

I define $\Theta_{is} \equiv \Theta(\phi_i, \lambda_s)$, and the employer's net surplus from exporting to j in sector s as $\widetilde{\pi}_{ijs}(\epsilon) \equiv \widetilde{\pi}_j(\epsilon, \phi_i, \lambda(s))$. From (6),

$$\widetilde{\pi}_{ijs}\left(\epsilon | \epsilon \geq \epsilon^*_{ijs}\right) = \frac{b_s Y_j}{P_{js}^{1-\sigma}} \left(\frac{\Theta_{is}\tau_{ij}}{\epsilon\eta}\right)^{1-\sigma} \frac{(1-\phi\lambda\eta)(1-\eta)}{1-\lambda\eta} - f_{ij},$$

where Y_j is the aggregate spending of country j, P_{js} is the price index of sector s in j, and ϵ^*_{ijs} is the productivity threshold above which firms in i export to j (to be determined below). Evidently, all else being equal, a firm in i exports more to a larger market j (i.e., a higher $P_{js}Y_j$).

The employer's net surplus depends on the term of endogenous comparative advantage due to i's labor laws Θ_{is}. Firms in i would export to j if the expected net surplus is sufficiently large to cover the fixed export cost f_{ij}. Thus, only a subset of firms export. Formally, the break-even condition, $\widetilde{\pi}_{ijs}(\epsilon) = 0$, pins down the productivity threshold for exporting ϵ^*_{ijs} as

$$\epsilon^*_{ijs} = \frac{\Psi_{is}\tau_{ij}}{P_{js}} \left(\frac{b_s Y_j}{f_{ij}}\right)^{\frac{1}{1-\sigma}}, \tag{7}$$

where

$$\Psi_{is} = \Theta_{js} \left(\frac{(1-\phi\lambda\eta)(1-\eta)}{1-\lambda\eta}\right)^{\frac{1}{1-\sigma}}.$$

With the presence of fixed trade costs f_{ij}, there are increasing returns to exporting at the firm level. Therefore, ϵ^*_{ijs} is increasing in f_{ij}, and is decreasing in Y_j and P_{js}. The impact of labor laws on ϵ^*_{ijs} is summarized by the following lemma.

[26] The assumption of Pareto distribution of exogenous productivity, orginally proposed by Melitz (2003), was adopted by a series of papers, such as Chaney (2008), Helpman, Melitz and Rubinstein (2008), among others. See Helpman, Melitz and Yeaple (2004) for evidence that the sample distributions of firm size in the U.S. and Europe are approximated closely by Pareto distribution.

[27] This assumption ensures that the distribution of firm sales has a finite mean in equilibrium.

Lemma 2 (Firm Selection into Exporting): All else being equal, the productivity thresholds for exporting are lower when labor laws become more protective; more so in sectors for which firm-specific skills are more important (higher λ).

Proof: See Appendix

Ceteris paribus, this result comes from the fact that an employer's net surplus $\widetilde{\pi}_{ijs}$ is increasing in workers' bargaining power ϕ_i, proportionally more so for the more firm-specific skill-intensive sectors.

Without firm-level data for a large sample of countries, it is difficult to test Lemma 2 empirically. However, conditional on a measure N_{is} of firms in country i and sector s, the fraction of firms exporting in sector s is : $0 < 1 - G\left(\epsilon^*_{ijs}\right) < 1$ with $\epsilon^*_{ijs} \in (1, \epsilon_H)$. In other words, at the country level, Lemma 2 can be examined indirectly by exploring the likelihood of a country's exporting to another country, which is summarized by the following testable proposition.

Proposition 1 (Extensive Margin of Trade): For a country's trade partners, those with more protective labor laws are more likely to export in more firm-specific skill-intensive sectors.

3.3 Sectoral Export Volume to a Foreign Market

By rewriting the demand level A in (5) in terms of the sectoral price (P_{js}) and aggregate spending (Y_j) of j, firm sales to country j can be written as

$$x_{ijs}\left(\epsilon|\epsilon \geq \epsilon^*_{ijs}\right) = b_s Y_j \left(\frac{\Theta_{is}\tau_{ij}}{\epsilon\eta P_{js}}\right)^{1-\sigma}.$$

Aggregating $x_{ijs}\left(\epsilon|\epsilon \geq \epsilon^*_{ijs}\right)$ across all firms exporting to j in sector s gives the sectoral volume of exports from i to j as

$$X_{ijs} = b_s N_{is} Y_j \left(\frac{\Theta_{is}\tau_{ij}}{\eta P_{js}}\right)^{1-\sigma} W_{ijs}, \tag{8}$$

where N_{is} is the number of all firms (including non-exporters) in sector s and country i. Following Manova (2010), we assume an exogenous N_{is}. With ϵ following a Pareto distribution over a bounded support $[1, \epsilon_H]$, the extensive margin term is derived similar to Helpman, Melitz and Rubinstein (2008) as

$$W_{ijs} = \max\left\{\left(\frac{\epsilon_H}{\epsilon^*_{jis}}\right)^{\xi-(\sigma-1)} - 1, 0\right\}. \tag{9}$$

The sectoral export volume X_{ijs} is increasing in the number of producers, N_{is}, and the sectoral price level of the importing country, P_{js}. The latter relationship represents the competition effects on export volume. All else equal, more would be exported to the less competitive foreign market.

In sum, labor protection affects the sectoral volume of exports on both the intensive margin and the extensive margin. First, higher firm productivity due to higher incentives in acquiring specific skills are associated with lower prices, and thus higher firm and sectoral export volumes (the intensive margin). Second, for a given foreign market, a higher ϕ_i implies a larger fraction of firms exporting. Since both margins imply a higher export volume, the combined effects of labor laws on trade flows are summarized as follows.

Proposition 2 (Intensive Margin of Trade): For a country's trade partners, those with more protective labor laws export relatively more in more firm-specific skill-intensive sectors.

Proof: see appendix.

The model can be closed in general equilibrium, under the assumptions made by Chaney (2008). Detailed derivation of the results can be found in Appendix A. The sector-level gravity equation derived in general equilibrium will then be used as the specification for traditional gravity estimation using OLS. In particular, the volume of bilateral exports in sector s is

$$X_{ijs} = \varsigma_s Y_i Y_j \left(\frac{\Delta_j}{\Psi_{is}} \right)^{\xi} \frac{1}{1 - \phi_i \lambda (s) \eta} \tau_{ij}^{-\xi} f_{ij}^{-\frac{\xi - (\sigma - 1)}{\sigma - 1}}, \tag{10}$$

where ς_s is a sector-specific constant (see derivation in Appendix A).[28] As in a standard gravity equation, X_{ijs} is decreasing in both variable and fixed trade costs, and is increasing in the product of incomes of the trading partners. Importantly, the comparative statics of ϕ and λ for sector-level exports derived in partial equilibrium, summarized in Proposition 2 in the previous section, continue to hold.[29]

4 Econometric Specifications

In the rest of the paper, I provide empirical evidence to examine the theoretical predictions about both the intensive and extensive margins of trade. To this end, I follow Manova (2010) to implement the two-stage procedure proposed by Helpman, Melitz and Rubinstein (2008) to estimate the gravity equation at the sector level. The first stage is a selection equation, based on the solution of ϵ_{ijs}^* in section 3.2, while the second stage is a bilateral trade flow equation, based on the solution of X_{ijs} in section 3.3. Implementing this procedure achieves two goals – to test the theoretical prediction on the extensive margin of trade, and to structurally correct the potential biases in the traditional gravity estimates using OLS.

[28] $\varsigma_s = \frac{\xi(1-\gamma\eta)\eta^{\xi}(1+\pi)^{-1}}{\xi-(\sigma-1)} b_s^{\frac{\xi}{\sigma-1}} \left[\frac{1}{\eta} \left(\frac{\xi-(\sigma-1)}{\xi} \right)^{\frac{1}{\xi}} \left(\frac{(1-\phi\lambda\eta)(1-\eta)b_s}{1-\lambda\eta} \right)^{\frac{1}{\xi}+\frac{1}{1-\sigma}} \right]^{\xi}$.

[29] However, with the assumption of $\epsilon_H \rightarrow \infty$, the prediction of the extensive margin of trade no longer holds. It is important to note that this assumption is needed to close the model in general equilibrium. Empirical evidence for the extensive margin of trade reported later in this paper requires ϵ distributed over a bounded support, regardless of whether $G(\epsilon)$ is Pareto or not.

4.1 Empirical Specification for Two-Stage Estimation

There are two potential biases in the OLS estimation of the gravity equation based on equation (10). The first bias is the Heckman (1979) sample selection bias. My sample shows that about 50% of the countries do not trade with each other in 1995.[30] At the sector level, about 80% of the observations have zero trade flows. This non-random selection induces a positive correlation between the unobserved trade frictions and the observed ones.[31] Hence, excluding the out-of-sample zeros from the regression induces a downward bias (closer to 0) in the estimates of the determinants of trade flows. To correct the selection bias, I include the inverse Mills' ratio in the second-stage equation, similar to the standard Heckman (1979) procedure. The inverse Mills' ratio is imputed using the predicted probability of exporting (by sector) from the first-stage estimation (to be discussed below).

Furthermore, Helpman, Melitz and Rubinstein (2008) posit that with firm heterogeneity, omitting the firm self-selection term as a control may lead to overestimation in the traditional estimates of the gravity equation using OLS. To correct for this type of biases, I derive the empirical specification for equation (8), under the assumption of stochastic fixed and variable trade costs (see details in Appendix A):

$$\ln X_{ijs} = \alpha + \beta Labor_i \times Spec_s + n_{is} + \chi p_{js} + \gamma_s + \delta_i + \delta_j - \vartheta d_{ij} + \omega_{ijs} + u_{ijs}. \tag{11}$$

where the explanatory variable of interest, $Labor_i \times Spec_s$ interacts exporter i's degree of labor protection, $Labor_i$, with sector s's firm-specific skill intensity $Spec_s$. Proposition 2 predicts $\beta > 0$. With stochastic fixed and variable trade costs as specified in Appendix A, the specification includes a sector fixed effect ($\gamma_s = \ln b_s$ in (8)), an exporting country fixed effect (δ_i) and an importing country fixed effect (δ_j); $d_{ij} \equiv \ln D_{ij}$ is the (log) bilateral distance;[32] α is a constant and u_{ijs} is an error term, which is assumed to be orthogonal to the regressors.

Notice that in (11), regressors also include the (log) number of firms, $n_{is} = \ln N_{is}$, in sector s of the exporting country i, and the (log) sectoral price level, $p_{js} \equiv \ln P_{js}$, in the importing country j. The specification also includes ω_{ijs}. This captures the extensive margin of trade as well as the composition of exporting firms. Omitting it would result in an overestimation of all estimates in the trade flow equation.[33] For the purpose of correcting both types of biases, I follow Helpman

[30] It means that country i does not export to country j , or vice versa. This number is very close to what Helpman, Melitz and Rubinstein (2008) find.

[31] With only positive trade flows included in the sample, countries with high observed trade costs that trade with each other (e.g., long distance between the a pair of trading countries) are likely to have low unobserved trade frictions.

[32] $\alpha = (\sigma - 1)\ln\eta$; $\delta_i = \ln w_i$, $\delta_j = \ln Y_j$

[33] As show in equation (7), ω_{ijs} is expressed as a function of the exporting productivity threshold ϵ^*_{ijs}, which according to the model, is a increasing function in fixed exporting costs f_{ij}. Thus, a lower sectoral export volume can be due to a lower export volume per firm, or fewer exporting firms, or both. Explicitly controlling for ω_{ijs} in (12) ensures that u_{ijs} comes entirely from the unobserved part of the variable trade costs. Second, ω_{ijs} summarizes the composition of exporting firms to country j, which affects the magnitude of the estimated elasticities of trade

Melitz and Rubinstein (2008) and implement a two-stage estimation procedure parametrically. I briefly outline the specification of the first-stage selection equation here. Readers are referred to their original paper for a detailed discussion.

4.1.1 Firm Selection Into Exporting (Derivation of the First-stage Estimation)

To empirically examine the extensive margin of trade according to equation (9), I derive the econometric specification for the first-stage regression as follows (see Appendix A for details):

$$\begin{aligned} \rho_{ijs} &= \Pr\left(I_{ijs}=1 \mid \text{observed variables.}\right) \qquad (12) \\ &= \Phi\left(\alpha^{*}+\beta^{*} Labor_{i}\times Spec_{s}+\chi p_{js}+\gamma_{s}^{*}+\delta_{i}^{*}+\delta_{j}^{*}-\vartheta^{*}d_{ij}-\varphi^{*}\psi_{ij}\right), \end{aligned}$$

where $I_{ijs} \in \{0,1\}$ is an indicator variable, which equals 1 if trade flows are observed from i to j in sector s, and 0 otherwise; $\Phi(.)$ is the c.d.f. of a unit-normal distribution. I estimate this selection equation as a Probit model.

This Probit estimation serves two purposes. It provides evidence, if any, for the extensive margin of trade. It also provides a regressor to control for the extensive margin of trade (ω_{ijs}) in specification (11). In particular, I use predicted probabilities of exporting at the sector level $\widehat{\rho}_{ijs}$ from estimating (12) to estimate $\omega_{ijs} = \ln W_{ijs}$ based on (9), which is then included as a regressor in the second-stage estimation to correct the two biases. Appendix A has a detailed discussion on how to consistently estimate ω_{ijs} using the first-stage estimates.

5 Data

5.1 Sector Proxies for Firm-specific Skill Intensity

To examine the theoretical predictions, I construct sector proxies for firm-specific skill intensity, which to my knowledge have not been estimated before. To this end, I follow the labor economics literature on tenure effects on wages (Altonji and Shakotko, 1987; Topel, 1991; Altonji and Williams, 2005; Kambourov and Manovskii, 2009) and use returns to firm tenure in the U.S. to gauge the importance of firm-specific skills. A number of alternative theories can explain an upward-sloping wage profile due to firm tenure, including among others, theories of incentive contracts to elicit workers' effort (Lazear, 1981), asymmetric information about workers' abilities (Katz and Gibbons, 1991) and wage compression due to search frictions in labor markets (Acemoglu and Pischke, 1999). I abstract, however, from these theories and adopt instead the most common and original explanation as the basis to construct my sector proxies for skill specificity.

Specifically, I estimate Mincer wage equation and include the employee's job tenure with her current employer (and its squared). To capture different returns to firm tenure across sectors, I

flows with respect to trade frictions and exporters' labor protection. These two particular features of ω_{ijs} suggest that including ω_{ijs} is essential for obtaining consistent estimates of the effects of institutions on trade flows.

interact an individual's job tenure with the dummy of the sector in which she is currently employed. The theory of firm-specific human capital postulates a higher coefficient on the interaction term for a sector in which firm-specific skills are more important in production.

Formally, the regression specification for constructing the sector proxies takes the following form:

$$\begin{aligned} \ln w_{kmst} &= \sum_s Sec_s \left(\beta_{1s} Firm\_Ten_{kmt} + \beta_{2s} \left(Firm\_Ten_{kmt} \right)^2 \right) \\ &\quad + \gamma_1 Work\_Exp_{kt} + \gamma_2 \left(Work\_Exp_{kt} \right)^2 + Cont_{kmt} + \Gamma_{kmst} + \varepsilon_{kmst}. \end{aligned} \tag{13}$$

where k, m, s and t stand for person, employer, sector and year, respectively; w_{kmst} denotes the real wage rate. Sec_s is a dummy for sector s. $Firm\_Ten_{kmt}$ is the worker's self-reported tenure with the current employer.

I use the estimated coefficients on $Firm\_Ten_{kmt}$ and its squared term (β_{1s}, β_{2s}) to construct the sector proxies for specific skill intensity as:

$$Spec_s^T = \widehat{\beta}_{1s} \times T + \widehat{\beta}_{2s} \times T^2,$$

where $Spec_s^T$ is the predicted return to T years of firm tenure (up to a squared term). It is worth noting that the estimated $\widehat{\beta}_{2s}$'s are small, and the bilateral correlation between any two $Spec_s^T$, $\forall$ $T \in [1, 10]$, is consistently higher than 95%. Importantly, the empirical results below are robust to using different $Spec_s^T$ estimated over different time horizons. I choose $T = 5$ as the baseline to construct the sector measures of specificity.

To account for the unexplained match-specific productivity that affects the continuation of a relationship, I include a continuation dummy, $Cont_{kmt}$, which equals 1 for tenure that exceeds one year. I also control for workers' labor-market experience, $Work\_Exp_{it}$, (and its squared) to parse out the effects of general (transferable) skills on wages.[34] As in most wage equations, I include a set of controls (Γ_{kmst}) in the regression according to (13), including education (and its squared), a dummy for union membership, as well as sector, occupation (at the 1-digit level), state and year fixed effects.

Data on wages, employees' tenure and other characteristics are taken from the Panel Study of Income Dynamics (PSID) dataset for 20 waves over 1974-1993.[35] I use U.S. as the reference country for two reasons. First, it is the only country I have access to for estimating the tenure effects for a large number of sectors. Second, according to the model, a flexible labor market in the U.S. implies lower investments in firm-specific skills for all sectors, compared to countries with more protective

[34] I also include interaction terms between $Work\_Exp_{kt}$ with SEC_s to partial out the wage effects of general skills, which may differ across sectors. The ranking of the estimated firm tenure effects changes slightly, but the main results of gravity estimation are very robust to using these alternative estimated tenure effects.

[35] I choose this sample period for data quality concerns.

labor laws. To the extent that different tenure effects are observed across sectors in the U.S., we can expect even more pronounced differences across sectors in countries with more protective labor laws. Therefore, as long as the rankings of these estimates are stable across countries, the predicted results are identifiable.[36]

Following the literature on the effects of seniority on wages, I use a PSID sample that includes males who are heads of households, aged between 21 and 60 (inclusive), worked for at least 500 hours in a year, and earned real hourly wages of at least $2 (in 1990 dollars). Furthermore, because trade data for a large number of countries are only available for manufacturing sectors, I use observations from only manufacturing sectors in the PSID sample to estimate tenure effects. I adopt the variable-construction procedure proposed by Kambourov and Manovskii (2009) to improve data quality. In particular, this procedure aims at making an individual's self-reported values of tenure and experience to be consistent across years (see Appendix B). All manufacturing sectors are included in estimating the return to firm tenure by sector. Although tenure effects (β_{1s}, β_{2s}) can potentially be estimated for all manufacturing sectors, I discard the estimates of the sectors that have fewer than 70 observations in the cleaned PSID sample (after applying the standard filters mentioned in Appendix B).[37] With this cutoff, I obtain a list of 36 3-digit PSID-classified sector measures of firm-specific skill intensity (out of 76 sectors in total).[38]

Table 1 lists the estimates of 5-year returns to tenure of 36 sectors included in the regression analyses. Among these 36 estimates, 23 of them are significantly different from 0 at the 5% significance level.[39] The top three specific skill-intensive sectors are Petroleum Refining (291), Beverages (208), and Cement, Concrete, Gypsum, and Plaster products (324, 327). For example, a worker who stays with the same employer for five years in the "Beverages" sector would experience approximately 25 percent real wage growth on average due to tenure with the same the employer. Since petroleum companies are oftentimes state-owned enterprises in many countries, with their associated exports determined by a government's strategic reasons rather than comparative advantage, I will perform a battery of sensitivity analyses to ensure that the main results are not driven by this sector. It is worth emphasizing in advance that excluding that sector does not affect the main results of the paper.

[36] The approach of using sector measures constructed using U.S. data originates from Rajan and Zingales (1998). In their study of the effects of countries' financial development on differential growth by sector, they use sector measures of dependence on external finance, which are constructed using data of U.S. publicly-listed firms. Subsequent empirical studies on comparative advantage have used the same approach. See Romalis (2003), Levchenko (2007), Nunn (2007) and Manova (2010), among others.

[37] The results are insensitive to small adjustments to this minimum observation requirement. I have decreased the requirement to 60 and the main empirical results of the paper remain unchanged. However, once I decrease this requirement significantly, say below 50, the main results will start being dominated by a few outliers of estimated tenure, determined by a few individuals in the occupation.

[38] Under the original census classification, the PSID dataset contains data for 81 (3-digit) census manufacturing sectors. However, five of them have no mapping to SIC codes, such as "Not specified electrical machinery, equipment, and supplies."

[39] Estimates which are not significantly different from 0 are very close to 0. I am aware that estimates of two consecutive sectors in the ranking may not be significantly different from each other. However, existing measures on contract dependence, for example, are estimated using the averaging approach and may have the same problem.

For the bottom 3 sectors (Ordnance; Glass and glass products; Radio, T.V. and communication equipment), the average firm-tenure effects are negative. There are at least two possible reasons for this. First, since an individual's working experience is controlled for in the regression, the partial effects of firm-specific skills could be negative for sectors in which general skills account for a substantial part of the real wage growth. In this situation, staying with the same firm for a longer time may reduce the accumulation of general skills and therefore wages. Second, if the average nominal wage growth in a sector is lower than inflation, the average real wage is decreasing in that sector. Nevertheless, in the sample of 36 sectors, 33 of them show non-negative estimated returns to firm tenure. All estimates are normalized to range between 0 and 1 to be used in the gravity estimation. Also listed in Table 1 are normalized measures for estimated returns to 5 and 10 years of firm tenure, with and without experience effects controlled for.

One may be concerned about the validity of the empirical results based on a sample with about half of the sectors dropped due to limited availability of the estimated sector proxies. Nevertheless, the fact that a sector has sufficient observations to remain in the final sample implies that it is a large industry, at least in the U.S. It turns out that the sectors included account for about 60 percent of global manufacturing trade flows in 1995, for both my sample (84 countries) and the sample that includes exporters without labor market protection measures (184 countries).

5.2 Other Country-level and Sector-level Data

Industry-level data on bilateral exports in 1995 are adopted from Feenstra (2000) World Trade Flows Dataset. I choose this year for its proximity to the time period for which labor regulation indices and other country-level data are available. The main regression results remain significant if I use data from other years in the 1990s.[40] To unify the definition of a sector, which varies across data sources with different industry classifications, I define a sector as an SIC87 3-digit category. Since Feenstra's trade data are classified based on the SITC (rev.2) system, I first map each SITC (4-digit) code into a unique SIC code using the concordance file on Feenstra's website.[41] For SIC codes that have multiple SITC codes mapped, I aggregate export values across SITC codes within the same SIC category. Similarly, for other sector-level data under classifications different from the SIC classification, I use publicly available concordance files to convert the industry codes into SIC codes. The sources of the concordance files and the mapping algorithms between different classification are discussed in detail in Appendix B. The original SIC87 3-digit classification has 140 sectors. However, using the concordance file from Feenstra's website, 118 SIC87 3-digit sectors suffice to cover all observations in the trade dataset. The availability of specific skill intensity proxies reduces the number of sectors from 118 to 62.

[40] Results are available upon request.

[41] Concordance file: http://cid.econ.ucdavis.edu/usixd/wp5515d.html
Since there are more SITC categories than SIC categories, I allow multiple mapping from SITC to SIC, but not vice versa.

Data on labor regulations for 84 countries are taken from Botero et al. (2004).[42] Based on countries' legal documents from the late 1990s, the authors codify the degree of regulations of labor markets on employment, collective relations and social security. Using principal component analysis, I compute the weighted average of the two main indices in their paper – "Employment Laws" index and "Collective Relations" index. The "Employment Laws" index represents costs associated with firing and employment contract adjustment. Specifically, it is an unweighted average of four subindices: (i) alternative employment contracts, (ii) costs of increasing hours worked, (iii) cost of firing workers, (iv) dismissal procedures. The "Collective Relations" index is an unweighted average of two subindices: (i) labor union power and (ii) collective disputes. A higher index implies more stringent labor laws. Table 2 lists the countries' indices of labor law protection in the sample. The two countries with the most protective labor laws (according to the average of the two indices) are Kazakhstan (1.000) and Portugal (0.985), while the two countries with the most flexible labor regulations are Nigeria (0.023) and Malaysia (0.000).

To estimate the gravity equation, I obtain bilateral "trade costs" variables from different sources. The first source is a data set from the Centre d'Etudes Prospectives et d'Informations Internationales (CEPII), which contains information on geographical variables and colonial relationships. For missing data, I refer to Glick and Rose (2002) and CIA World Factbook to augment the CEPII data. Second, I obtain information on whether two countries are signatories of a regional trade agreement (RTA) from the websites of WTO and various regional trade blocs. Finally, I obtain information for whether two countries share a common legal origin from Botero et al. (2004). See Appendix B for more details of these variables, as well as other country-level and sector-level variables used in the empirical analysis.

The final sample contains 84 countries and 62 SIC 3-digit sectors, which captures about 58% of global manufacturing exports in 1995, including the out-of-sample countries and sectors.

6 Results

6.1 Cross-country Correlation between Labor Protection and Industrial Specialization

Before examining the effects of labor laws on export patterns based on the framework developed in section 4, I first present reduced-form cross-country evidence to verify whether countries with protective labor laws have their exports biased toward more specific skill-intensive sectors. To this end, I construct country i's proxy for firm-specific skill intensity of exports, $XSpec_i$, as follows:

$$XSpec_i = \sum_s \left(\frac{X_{is}}{X_i} \right) Spec_s, \tag{14}$$

[42] The Botero et al. (2004) dataset contains 85 countries. Here, I do not include Taiwan in my sample, as trade costs data for Taiwan are not available.

where i and s stand for exporting country and sector, respectively. X_{is} is the value of i's exports (in US 2000 dollars) to the rest of the world in s, X_i is i's total exports. $Spec_s$ is the measure of firm-specific skill intensity for sector s, an estimate from estimating (13).

The model predicts a positive relationship between $XSpec_i$ and workers' bargaining power in country i. As is mentioned in the introduction, Figure 2 suggests a strongly positive correlation between $XSpec_i$ and countries' degree of labor market protection for the sample countries in 1995. Notice that both developed and developing countries are well represented on both ends of the distribution of the labor protection indices. Controlling for exporting countries' factor abundance (capital, human capital and natural resources) strengthens the correlation (Figure 3). The positive relationship is observed among the OECD countries (members by the 90s), after factoring out the effects of relative factor abundance (Figure 4).

These figures mask important cross-country heterogeneity. To provide evidence more systematically about the proposed comparative advantage, I estimate the following equation

$$\ln X_{is} = \alpha_i + \alpha_s + \beta Labor_i \times Spec_s + \mathbf{Z}_i \mathbf{h}_s \boldsymbol{\gamma} + e_{is}, \quad (15)$$

where i and s stand for country and sector, respectively. $\ln X_{is}$ is (log) country i's exports in sector s to the rest of the world; $Labor_i$ is i's index of labor protection; $\mathbf{Z}_i$ is a vector of country characteristics, such as physical and human capital endowments, while $\mathbf{h}_s$ is a vector of sector characteristics, such as physical and human capital intensities. The interaction terms $\mathbf{Z}_i\mathbf{h}$ are included to control for countries' characteristics besides labor market institutions that affect their comparative advantages; e_{is} is the error term; α_i and α_s represent country and sector fixed effects. The functional form of the specification is identical to the baseline specification in Nunn (2007).

Table 3 presents the results from estimating (15). Standardized beta coefficients are reported, so that the magnitude of the coefficients can be interpreted in terms of standard-deviation units. Without controlling for other sources of comparative advantage, column (1) reports results that countries with more protective labor laws export relatively more to the rest of the world in specific-skill intensive sectors, consistent with the channel of comparative advantage proposed in the model. The coefficient on $Labor_i \times Spec_s$ is positive and significant at the 5 percent level. Specifically, one standard deviation increase in $Labor_i \times Spec_s$ is associated with a 0.08 standard-deviation increase in $\ln X_{is}$. In columns (2) to (3), I control for the Heckscher-Ohlin determinants of comparative advantage by including the interaction terms between a country's factor endowment and a sector's factor intensity. Adding interaction terms for physical, human capital and natural resources does not affect the significance of the coefficient on $Labor_i \times Spec$. Notice that the sample size decreases substantially when factor endowment controls are included. Following Nunn (2007), in column (4), I add an interaction term between a country's (log) per capita GDP and the a sector's value-added share, as well as an interaction between a country's per capita income and the sectoral annualized growth rate in the U.S.[43] The coefficient on the labor market interaction term remains significant and similar in magnitude.

Recent research argues that industrial specialization due to international trade may in turn affect institutions (Acemoglu et al., 2005; Do and Levchenko, 2007). To address this potential reverse causality, I use legal origins (British, French, German, Scandinavian legal origins) as instruments for labor protection, and estimate (15) using 2SLS.[44] Botero et al. (2004) also use legal origins as instruments for countries' labor market institutions to study the impact of labor protection on labor market outcomes.[45] The estimates in the second stage of the 2SLS estimation, as shown in Panel B, become more significant, both statistically and economically. Although a country's legal origin can be used to isolate countries' variation in labor market institutions unaffected by trade flows, they may also affect specialization through other channels, such as contracting institutions, as has been postulated by Levchenko (2007), Nunn (2007) and Costinot (2009a). One should therefore interpret the stronger 2SLS results here with caution, and notice that the legal origin of a country may not satisfy the exclusion restriction criteria for a valid instrument.[46] In the following gravity estimation, I do not use legal origins as instruments, even though such 2SLS regressions often yield more statistically significant results (in unreported results).

In addition to the factor endowment interactions added in the previous table, in Table 4, I add more interaction terms between sectoral firm specificity and various country characteristics, including factor endowments and per capita GDP. In addition, recent studies have shown that a country's contracting institution is an important determinant of trade patterns. In my model, investments in specific skills are assumed to be completely non-contractible. One can argue that if these investments are partially contractible, with the degree of contractibility of investments affecting workers' investment decisions, not controlling for a country's contracting institutions would result in biased estimation of the effects of labor market institutions. To this end, I add an interaction term between country i's judicial quality and sector s's specific skill intensity in column (5). In short, controlling for interactions with different country characteristics, the coefficient on $Labor_i \times Spec_s$ remains significant and similar in magnitude across specifications.

6.2 The Impact of Labor Laws on Export Volume

In this section, I test whether labor protection affects countries' intensive and extensive margins of trade by estimating sector-level gravity equations. The baseline results for testing the intensive margin are based on traditional gravity estimation using OLS. After presenting the OLS results, I implement the two-stage estimation procedure as specified in (11) and (12) above.

[43] Appendix B describes these variables in detail.

[44] The Socialist legal origin is the comparison group.

[45] In unreported results, I find that legal origins strongly predict labor law rigidity in the first stage of the 2SLS estimation, with an R^2 equal to 0.43.

[46] Nunn (2007) also uses legal origins as instruments for contracting institutions, and find more significant 2SLS estimates than the OLS estimates. He also discusses that these instruments may not satisfy the exclusion restritcions.

Each observation in the sample represents a bilateral trade relationship in each sector. The sample includes 958272 potential bilateral relationships (84 exporting countries $\times$ 184 importing countries $\times$ 62 sectors). In my sample, about half of the countries do not trade with each other in 1995. This is consistent with what Helpman, Melitz and Rubinstein (2008) find for their sample in the 1980's. At the sector level, about 88% of the potential trade relationships are zeros, rendering the need to handle the extensive margin of trade carefully.[47]

First, I estimate (11) using OLS. In column (1) of Table 5, I regress (log) export volume from i to j in sector s ($\ln X_{ijs}$) on the interaction term between i's labor protection and s's firm-specific skill intensity $Labor_i \times Spec_s$. I find a positive point estimate on the interaction term ($\widehat{\beta} = 0.759$, $t - stat = 7.79$), supporting Proposition 2. As specified in (11), included in the regression are exporter, importer and sector fixed effects. Moreover, I always cluster standard errors by importer-exporter pair to account for the correlation between unobserved trade barriers (u_{ijs} and ν_{ijs}) common across sectors for each country pair.

To control for observable trade costs and distances that may affect the revealed pattern of trade, I include nine "trade costs" variables between two trading partners in the regression. Consistent with the traditional gravity estimates, the estimated coefficients on these "trade costs" variables show that two countries trade relatively more with each other if (i) they are closer to each other, (ii) have ever been in a colonial relationship, (iii) have majority of the populations speaking a common language, (iv) share a common border, (v) share the same legal origin and (vi) belong to the same currency union. The estimates on the dummies for whether one of the countries is landlocked and whether one of the countries is an island are insignificant. Two land-locked countries appear to trade more between themselves, contrasting the existing findings. Unless specified otherwise, this entire set of "trade costs" will be controlled for in the rest of the gravity estimation.

The sectoral volume of exports depends on the competitiveness in the sector of the importing country, which according to (11), is captured by p_{js} ($\ln(P_{js})$). Without the measures of sectoral prices for a large number of countries, I use the interaction term between the consumption price level (relative to the U.S.) of country j and the dummy for sector s to proxy for p_{js}, following Manova (2010). In column (2), I re-run the regression of column (1) by including these interactions. The baseline estimates remain robust.

In addition to all regressors included in column (2), column (3) takes into account the Heckscher-Ohlin determinants of comparative advantage by including interactions between countries' factor endowments and sectors' factor intensities. Controlling for the effects of per capita endowments of capital and human capital on export volumes, labor market institutions remain a significant determinant of comparative advantage. Additionally, column (4) controls for the effects of natural resource endowment on trade flows.

[47] Manova (2010) finds that 75% of potential trade flows being 0 at a more aggregated industry level (28 ISIC sectors).

The effect of labor regulations is economically significant. For example, if the U.S., the country at the 10th percentile of the distribution of labor protection, adopts the set of labor laws of Germany, the country at the 90th percentile, the gap between the average unilateral export volume of office furniture (75th percentile in terms of firm specificity of skills) and that of ship and boat building and repairing (25th percentile in terms of firm specificity of skills) would increase by about 15 percentage points.[48]

According to (11), the sectoral volume of exports also depends positively on the number of producers in the exporting country. In light of this, I include the (log) number of firms in the exporter's sector as a control (column (5)).[49] The baseline estimates again remain statistically significant. In column (6), standardized beta coefficients are reported for the same regression of column (5). As can been seen, a standard deviation increase in $Labor_i \times Spec_s$ is associated with a 0.08 standard deviation increase in the sectoral export value. The magnitude of the coefficient is very close to that from the reduced-form regressions reported in Table 3. Taken at face value, the magnitude is about one-fifth of that associated with comparative advantage due to human capital endowment.

6.3 First-stage Estimation of the Extensive Margin of Trade

Next I present the empirical results of the two-stage estimation outlined in section 4. In particular, I disentangle the impacts of labor market institutions on trade patterns into that for firm selection into exporting, and that for export volumes.

Proposition 2 posits that countries with more protective labor laws are more likely to export in specific skill-intensive sectors. I test this proposition by estimating its empirical counterpart, formulated as a Probit equation in (12). The dependent variable is an indicator which is equal to 1 if positive trade flows are observed from i to j in s, and 0 otherwise.

I use a Probit model to estimate (12). Exporter, importer, sector fixed effects and proxies for sectoral prices in the importing country are always included. In addition to testing the extensive margin, I use the predicted probability based on this estimation to construct measures to correct for the two biases discussed in Helpman, Melitz and Rubinstein (2008). Variables that satisfy the exclusion restriction criteria, which are required to correct for the standard Heckman selection, are needed. Thus, in addition to the nine "trade costs" variables included in the gravity estimation above, I include two additional trade barrier variables in the regressions – the number of procedures

[48] This comparative statics exercise is based on the estimates in column (4). Formally, this "diff-in-diff" result is derived from the following formula $\exp\left[\triangle \ln X_{ijs}^{i'} - \triangle \ln X_{ijs'}^{i'}\right] = \exp\left[\widehat{\beta} \triangle Labor_i^{i'} \times \triangle Spec_s\right] \simeq 1.148$ where $\widehat{\beta} \simeq 1.001$, The difference in the indices of labor protection between Germany and the U.S. is $\triangle Labor_i^{i'} = 0.858 - 0.102$, and the difference in specificity between the two industries is $\triangle Spec_s \simeq 0.502 - 0.319$. Notice that this "diff-in-diff" exercise has no prediction on the direction of the change in exports of either sector.

[49] The measure for the number of firms per sector in 1995 is from UNIDO (2005) dataset, which is disaggregated only at the ISIC 3-digit industry level (28 industries).

and the number of days required to legally start a business in both importing and exporting countries. These two measures are from Djankov et al. (2002) for a subset of the exporting countries in my sample. Without measures of fixed trade costs, they are used as proxies for legal barriers that deter any cross-border transactions. These two entry cost variables are included as regressors in the first-stage equation, but will be excluded in the second-stage gravity estimation, in the belief that they only affect countries' participation in exports, but not the export volume conditional on positive exports. In other words, lower entry costs in either the importing or exporting country increase the chance of firms' selection into export markets, and thus increase the likelihood of trade between the two countries. But once the hurdle is overcome and a trade relationship is established, these start-up costs do not impair trade flows. Averages of these two variables between the importing and exporting countries are used, similar to Manova (2010), assuming that firm entry costs affect domestic and foreign exporting firms symmetrically.[50]

Table 6 presents the results of the first-stage Probit estimation. The specifications are parallel to those in Table 5 in terms of the set of regressors included. Most of the estimated coefficients on "trade costs" variables have the same signs as those reported in Table 5 (although not always significant). Importantly, the estimates across all four specifications show that countries with more protective labor laws are more likely to export to another country in specific skill-intensive sectors. These findings support Proposition 2, and are robust to the inclusion of variables for the traditional sources of comparative advantage.

Based on the model, a higher probability of exporting is a direct result of a larger fraction of existing firms self-selecting into export markets. Therefore, as mentioned in Helpman, Melitz and Rubinstein (2008), even without firm-level data, Lemma 2 can be verified based on the empirical results at the country-sector level. In other words, the results in Table 6 can be interpreted as follows: relatively more firms self-select into exporting in the specific skill-intensive sectors in countries where labor laws are more protective.

6.4 Second-stage Estimation of the Trade Flow Equation

Using the predicted probabilities obtained from the Probit estimation, I correct both types of biases in the OLS estimation as discussed in section 4, and examine whether labor regulations continue to affect the pattern of trade flows. I estimate the second-stage trade flow equation (12) controlling for the effects of firm self-selection into exporting. Briefly speaking, to correct for the bias due to this unobserved firm heterogeneity, I include an estimate of ω_{ijs} as a regressor. As discussed in Appendix A, a consistent estimate of ω_{ijs} in (12) is $\widehat{\overline{\omega}}_{ijs} \equiv \ln\left[\exp\left(\beta_z\left(\widehat{z}^*_{ijs}+\widehat{\overline{e}}^*_{ijs}\right)\right)-1\right]$, where $\widehat{z}^*_{ijs}=\Phi^{-1}\left(\widehat{\rho}_{ijs}\right)$, $\widehat{\overline{e}}^*_{ijs}=\phi\left(\widehat{\rho}_{ijs}\right)/\ \Phi\left(\widehat{\rho}_{ijs}\right)$, and $\widehat{\rho}_{ijs}$ is the predicted probability of exporting (by sector) from estimating first-stage equation. Additionally, to correct the Heckman selection bias, I

[50] Helpman, Melitz and Rubinstein (2008) use dummy variables, which are set equal to one if both the importing and the exporting countries have business start-up costs (e.g. days to start a business) that are higher than the median in the sample.

include the inverse Mills' ratio $\widehat{\overline{e}}_{ijs}^{*}$ as a stand-alone regressor. Because $\widehat{\overline{\omega}}_{ijs}$ is a non-linear function of $\widehat{z}_{ijs}^{*}$ and $\widehat{\overline{e}}_{ijs}^{*}$, I estimate (11) using maximum likelihood estimation (MLE).

Table 7 presents the results of the second-stage MLE estimation. With all regressors from the first-stage beside the two "entry cost" variables included, the interaction term for labor protection remains positive and significant for all specifications. This result is robust to the inclusion of the interactions for the Heckscher-Ohlin sources of comparative advantage. Notice that the coefficients should not be compared directly with their OLS counterparts in Table 5, as only a subset of countries have data on entry costs from Djankov et al. (2002). In column (6), I report the OLS estimates for the results that correspond to column (5), using the same sample. As is shown, the OLS point estimates are larger than the MLE estimates, suggesting that the upward bias arising from omitting the extensive margin of trade dominates the Heckman selection bias in the OLS estimates. This finding is consistent with Helpman, Melitz and Rubinstein (2008).

To check the robustness of the MLE results, I relax the Pareto distribution assumption of firm productivity, as well as the joint normality assumption of the unobserved fixed and variable trade costs (u_{ijs} and v_{ijs}). To correct the two sources of biases, I first assign the predicted probability $\widehat{\rho}_{ijs}$'s of exporting into 50 bins, each having the same number of observations. Then I replace $\widehat{\overline{\omega}}_{ijs}$ and $\widehat{\overline{e}}_{ijs}^{*}$ by these 50 dummies, and estimate the second-stage gravity equation again. The results estimated using OLS are presented in Panel B of Table 6. They largely confirm the MLE results in Panel A.

6.5 Robustness

To check the robustness of the gravity estimation, I re-run the regression of column (4) in Table 7 using various subsamples of exporting countries.[51] The results for the sensitivity analyses are reported in Table 8. First, I separate the sample into OECD (column (1)) and non-OECD (column (2)) exporters. The coefficient on $Labor_i \times Spec_s$ is significant in both samples, but is quantitatively larger for the non-OECD one. Given that petroleum refining is the most firm-specific skill intensive sector according to my estimation, one can be concerned about my results being driven by the large oil exporting countries, for which comparative advantage may not be the main force shaping trade patterns. To tackle this issue, we exclude exporting countries that have more than half of the total exports coming from the "petroleum refining exports" sector (column (3)). In column (4), I simply exclude the sector of petroleum refining. Excluding oil exporting countries or the entire petroleum-refining industry from the sample does not affect the significance of the results. Finally,

[51] I use this specification instead of the one in column (5) because of concerns of potential collinearity between institutions and the number of firms in a given exporting country. For example, better contracting institutions are often associated with lower business costs, which encourage entrepreneurship, and therefore increase the number of firms in a given country. Moreover, this effect is probably different across sectors with different degrees of contract dependence, fixed costs of entry, and so on. It is noted that the results become even stronger after the inclusion of the number of variables as a control. In unreported results, when the (log) number of firms by sector is added as a regressor, the estimated coefficient on $Labor \times Spec$ becomes even more robust.

to ensure that my results are not driven by a few outlier industries, I drop the top two and the bottom two firm-specific skill intensive sectors from the regression. As expected, the coefficient on $Labor_i \times Spec_s$ decreases in size, but remains significant.

In Table 9, I check whether the baseline results are driven by alternative hypotheses proposed in the existing literature on institutional comparative advantage. First, one may claim that since uncertainty of firm performance would deter workers' ex-ante investments in firm-specific skills, the sector measure of firm-specific skill intensity may be highly correlated with sales volatility. If this is the case, the results reported so far simply support the findings by Cuñat and Melitz (2010a), who show both theoretically and empirically that countries with flexible (rigid) labor markets specialize in volatile (stable) sectors. First, notice that the bilateral correlation between sales volatility and specific skill intensity in my sample is only -0.06 (see Table A2 in the appendix). To address the problem more formally, I estimate the specification for column (4) in Table 7 by adding an interaction between a country's labor protection and sectoral sales volatility. The results in column (1) support the Cuñat-Melitz prediction: countries with more protective labor laws tend to export *less* in the sectors that exhibit higher sales uncertainty.

In column (2), I use gross job flow rates in the U.S. at the sector level from Davis, Haltiwanger and Schuh (1996) as a measure for sectoral volatility. The measure captures the degree of instability of employer-employee relationships across sectors. The coefficient on the interaction with gross job flows is negative and significant, providing another piece of supporting evidence for Cuñat and Melitz (2010a). Importantly, sectoral differences in specific skill intensity remain an independent and important channel through which labor laws shape trade patterns.

Next, I examine whether cross-country differences in contracting institutions affect the main results. As discussed in the model, another important source of comparative advantage regarding firm-specific investments is the quality of domestic contracting institutions. In the present context, the underinvestment problem becomes less severe if contracts are more complete, potentially through better contract enforcement. Furthermore, recent literature on institutional comparative advantage shows that countries with better contracting institutions specialize in sectors that rely more on effective contract enforcement (Levchenko, 2007; Nunn, 2007). I control for this type of comparative advantage by including an interaction between the country's quality of judicial system and the sector's dependence on contract enforcement, which is the same interaction term used by Nunn (2007). Specifically, a sector's dependence on contract enforcement is proxied by the inverse of the market thickness of the upstream supplier industries. Using this sector measure, I find supporting evidence for the existing literature on contract enforcement and trade. Importantly, the argument that labor market institutions are an important source of comparative advantage remains robust.

In the last column of Table 9, I report standardized beta coefficients to compare economic significance of different institutional channels of comparative advantage. A one standard-deviation increase in the labor law interaction is associated with a 0.06 standard deviation increase in (log) export volume. While it seems small, its impact is non-negligible. As a comparison, the beta coefficient on the labor-law-job-flow interaction is -0.07, while that on the legal-contract interaction is 0.12 (column (6)).[52]

After examining the effects of other sources of institutional comparative advantage, I verify the robustness of the results by sequentially isolating the effects of other country characteristics on the trade patterns. In Table 10, I interact specific skill intensity with different exporting country characteristics, and include the interaction terms as controls. The country characteristics that I consider include: (1) log GDP per capita; (2) human capital endowment; (3) physical capital endowment; (4) quality of the judicial system; (5) the level of financial development. Moreover, all regressions in Table 10 already control for the interactions for the Heckscher-Ohlin sources of comparative advantage. With all these country control interactions included, the coefficient on the labor protection interaction remains positive and significant,

Finally, to confirm that firm specific skill intensity is a crucial sectoral channel through which labor market institutions shape trade patterns, and is independent from the effects of other sectoral characteristics, I interact the labor protection index with various sector measures. The sector-level attributes that are considered include: (1) the sector's share of total manufacturing value added; (2) skill intensity; (3) capital intensity; (4) the dependence on contract enforcement; (5) dependence on external finance and (6) total factor productivity growth rate. All these measures are constructed using U.S. manufacturing firms over the 1990s. Details about these sector measures can be found in Appendix B. As Table 11 shows, controlling for the standard determinants of trade patterns, the type of comparative advantage proposed in this paper remains robust.

7 Conclusion

This paper identifies a new source of comparative advantage arising from the interaction between workers' investments in firm-specific skills and a country's labor regulations. Importantly, I show that this endogenous channel of comparative advantage is independent of the previously examined sectoral channel through which labor market institutions affect trade patterns.

I develop a simple model to show that workers have increased incentive to acquire firm-specific skills relative to general skills in more protective labor markets. By embedding this model in a multi-sector open-economy framework, I show that countries where labor laws are more protective specialize in firm-specific skill-intensive sectors. In particular, for a given importer, countries with more protective labor laws export relatively more, and are more likely to export in industries for which firm-specific skills are more important.

[52] Chor (2010) finds the same order of magnitude of the beta coefficients on these institutional comparative advantage interactions.

By estimating sector-level gravity equations over a sample of 84 countries, I find supporting evidence for the theoretical predictions. The empirical results are robust to the correction of the biases arising from countries' selection into trade partners, and firm self-selection into exporting. Importantly, the empirical findings are independent of other sources of comparative advantage, including factor endowments, income and contracting institutions.

Future research includes constructing sector measures for specific skill intensity using data from other countries, and extending the model in a dynamic framework to study labor market dynamics. A dynamic model would shed light on the effects of labor laws on workers' on-the-job and off-the-job investment decisions, which in turn affect trade patterns. It is also important to examine how trade openness, by affecting workers' skill acquisition, may reinforce persistent differences in labor market institutions across countries.

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A Proofs and Derivation

A.1 Proof of Lemma 1

Recall from the text that

1. $\varsigma_{\phi} \equiv \partial \ln f^{*}(\phi,\lambda)/\partial \ln \phi = \lambda/\left(1-\lambda\eta\right);$
2. $\varsigma_{\lambda} \equiv \partial \ln f^{*}(\phi,\lambda)/\partial \ln \lambda = \left(1-\lambda\eta\right)^{-2}\ln\left(\phi\lambda\eta B\overline{h}\right) + \eta\left(1-\lambda\eta\right)^{-2}\ln\left(\epsilon\overline{h}\right);$
3. $\ln f = \frac{1}{1-\lambda\eta}\left[\lambda \ln\left(\phi\lambda\eta B\overline{h}\right) + \left(1-\lambda\eta\right)\ln \epsilon\overline{h}\right].$

$\partial\varsigma_{\phi}/\partial\phi = \left(1-\lambda\eta\right)^{-2} > 0$. Although the sign of the elasticity of f with respect to λ depends on parameter values,[53] $\partial\varsigma_{\lambda}/\partial\phi = \left(1-\lambda\eta\right)^{-2}\phi^{-1}$ is unambiguously positive.■

A.2 Rewriting the employer's maximization problem in 2.5.3

By replacing $R\left(\phi,\lambda,\epsilon\right)$ by $D^{1-\eta}\left(a\left(\phi,\lambda,\epsilon\right)l\right)^{\eta}$ and $a\left(\lambda,\phi,\epsilon\right) = \left[\phi\lambda\eta B\left(\epsilon\overline{h}^{1-\lambda}\right)^{\eta}\right]^{\frac{1}{1-\lambda\eta}}$ (from (3)) in $\widetilde{\pi}\left(\phi,\lambda,\epsilon\right) = R\left(\phi,\lambda,\epsilon\right) - a\left(\phi,\lambda,\epsilon\right)l - \overline{h}l$, I can express $\widetilde{\pi}\left(\phi,\lambda,\epsilon\right)$ in terms of parameter values and ϵ as

$$\widetilde{\pi}\left(\phi,\lambda,\epsilon\right) = \left(D^{1-\eta}\epsilon^{\eta}\right)^{\frac{1}{1-\lambda\eta}}\psi\left(\phi,\lambda\right)\left(\overline{h}l\right)^{\delta(\lambda)} - \overline{h}l \tag{16}$$

where $\psi\left(\phi,\lambda\right) = \left(\phi\lambda\eta\right)^{\frac{\lambda\eta}{1-\lambda\eta}}\left(1-\phi\lambda\eta\right)$. Since $\delta\left(\lambda\right) = \left(1-\lambda\right)\eta/\left(1-\lambda\eta\right) \in (0,1)$, the maximization problem with respect to l is convex. The first order condition of the problem has a unique solution.
■

A.3 Derivation of p, y, R and $\widetilde{\pi}$

Using

1. $\psi\left(\phi,\lambda\right) = \left(\phi\lambda\eta\right)^{\frac{\lambda\eta}{1-\lambda\eta}}\left(1-\phi\lambda\eta\right)$
2. $l^{*} = \left(\delta\left(\lambda\right)\left(A^{1-\eta}\epsilon^{\eta}\right)^{\frac{1}{1-\lambda\eta}}\psi\left(\phi,\lambda\right)\right)^{\frac{1}{1-\delta(\lambda)}}\overline{h}^{-1}$
3. $f^{*} = \left[\left(\phi\lambda\eta B\epsilon^{\eta}\right)^{\lambda}\overline{h}^{1-\lambda}\right]^{\frac{1}{1-\lambda\eta}},$

The price of a firm with productivity ϵ can be expressed as $p(\phi,\lambda,\epsilon) = \left(D/f^{*}l^{*}\right)^{1-\eta} = \Theta(\phi,\lambda)/\epsilon\eta$, where $\Theta\left(\phi,\lambda\right) = \widetilde{\lambda}\phi^{-\lambda}\left(\left(1-\lambda\eta\right)/\left(1-\phi\lambda\eta\right)\right)^{1-\lambda}$ and $\widetilde{\lambda} = \left(1-\lambda\right)^{-(1-\lambda)}\lambda^{-\lambda}$. Firm revenue $R\left(\epsilon\right) = Dp\left(\epsilon\right)^{1-\sigma}$ and output $y\left(\epsilon\right) = Dp\left(\epsilon\right)^{-\sigma}$ can then be solved accordingly. Using the solution to the employer's maximization problem, the net surplus of the employer $\widetilde{\pi}\left(\phi,\lambda,\epsilon\right) = D\left(\frac{\Theta(\phi,\lambda)}{\epsilon\eta}\right)^{1-\sigma}\frac{(1-\phi\lambda\eta)(1-\eta)}{1-\lambda\eta}$.
■

[53] $\varsigma_{\lambda} > 0$ if $\phi\lambda\eta B\overline{h}^{1-\eta} > \epsilon^{\eta}$ and $\varsigma_{\lambda} \leq 0$ if $\phi\lambda\eta B\overline{h}^{1-\eta} \leq \epsilon^{\eta}$.

A.4 Determining the signs of the cross partials on p, y, R and $\widetilde{\pi}$

It is useful to sign the elasticities of $\Theta(\phi,\lambda)$ with respect to ϕ and λ. Since $\ln\Theta(\phi,\lambda) = \ln\widetilde{\lambda} - (1-\lambda)\ln[(1-\phi\lambda\eta)/(1-\lambda\eta)] - \lambda\ln\phi$, it follows that

1. $\frac{\partial\ln\Theta(\phi,\lambda)}{\partial\ln\phi} = -\lambda\left(\frac{1-\phi\eta}{1-\phi\lambda\eta}\right) < 0$;
2. $\frac{\partial}{\partial\lambda}\frac{\partial\ln\Theta(\phi,\lambda)}{\partial\ln\phi} = -\left(\frac{1-\phi\eta}{1-\phi\lambda\eta}\right) - \lambda\left(\frac{\phi\eta(1-\phi\eta)}{(1-\phi\lambda\eta)^2}\right) < 0$;
3. $\frac{\partial\ln\Theta(\phi,\lambda)}{\partial\ln\lambda} = \lambda\left[-\ln\left(\frac{1-\lambda\eta}{1-\phi\lambda\eta}\right) + \frac{\phi(1-\lambda)\eta}{1-\phi\lambda\eta} - \frac{(1-\lambda)\eta}{1-\lambda\eta} - \ln\phi\right] \lesseqgtr 0.$

$\frac{\partial}{\partial\phi}\frac{\partial\ln\Theta(\phi,\lambda)}{\partial\ln\lambda} = \lambda\left[\frac{\eta-\left(2\lambda\eta-\phi(\lambda\eta)^2\right)}{1-\phi\left(2\lambda\eta-\phi(\lambda\eta)^2\right)} - \phi^{-1}\right] < 0$, since the first term inside the square brackets is less than 1. After deriving the comparative statics on $\Theta(\phi,\lambda)$, it is straightforward to do the same for $\widetilde{\pi}(\phi,\lambda,\epsilon)$ as follows.

1. $\frac{\partial\ln\widetilde{\pi}}{\partial\ln\phi} = \lambda\left[\frac{(\sigma-1)(1-\phi)}{1-\phi\lambda\eta}\right] > 0$;
2. $\frac{\partial}{\partial\lambda}\frac{\partial\ln\widetilde{\pi}}{\partial\ln\phi} > 0$;
3. $\frac{\partial}{\partial\phi}\frac{\partial\ln\widetilde{\pi}}{\partial\ln\lambda} = (\sigma-1)\lambda\left[\phi^{-1} - \frac{1-\left(2\lambda\eta-\phi(\lambda\eta)^2\right)}{1-\phi\left(2\lambda\eta-\phi(\lambda\eta)^2\right)}\right] > 0.$

Repeating the same steps for prices and revenue yields:

$$\frac{\partial\ln p}{\partial\ln\phi} < 0; \qquad \frac{\partial}{\partial\lambda}\frac{\partial\ln p}{\partial\ln\phi} < 0; \qquad \frac{\partial}{\partial\phi}\frac{\partial\ln p}{\partial\ln\lambda} < 0$$

$$\frac{\partial\ln R}{\partial\ln\phi} > 0; \qquad \frac{\partial}{\partial\lambda}\frac{\partial\ln R}{\partial\ln\phi} > 0 \qquad \frac{\partial}{\partial\phi}\frac{\partial\ln R}{\partial\ln\lambda} > 0.$$

■

A.5 Proof of Lemma 2

Recall from the main text that $\Theta_{is} = \Theta(\phi_i, \lambda(s))$ and $\Psi_{is} = \Theta_{is}\left(\frac{(1-\phi\lambda\eta)(1-\eta)}{1-\lambda\eta}\right)^{\frac{1}{1-\sigma}}$.

Consider the elasticity of $\Psi(\phi,\lambda)$ with respect to ϕ: $\frac{\partial\ln\Psi_{is}}{\partial\ln\phi} = -\frac{\lambda\eta(1-\phi)}{1-\phi\lambda\eta} < 0$. The partial impacts of higher λ or ϕ on the elasticity are

1. $\frac{\partial}{\partial\lambda}\frac{\partial\ln\Psi_{is}}{\partial\ln\phi} = -\frac{\eta(1-\phi)}{(1-\phi\lambda\eta)^2} < 0$;
2. $\frac{\partial}{\partial\phi}\frac{\partial\ln\Psi_{is}}{\partial\ln\lambda} = \frac{\partial}{\partial\phi}\left[\frac{\partial\ln\Theta_{is}}{\partial\ln\lambda} + \frac{\lambda\eta}{1-\sigma}\left[\frac{1-\phi}{(1-\phi\lambda\eta)(1-\lambda\eta)}\right]\right] = \lambda\left[\frac{1-\left(2\lambda\eta-\phi(\lambda\eta)^2\right)}{1-\phi\left(2\lambda\eta-\phi(\lambda\eta)^2\right)} - \phi^{-1}\right] < 0.$

Given that $\epsilon^*_{ijs} = \frac{\Psi_{is}\tau_{ij}}{P_{js}}\left(\frac{b_sY_j}{f_{ij}}\right)^{\frac{1}{1-\sigma}}$ (from (7)), we have

$$\frac{\partial\ln\epsilon^*_{ijs}}{\partial\ln\phi} < 0 \qquad \frac{\partial}{\partial\lambda}\frac{\partial\ln\epsilon^*_{ijs}}{\partial\ln\phi} < 0 \qquad \frac{\partial}{\partial\phi}\frac{\partial\ln\epsilon^*_{ijs}}{\partial\ln\lambda} < 0$$

Consider two exporters, i and k, which are identical, except that labor laws are more protective in country i than k, i.e. $\phi_i > \phi_k$. The ratio of the cutoffs for exporting to j between the two exporting countries is $\epsilon^*_{ijs}/\epsilon^*_{kjs} = \Psi_{is}/\Psi_{ks} < 1$. The fact that $\frac{\partial}{\partial\lambda}\frac{\partial \ln \epsilon^*_{ijs}}{\partial \ln \phi} < 0$ and $\frac{\partial}{\partial\phi}\frac{\partial \ln \epsilon^*_{ijs}}{\partial \ln \lambda} < 0$ together implies that $\epsilon^*_{ijs}/\epsilon^*_{kjs}$ is decreasing in λ.■

A.6 Proof of Proposition 2

Recall from the main text that $X_{ijs} = \frac{b_s N_{is} Y_j}{(\eta P_{js})^{1-\sigma}} (\Theta_{is}\tau_{ij})^{-(\sigma-1)} W_{ijs}$ where $W_{ijs} = \left\{ \left(\frac{\epsilon_H}{\epsilon^*_{jis}}\right)^{\xi-(\sigma-1)} - 1, 0 \right\}$. Lemma 2 postulates that $\epsilon^*_{ijs}/\epsilon^*_{kjs}$ is decreasing in λ as long as $\phi_i > \phi_k$. Therefore, $\forall W_{ijs} > 0$, W_{ijs}/W_{kjs} is increasing λ. Similarly, given that $\phi_i > \phi_k$, $X_{ijs}/X_{kjs} > 1$. Also, since $\frac{\partial}{\partial\phi}\frac{\partial \ln \Theta(\phi,\lambda)}{\partial \ln \lambda} < 0$ and $\frac{\partial}{\partial\lambda}\frac{\partial \ln \Theta(\phi,\lambda)}{\partial \ln \phi} < 0$, X_{ijs}/X_{kjs} is increasing in λ.■

A.7 Solving for firm-level variables in general equilibrium

This section discusses how to close the multi-sector open-economy model in general equilibrium and derive equation (10) in the text. To this end, I make three assumptions following Chaney (2008). First, instead of imposing the firm free-entry condition, the number of firms in each sector is assumed to be proportional to the size of the economy $w_i L_i$.[54] Second, firm profits are distributed back to workers through a global mutual fund. In particular, each worker in country i owns w_i shares of a global mutual fund, which collects and distributes firm profits. Each shareholder gets π per share without transaction costs. Thus, aggregate income of country i equals $w_i (1+\pi) L_i$, where $\pi = \left(\sum_j^N w_j L_j\right)^{-1} \sum_{i,j}^N \sum_s^S w_j L_j \left[\int_{\epsilon^*_{ijs}} \pi(\epsilon)\, dG(\epsilon)\right]$.

Finally, I assume that $\epsilon_H \to \infty$. Notice that for Proposition 2 to hold, ϵ_H needs to be bounded. Otherwise, the likelihood of a country's exporting is not defined.

Under these assumptions and the Pareto distribution assumption for ϵ, the ideal price index for goods in sector s and country i is expressed as

$$P_{is} = \left[\int_{\omega\in\Omega_{is}} p_{is}(\omega)^{1-\sigma} d\omega\right]^{\frac{1}{1-\sigma}} = \left[\sum_j^N w_j L_j \left(\frac{\eta}{\Theta_{js}}\right)^{\sigma-1} \frac{\xi}{\xi-(\sigma-1)} \left(\epsilon^*_{jis}\right)^{\sigma-1-\xi}\right]^{\frac{1}{1-\sigma}}.$$

Substituting ϵ^*_{jis} from (7) gives

$$P_{js} = \mu_1 Y_i^{\frac{1}{\xi}+\frac{1}{1-\sigma}} \Delta_i,$$

where $\mu_1 = \frac{1}{\eta}\left(\frac{\xi-(\sigma-1)}{\xi}\right)^{\frac{1}{\xi}} \left(\frac{(1-\phi\lambda\eta)(1-\eta)b_s}{1-\lambda\eta}\right)^{\frac{1}{\xi}+\frac{1}{1-\sigma}}$ and

$$\Delta_j^{-\xi} = \sum_i^N \frac{Y_i \Theta_{is}^{-\xi}}{1+\pi} \tau_{ij}^{-(\xi-(\sigma-1))} f_{ij}^{-\frac{\xi-(\sigma-1)}{\sigma-1}},$$

which captures country j's remoteness from the rest of the world. It accounts for the impact of both fixed and variable trade costs j imposes on other countries. Δ_j is positively correlated with the average trade costs for its exporters, and thus P_{js}. Notice that Δ_j is similar to "multilateral resistance" in Anderson and van Wincoop (2003). In their paper, a country's multilateral resistance

[54] Eaton and Kortum (2002) make a similar assumption by taking the set of goods as exogenously given.

depends on its trading partners' respective multilateral resistances, while here Δ_j summarizes the effects on the sectoral price of j's trading partners' nominal income, Y_i, and their degrees of labor protection, Θ_{is}, weighted by respective distances from its trading partners.

For sector s in country j, the aggregate demand term $D_{js} = P_{js}^{\sigma-1} b_s Y_j$ is now solved solely as a function of Y_j. I can express the volume of firm-level exports x_{ijs} and the productivity threshold for exporting ϵ_{ijs}^* in terms of j's income and parameters as:

$$x_{ijs}\left(\epsilon | \epsilon \geq \epsilon_{ijs}^*\right) = \mu_2 \Delta_j^{\sigma-1} Y_j^{\frac{\sigma-1}{\xi}} \left(\frac{\Theta_{is}\tau_{ij}}{\epsilon\eta}\right)^{1-\sigma}, \tag{17}$$

$$\epsilon_{ijs}^* = \mu_3 \Delta_j^{-1} Y_j^{-\frac{1}{\xi}} \tau_{ij} f_{ij}^{\frac{1}{\sigma-1}} \Psi_{is}, \tag{18}$$

where μ_2 and μ_3 are sector-specific constants.[55] Perhaps surprisingly, x_{ijs} is increasing in Δ_j. When country j is far from any country in the world, the relative distance between i and j is shorter. However, the effect of "remoteness" is likely to be dominated by both fixed and variable trade costs (f_{ij} and τ_{ij}), which deter exports and increase the exporting threshold.

Finally, the labor market clears in each country, as long as the homogeneous-good sector is active in all economies.■

A.8 Deriving X_{ijs} in equation (10)

The assumption that $N_{is} = w_i L_i$, together with (8) and (9) give the value of sectoral exports as $X_{ijs} = w_i L_i \int_{\epsilon_{ijs}^*}^{\epsilon_H} x_{ijs}(\epsilon) G(\epsilon)$. By substituting $x_{ijs}(\epsilon)$ with (17), ϵ_{jis}^* with (18), and evoking the assumption that $\epsilon_H \to \infty$, X_{ijs} can be expressed as

$$X_{ijs} = \varsigma Y_i Y_j \left(\frac{\Delta_j}{\Psi_{is}}\right)^{\xi} \frac{1}{1-\phi\lambda\eta} \tau_{ij}^{-\xi} f_{ij}^{-\frac{\xi-(\sigma-1)}{\sigma-1}}$$

where $\varsigma = \frac{\xi(1-\lambda\eta)\eta^{\xi}(1+\pi)^{-1}}{(1-\eta)[\xi-(\sigma-1)]} b_s^{\frac{\xi}{\sigma-1}} \mu_1^{\xi}$, Θ_{js} and Ψ_{js} are defined in the text.■

A.9 Deriving the empirical specifications

This section discusses the derivations of the empirical specifications (11) and (12). Following Helpman, Melitz and Rubinstein (2008), I make several parametric assumptions. For variable trade costs, let $\tau_{ijs}^{\sigma-1} \equiv D_{ij}^{\vartheta} e^{-u_{ijs}}$, where D_{ij} represents the distance between country i and country j. $u_{ijs} \sim N\left(0, \sigma_u^2\right) \forall s$ captures any (symmetric) unmeasured trade frictions for the country pair at the sector level. For fixed trade costs, let $f_{ij} \equiv \exp\left(\psi_{ex,i} + \psi_{im,j} + \varphi\psi_{ij} - \upsilon_{ijs}\right)$, where $\upsilon_{ijs} \sim N\left(0, \sigma_\upsilon^2\right)$ represents unobserved fixed trade costs for the country pair. $\psi_{ex,i}$ is a measure of observed fixed export costs in i (to any destination); $\psi_{im,j}$ captures the observed trade barrier imposed by j on all importers; ψ_{ij} represents other observed fixed trade costs that are specific to the country pair. Plugging these functions into equation (8) and taking log, I obtain the specification for the second-stage gravity equation as

$$\ln X_{ijs} = \alpha + \beta Labor_i \times Spec_s + \chi p_{js} + n_{is} + \gamma_s + \delta_i + \delta_j - \vartheta d_{ij} + \omega_{ijs} + u_{ijs}.$$

where the explanatory variable of interest $Labor_i \times Spec_s$ is an interaction term between i's degree of labor protection and sector s's firm-specific skill intensity. Together with the exporter fixed δ_j, It is

[55] $\mu_2 = b_s \mu_1^{\sigma-1}$ and $\mu_3 = b_s^{\frac{1}{1-\sigma}} \mu_1^{-1}$.

used to proxy for $\ln\left(\phi^{-\lambda}\left(\left(1-\lambda\eta\right)/\left(1-\phi\lambda\eta\right)\right)^{1-\lambda}\right)$. $\alpha=(\sigma-1)\ln\eta$ is a constant; $\gamma_s=\ln b_s+\ln\widetilde{\lambda}$ is a sector fixed effect; $n_{is}=\ln N_{is}$; $\delta_j=\ln Y_j$ is an importer fixed effect; $p_{js}=\ln P_{js}$, $d_{ij}=\ln D_{ij}$ and $\omega_{ijs}=\ln W_{ijs}$.

The econometric specification for the extensive margin of trade is derived from equation (9). In the model, when there are positive trade flows between i and j in sector s, $W_{ijs}>0$. I define a latent variable $Z_{ijs}=\left(\epsilon_H/\epsilon^*_{jis}\right)^{\sigma-1}$ such that $W_{ijs}=Z^{\delta}_{ijs}-1$, where $\delta=\frac{\xi}{\sigma-1}-1$ (see (9)), and $W_{ijs}>0$ if and only if $Z_{ijs}>1$. With ϵ^*_{ijs} solved explicitly in (7), I can express the latent variable as

$$Z_{ijs}=\left(\frac{\epsilon_H P_{js}}{\Psi_{is}\tau_{ij}}\right)^{\sigma-1}\frac{b_s Y_j}{f_{ij}}.$$

This equation serves as the foundation of the first-stage estimation. Using the stochastic fixed and variable trade costs specified above, I obtain the log-linear specification for the first-stage estimation as

$$z_{ijs}\equiv\ln Z_{ijs}=\alpha^z+\beta^z Labor_i\times Spec_s+\chi^z p_{js}+\gamma^z_s+\delta^z_i+\delta^z_j-\vartheta^z d_{ij}-\varphi^z\psi_{ij}+e_{ijs},$$

where $e_{ijs}=u_{ijs}+\upsilon_{ijs}\sim N\left(0,\sigma^2_u+\sigma^2_\upsilon\right)$ is an i.i.d. error term;[56] γ^z_s, δ^z_j and δ^z_i are sector, importer and exporter fixed effects, respectively. α^z is a constant term and ψ_{ij} is a measure of observed fixed trade costs between a country pair.[57]

With positive trade flows, $W_{ijs}>0$ and $Z_{ijs}>1$, implying $\ln Z_{ijs}>0$. Since Z_{ijs} is unobservable in the data, I use an indicator variable $I_{ijs}\in\{0,1\}$ to represent $\ln Z_{ijs}$. Specifically, I_{ijs} equals 1 if trade flows are observed from i to j in sector s, and 0 otherwise. I therefore estimate the selection equation by a Probit model as:

$$\begin{aligned}\rho_{ijs} &= \Pr\left(I_{ijs}=1|\text{ observed vars.}\right) \\ &= \Phi\left(\alpha^*+\beta^* Labor_i\times Spec_s+\chi^* p_{js}+\gamma^*_s+\delta^*_i+\delta^*_j-\vartheta^* d_{ij}-\varphi^*\psi_{ij}\right),\end{aligned} \tag{19}$$

where $\Phi(.)$ is the c.d.f. of a unit-normal distribution. All starred coefficients represent the original ones (with superscripts 'z') divided by σ_e, the standard deviation of e. This coefficient transformation is essential if a unit-normal distribution of the error term is assumed.

This Probit estimation serves two purposes. First, it tests Proposition 2. Second, it permits an imputation of $\widehat{\omega}_{ijs}$, a regressor to be included in the second-stage estimation to control for the extensive margin of trade. I use predicted probabilities of exporting $\widehat{\rho}'_{ijs}s$, from estimating (12) to impute the estimated latent variable as $\widehat{z}^*_{ijs}=\Phi^{-1}\left(\widehat{\rho}_{ijs}\right)$. In turn, I estimate W_{ijs} according to (9) as $\widehat{W}_{ijs}=\left\{\widehat{Z}^{*\delta_z}_{ijs}-1,0\right\}$, where $\delta_z=\frac{\sigma_e(\xi-(\sigma-1))}{\sigma-1}$ and $\widehat{Z}^*_{ijs}=\exp\widehat{z}^*_{ijs}$.[58] As a result, the required regressor $\widehat{\omega}_{ijs}=\ln\widehat{W}_{ijs}$ takes form as $\ln\left\{\exp\left(\delta_z\widehat{z}_{ijs}\right)-1\right\}$.

Since u_{ijs} is correlated with observable trade frictions (d_{ij}) due to the Heckman sample selection, and ω_{ijs} is also correlated with u_{ijs} because $e_{ijs}=u_{ijs}+\upsilon_{ijs}$. According to Helpman Melitz and Rubinstein (2008), a consistent estimation of ω_{ijs} requires controlling for firm selection into exporting conditional on positive exports, i.e. $\overline{\omega}_{ijs}=E\left[\omega_{ijs}|I_{ijs}=1\right]$, and the standard Heckman correction for sample selection bias, $E\left[u_{ijs}|I_{ijs}=1\right]=corr\left(u_{ijs},e_{ijs}\right)\left(\sigma_u/\sigma_e\right)\widehat{\overline{e}}^*_{ijs}$. Both terms

[56] u_{ijs} and υ_{ijs} are assumed to be uncorrelated. Therefore, u_{ijs} and υ_{ijs} are jointly normal.

[57] $Labor_i\times Spec_s$ reprensents $(1-\sigma)\ln\Psi_{is}$;
$\delta^z_j=\ln Y_j-\psi_{im,j}$; $\delta^z_i=-\psi_{ex,i}$;
$\gamma^z_s=\ln b_s$;

[58] σ_e is multiplied in front of the exponent of equation (11) because in the Probit model, all variables, including the predicted value, are divided by σ_e. See Helpman, Melitz and Rubinstein (2008) for details.

depend on $\widehat{\overline{e}}^*_{ijs} = \phi\left(\widehat{z}^*_{ijs}\right) / \Phi\left(\widehat{z}^*_{ijs}\right)$, the inverse Mills' ratio. Thus, the consistent estimate of the latent variable, $\overline{z}^*_{ijs}$ and $\overline{\omega}_{ijs}$ are $\widehat{\overline{z}}^*_{ijs} = \widehat{z}^*_{ijs} + \widehat{\overline{e}}^*_{ijs}$ and $\widehat{\overline{\omega}}^*_{ijs} \equiv \ln\left\{\exp\left(\beta\widehat{\overline{z}}^*_{ijs}\right) - 1\right\}$, respectively. Therefore, I always include both $\widehat{\overline{e}}^*_{ijs}$ and $\widehat{\overline{\omega}}^*_{ijs}$ as regressors when I estimate the second-stage trade flow equation.

B Dataset Construction and Definition of Variables

B.1 Improving the quality of the PSID data to construct sector proxies for firm-specific skill intensity

The sample for constructing the sector proxies for firm-specific skill intensity includes observations in the Panel Study of Income Dynamics (PSID) dataset (1985-1993) that satisfy the following filters in order:

1) Following the related literature, the sample is restricted to white male heads of households, aged 18 to 64, who worked in manufacturing sectors for at least 500 hours in a year, and earned real hourly wages of at least $2 (in 1990 dollars).

2) I follow the exact procedures reported in the "Variable Construction Procedures" section in Kambourov and Manovskii (2009) to enhance data quality. This procedure identifies an employer switch whenever the reported length of present employment is smaller than the time elapsed since the last interview date. Same rule applies to sector switches. An updated employee's time-series of firm tenure is constructed based on her corrected sequence of firm and sector switches. The procedure also checks consistency of the reported tenure and working experience, and make adjustments accordingly. For example, a worker may report to have worked for 8 years in the previous interview, but report 8 years again a year later. In this case, 1 year is added to the previously reported experience. Similar corrections are made for the subsequent reported experience of the same worker accordingly.

3) An individual might report to have been with the same employer, but have switched sector. In that case, within the same employer-specific job spell, the sector that appears more than half of the time is identified to be the sector for that spell. If no sector appears more than 50% of the time within a spell, all observations of that spell are dropped from the sample. This rule excludes 17% of the observations in the restricted sample after applying filter 1.

4) Although returns to firm tenure for different sector are estimated using all observations, in the end, only sectors that have at least 70 observations are retained in the sample.

B.2 Mapping industry codes from different classification systems

B.2.1 Mapping census codes to SIC72 codes

The concordance file is taken from Appendix 2 of 1981 PSID wave XIV documentation. Since there are 76 categories under the census classification (The original classification has 81 sectors, but 5 of them have no mapping to SIC72 codes), while there are 143 SIC72 categories, I restrict a SIC72 code from being mapped to more than one census codes. For the SIC72 categories that have more than one census maps (SIC72 = 282, 331, 333, 334, 335, 336, 339, 357, 379), I use the average of the specific skill intensity measures across the census categories within the same SIC category as the measure for that SIC category. Using the median has a negligible impact on the significance of the empirical results. In the end, each of the 143 SIC72 categories has a unique assignment to a census code.

B.2.2 Mapping SIC72 (3-digit) codes to SIC87 (3-digit) codes

The concordance file is taken from Bartelsman and Gray (1996) at the NBER-CES Manufacturing Industry Database.[59] Of the 140 SIC87 3-digit codes, 136 remain the same as the SIC72 codes. For those SIC87 (3-digit) categories that have multiple SIC72 (3-digit) categories identified, I choose

[59] http://www.nber.org/nberces/

the SIC72 code that accounts for the largest shipment value. As a result, each of the 143 SIC72 3-digit categories are assigned to a unique SIC87 3-digit category.

B.2.3 Mapping SITC (4-digit rev. 2) codes to SIC87 (4-digit) codes

Mapping SITC (4-digit rev.2) codes into SIC87 (4-digit) requires first converting each of the classification systems to the Harmonized system (HS 10-digit). The concordance file for mapping between SITC (4 digit revision 2) codes and HS (10-digit) codes is taken from Feenstra's website[60]. The concordance file for mapping between SIC87 (4-digit) codes and HS (10-digit) codes is taken from Peter Schott's website[61]. Following Nunn (2007), I use the number of 10-digit Harmonized-system categories shared between two codes from different classification systems to decide which SIC code to use for a given SITC code. When more than one SIC codes are identified for a SITC code, the SIC code that shares the most HS10 categories with that SITC code is used. For some rare cases, a SITC code has multiple SIC codes tied in the number of HS10 categories shared (It happens for 26 SITC codes out of 760 total). In those situations, I choose the SIC category that has the highest number of HS categories under it. As a result, 118 SIC87 3-digit codes suffice to cover all SITC codes.

B.3 Bilateral Variables

Bilateral Export Volumes at the Sector Level From Feenstra (2000), for the year 1995. Sector-level bilateral exports data are originally disaggregated at the 4-digit SITC (4-digit rev. 2) level.

Bilateral "Trade Costs" From the Centre d'Etudes Prospectives et d'Informations Internationales (CEPII).[62] Physical distance between two countries is calculated using the great circle formula. Other "trade costs" variables include 1) a "Common Language" dummy equal to 1 if at least 9% of the population in each country's speaks a common language; 2) a "Colony" dummy equal to 1 if a country had been a colony of the other in the same country pair; 3) a "Border" dummy equal to 1 if the countries share a common land border; 4) an "Island" dummy equal to 1 if one of the countries is an island; 5) a "Landlocked" dummy equal to 1 if one of the countries is landlocked. 6) a "Legal" dummy equal to 1 if both trade partners share the same legal origin (British, French, German, Scandinavian). I refer to Rose (2004) and CIA World Factbook to augment the CEPII data, so all these "trade costs" variables are available for all country pairs in my sample.

Trade Partnership From the websites of the WTO and various regional trade blocs. The RTA dummy equals 1 if both countries are signatories of one of the following regional trade agreements by 1995: EU, US-Isreal, NAFTA, Canada-US, CARICOM, PATCRA, ANZ-CERTA, CACM, MERCOSUR, ASEAN, SPARTECA.

Currency Union From Glick and Rose (2002) and Helpman, Melitz and Rubinstein (2008). A dummy equals 1 if the importing country and the exporting country used the same currency in 1995, or if money was interchangeable at a 1:1 exchange rate.

[60] http://cid.econ.ucdavis.edu/usixd/wp5515d.html
[61] http://www.som.yale.edu/faculty/pks4/sub_international.htm
[62] http://www.cepii.fr/anglaisgraph/bdd/distances.htm

B.4 Country Characteristics

Labor Regulations From Botero et al. (2004).[63] A baseline labor protection index for a country is a weighted average over two indices: the "Employment Laws" and "Collective Relations" indices, using the principal component analysis method. The unweighted average of the two indices is also used to check the robustness of the main results. Taken directly from Botero et al. (2004), the "Employment Laws" index is an unweighted average of four subindices of the labor market: (1) Alternative employment contracts (2) Costs of increasing hours worked (3) Costs of firing workers, (4) Dismissal procedures. The "Collective Relations" index is an unweighted average of (1) Labor Union Power and (2) Collective Disputes. With Taiwan excluded from the sample due to missing "trade costs" data on bilateral variables, the sample for the baseline regression contains 84 countries. Indices are constructed by the authors using information from countries' legal documents in the late 1990s.

Factor Endowments Physical capital endowment and human capital endowment are taken from Caselli (2005). A country's stock of physical capital is the natural log of the average capital stock per worker. The stock of human capital is the natural log of the ratio of workers with a high school degree to those who did not. The measures used are from 1992, the closest year of which data are available. 60 of the countries in my sample have both of these measures.

Natural resources endowment is adopted from the World Bank's (1997) "Expanding the Measure of Wealth" dataset. A country's stock of raw materials is the natural log of the estimated dollar value of natural resources stock per worker. Natural resources included in this measure are 1) pastureland, 2) cropland, 3) timber resources, 4) nontimber forest resources, 5) protected areas and 6) subsoil assets. 57 countries in my sample have this measure.

Price Level of Consumption From the Penn World Tables. It is the PPP over the value of consumption divided by the exchange rate. By construction, the price level of the U.S. is set to 1, such that cross-country price levels can be compared within a year. All countries in my sample have this measure.

Quality of the Judicial System From Kaufmann, Kraay, and Mastruzzi (2006). Data to construct this measure were collected in 1996 by World Bank staff. The measure I use is a composite of 3 subindices, which include 1) perceptions of incidence of crime; 2) the effectiveness and predictability of judiciary; 3) the enforceability of contracts. The original measure ranges from -2.5 to 2.5, with a higher number indicating better judiciary. Following Nunn (2007), I rescale it to range between 0 and 1. All countries in my sample have this measure.

Financial Development From Beck et al.'s (2000). It is equal to the amount of credit extended by banks and other financial intermediaries to the private sector divided by GDP. I use the value from 1995. 69 of the countries in my sample have this measure.

Entry Costs From Djankov et al. (2002) for 1999. "Procedures to start businesses" is the average number of legal procedures a person has to go through to start a business. "Days to start business" is the average number of days a person needs to acquire all necessary permits to start a new business.

[63] http://www.economics.harvard.edu/faculty/shleifer/Data/labor_dataset_qje_dataforweb_2005.xls

B.5 Industry Characteristics

Factor Intensities From Bartelsman and Gray's (1996) NBER-CES Database. Following Chor (2010), capital intensity is the log of real capital stock to total employment; skill intensity is the log of the ratio of non-production workers to total employment; material intensity (s_m) is the ratio of the value of material costs to the sum of value added and material costs. Averages of the intensity measures over 1990-1999 are used. Since original data are disaggregated at the SIC 4-digit level, while the level of aggregation is SIC 3-digit in this paper, I use average value over all 4-digit SIC categories within the same SIC 3-digit as my sector measure.[64] All 3-digit SIC sectors have this measure.

Dependence on Contract Enforcement From Nunn (2007). A sector is considered more dependent on contract enforcement if a larger fraction (by value) of its inputs are not sold on an organized exchange, according to the classification constructed by Rauch (1999). Since his measures are grouped into BEA IO categories, I use the mapping algorithm from Nunn (2007) to map IO categories into SIC87 categories. For cases in which multiple IO categories are identified for a given SIC category, the IO category with the greatest number of shared HS codes is used. After applying this procedure, three SIC 4-digit categories still have multiple IO categories identified. For these cases, I manually pick the unique crosswalk. As a result, 389 SIC87 4-digit categories have the contract dependence measure. The average value of all 4-digit categories within a 3-digit category is used as the sectoral measure. All 3-digit SIC sectors have this measure.

Sales Volatility From Cuñat and Melitz (2010a), through email communication. It is the employment-weighted standard deviation of sales growth for publicly listed firms from the Compustat data set over 1980-2004. All 3-digit SIC sectors have this measure.

Gross Job Flows From an updated dataset of Davis, Haltiwanger and Schuh (1996) at Haltiwanger's website.[65] It is the average of job creation and job destruction rates. The job creation rate of a sector is defined as the employment-weighted average of employment growth across plants within a sector. The job destruction rate of a sector is defined as employment-weighted average of the absolute value of negative employment growth across plants within a sector. I use the annual series of gross job flows over 1990-1999. First, I compute the employee-weighted average over all SIC 4-digit categories within a SIC 3-digit category. Then averages are taken over 1990-1999 for each SIC 3-digit category. All 3-digit SIC sectors have this measure.

Dependence on External Finance From Rajan and Zingales (1998). It is the fraction of total capital expenditure over 1980-1989 not financed by internal cash flow. It is computed based on the publicly listed firms in the Compustat dataset. Original data are constructed at the ISIC (rev.2) 3-digit industry level. I manually map them into SIC87 2-digit, and then into SIC87 3-digit categories available in my sample. Averages are used when a mapping goes from a lower to a higher level of aggregation.

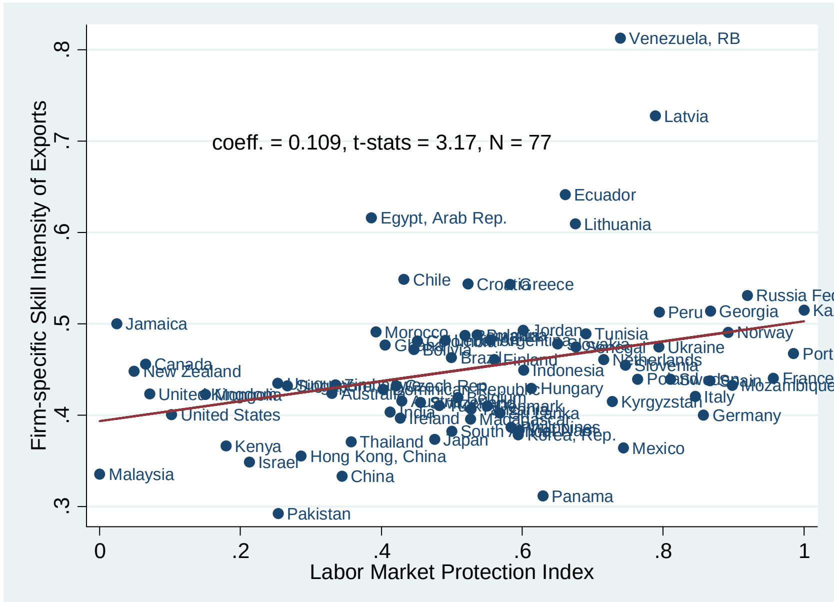
Value-added Share From Bartelsman and Gray's (1996) NBER-CES Database. It is an industry's value added divided by total manufacturing value added of shipment. Averages are taken over 1990-1999. All 3-digit SIC sectors have this measure.

[64] Instead of the averages, the medians of the intensity measures are also used as my 3-digit level measure. The empirical results remain robust upon using the medians.

[65] http://econweb.umd.edu/~haltiwan/download.htm

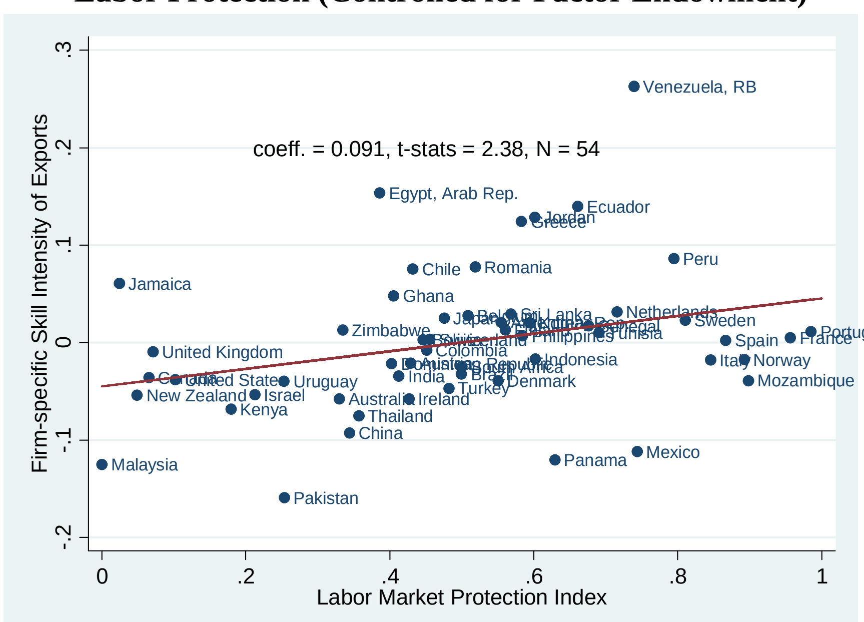
TFP Growth From Bartelsman and Gray's (1996) NBER-CES Database. It is an industry's annual growth rate in total factor productivity. Averages are taken over 1990-1999. All 3-digit SIC sectors have this measure.

Figure 2: Countries' Firm-specific Skill Intensity of Exports and Labor Protection (Full Sample)



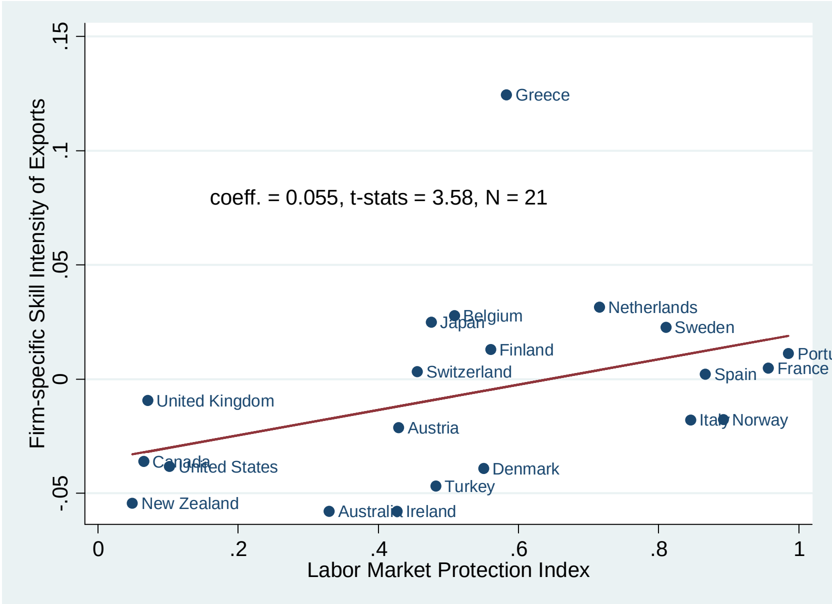
A country's firm-specific skill intensity of exports is computed according to equation (14) in the text. It is an export-weighted average across 62 sector proxies of firm-specific skill intensity. Each sector measure is weighted by the sector share of total exports from the country.
Oil exporters (share of oil exports > 0.5) -- Armenia, Burkina Faso, Malawi, Mali, Nigeria, Uganda and Zambia -- are excluded.

Figure 3: Countries' Firm-specific Skill Intensity of Exports and Labor Protection (Controlled for Factor Endowment)



A country's firm-specific skill intensity of exports is computed according to equation (14) in the text. It is an export-weighted average across 62 sector proxies of firm-specific skill intensity. Each sector measure is weighted by the sector share of total exports from the country.
Oil exporters (share of oil exports > 0.5) -- Armenia, Burkina Faso, Malawi, Mali, Nigeria, Uganda and Zambia-- are excluded.

Figure 3: Countries' Firm-specific Skill Intensity of Exports and Labor Protection (OECD Members (by 90s), Controlled for Factor Endowment)



A country's firm-specific skill intensity of exports is computed according to equation (14) in the text. It is an export-weighted average across 62 sector proxies of firm-specific skill intensity. Each sector measure is weighted by the sector share of total exports from the country.

Table 1: Sector Measures of Firm-specific Skill Intensity

PSID Code	Industry Description (SIC 72 3-digit Code)	Tenure Estimates					Num. Obs.
		5 year	5 yr, Normalized	10 years	10 yr, Normalized	10 yr, Exp. Incl. Normalized	
377	Petroleum refining (291)	0.322	1.000	0.555	1.000	1.000	98
289	Beverage industries (208)	0.250	0.813	0.331	0.639	0.705	94
127	Cement, concrete, gypsum, and plaster products (324, 327)	0.195	0.671	0.268	0.536	0.708	91
357	Drugs and medicines (283)	0.193	0.667	0.360	0.685	0.636	81
287	Bakery products (205)	0.191	0.662	0.364	0.691	0.512	106
329	Miscellaneous paper and pulp products (264)	0.189	0.656	0.368	0.697	0.787	74
189	Electronic computing equipment (3573)	0.184	0.643	0.283	0.561	0.311	324
328	Pulp, paper, and paperboard mills (261-263, 266)*	0.180	0.632	0.273	0.543	0.626	95
369	Not specified chemicals and allied products	0.178	0.628	0.302	0.591	0.538	70
187	Metalworking machinery (354)	0.148	0.551	0.209	0.440	0.487	139
108	Sawmills, planing mills, and mill work (242, 243)	0.146	0.544	0.257	0.518	0.631	278
118	Furniture and fixtures (25)	0.129	0.502	0.189	0.408	0.435	227
247	Optical and health services supplies (383, 384, 385)	0.129	0.501	0.335	0.645	0.633	95
337	Paperboard containers and boxes (265)	0.124	0.488	0.313	0.609	0.620	95
319	Apparel and accessories (231-238)	0.117	0.470	0.270	0.539	0.547	135
219	Motor vehicles and motor vehicle equipment (371)	0.112	0.457	0.218	0.455	0.465	805
208	Electrical machinery, equipment, and supplies, n.e.c. (361, 362, 364, 367, 369)	0.110	0.451	0.172	0.381	0.436	362
268	Meat products (201)*	0.106	0.442	0.212	0.446	0.492	223
139	Blast furnaces, steel works, rolling and finishing mills (3312, 3313)	0.106	0.442	0.188	0.407	0.641	121
339	Printing, publishing, and allied industries, except newspapers (272-279)*	0.106	0.442	0.237	0.485	0.425	438
227	Aircraft and parts (372)	0.098	0.421	0.258	0.520	0.508	369
379	Rubber products (301-303, 306)	0.094	0.410	0.170	0.378	0.474	135
259	Miscellaneous manufacturing industries (39)*	0.090	0.399	0.153	0.350	0.460	174
179	Construction and material handling machines (353)	0.088	0.395	0.164	0.367	0.369	166
168	Miscellaneous fabricated metal products (341, 343, 347, 348, 349)	0.075	0.362	0.145	0.336	0.590	192
228	Ship and boat building and repairing (373)*	0.059	0.319	0.095	0.256	0.150	198
197	Machinery, except electrical, n.e.c (355, 356, 358, 359)*	0.058	0.317	0.118	0.294	0.261	350
338	Newspaper publishing and printing (271)*	0.050	0.296	0.136	0.322	0.222	189
387	Miscellaneous plastic products (307)*	0.039	0.268	0.153	0.349	0.199	186

317	Yarn, thread, and fabric mills (221-224, 228)*	0.038	0.265	0.131	0.314	0.451	150
158	Fabricated structural metal products (344)	0.036	0.261	-0.004	0.096	0.078	212
239	Scientific and controlling instruments (381, 382)*	0.022	0.224	0.055	0.191	0.490	71
188	Office and accounting machines (357 except 3573)*	0.014	0.203	0.199	0.425	0.283	72
258	Ordnance*	-0.036	0.076	0.016	0.129	0.536	101
119	Glass and glass products (321-323)*	-0.064	0.003	-0.063	0.000	0.080	83
207	Radio, T.V., and communication equipment (365, 366)	-0.065	0.000	-0.010	0.086	0.000	157

*** *not significant* at the 5% level.**

Table 2: Countries' Labor Protection Indices

Rank	Country	Labor Protection	Rank	Country	Labor Protection	Rank	Country	Labor Protection
1	Kazakhstan	1.000	31	Vietnam	0.596	61	Dominican Republic [khn]	0.403
2	Portugal [khn]	0.985	32	Korea, Rep. [khn]	0.595	62	Morocco [kn]	0.392
3	France [khn]	0.957	33	Mali [khn]	0.592	63	Egypt, Arab Rep. [khn]	0.386
4	Russia	0.919	34	Philippines [khn]	0.584	64	Thailand [khn]	0.357
5	Mozambique [khn]	0.898	35	Greece [khn]	0.583	65	China [khn]	0.344
6	Norway [khn]	0.892	36	Burkina Faso [kn]	0.570	66	Uganda [kh]	0.341
7	Georgia	0.867	37	Sri Lanka [khn]	0.568	67	Zimbabwe [khn]	0.334
8	Spain [khn]	0.867	38	Finland [khn]	0.560	68	Australia [khn]	0.330
9	Germany	0.858	39	Argentina [khn]	0.555	69	Hong Kong, China [kh]	0.286
10	Italy [khn]	0.846	40	Denmark [khn]	0.550	70	Singapore [khn]	0.266
11	Sweden [khn]	0.810	41	Bulgaria	0.536	71	Pakistan [khn]	0.254
12	Peru [khn]	0.795	42	Tanzania [k]	0.528	72	Uruguay [khn]	0.253
13	Ukraine	0.794	43	Madagascar [kn]	0.527	73	Israel [khn]	0.213
14	Latvia	0.789	44	Croatia	0.523	74	Kenya [khn]	0.179
15	Poland	0.764	45	Romania [khn]	0.519	75	Mongolia	0.150
16	Slovenia	0.747	46	Belgium [khn]	0.509	76	United States [khn]	0.102
17	Mexico [khn]	0.743	47	South Africa [khn]	0.500	77	Zambia [khn]	0.086
18	Venezuela, RB [khn]	0.739	48	Brazil [khn]	0.500	78	United Kingdom [khn]	0.071
19	Kyrgyzstan	0.728	49	Lebanon	0.491	79	Canada [khn]	0.065
20	Netherlands [khn]	0.716	50	Turkey [khn]	0.482	80	Malawi [khn]	0.063
21	Tunisia [khn]	0.690	51	Japan [khn]	0.475	81	New Zealand [khn]	0.049
22	Armenia	0.682	52	Switzerland [khn]	0.456	82	Jamaica [khn]	0.024
23	Senegal [khn]	0.676	53	Colombia [khn]	0.451	83	Nigeria [kn]	0.023
24	Lithuania	0.675	54	Bolivia [khn]	0.446	84	Malaysia [khn]	0.000
25	Ecuador [khn]	0.661	55	Chile [khn]	0.432			
26	Slovakia	0.651	56	Austria [khn]	0.429			
27	Panama [khn]	0.629	57	Ireland [khn]	0.427			
28	Hungary [hn]	0.613	58	Czech Rep [k]	0.421			
29	Indonesia [khn]	0.602	59	India [khn]	0.413			
30	Jordan [khn]	0.601	60	Ghana [khn]	0.406			

Labor protection index is a linear combination of the "Employment Law" index and "Collective Relations" index from Botero et al. (2004), with weights estimated using principle component analysis. Superscripts 'k' and 'h' indicate that the country has both physical capital and human capital endowments measures from Caselli (2005). Superscript 'n' indicates that the country has the measure for natural resources endowment from the World Bank (1997). See Appendix B for detailed description of these measures.

Table 3: Regression Results for Exports to the Rest of the World

This table examines the effects of labor protection on trade flows across sectors to the rest of the world, using regression specification (15).

Dependent Variable: (ln) exports from i to the rest of the world by sector: $\ln(X_{is})$						
Panel A: OLS Estimation	(1)	(2)	(3)	(4)	(5)	(6)
			All		Exclude Main Oil Exporters	
Labor x Spec.	0.076**	0.068**	0.065**	0.066**	0.066**	0.067**
	(2.45)	(2.02)	(2.13)	(2.21)	(2.11)	(2.17)
ln(K/L) x Capital Intensity		0.162	-0.047	-0.031	-0.048	-0.035
		(0.98)	(-0.26)	(-0.17)	(-0.26)	(-0.19)
ln(H/L) x Skill Intensity		0.392***	0.393***	0.362***	0.398***	0.370***
		(6.41)	(6.33)	(5.22)	(6.27)	(5.27)
ln(Resource/L) x Mat. Intensity			0.581***	0.642***	0.573***	0.627***
			(4.08)	(3.83)	(3.96)	(3.70)
Ln(RGDP) x Value added				0.185		0.175
				(1.06)		(0.96)
Ln(RGDP) x TFP Growth				0.052		0.066
				(0.36)		(0.40)
Country Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Sector Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Num. of Observations	4153	3141	3009	3009	2972	2972
Num. of Countries	84	60	57	57	50	50
Num. of SIC Sectors	62	62	62	62	62	62
R^2	0.76	0.77	0.77	0.77	0.77	0.77
Panel B: 2SLS Estimation						
Labor x Spec.	0.159***	0.165***	0.144***	0.145***	0.148***	0.149***
	(3.20)	(3.11)	(3.02)	(3.11)	(3.00)	(3.07)

Standardized beta coefficients are reported.
t-statistics based on standard errors clustered at the country level are in parentheses.
***, ** and * denote 1%, 5% and 10% significance levels.
The instruments for *Labor x Spec.* in the 2SLS estimation are the four legal origin dummies (British, French, German and Socialist), each interacted with *Spec*. The results for the first stage and other interaction terms are suppressed to save space.
The main oil exporters excluded in columns (5) and (6) are Armenia, Burkina Faso, Malawi, Mali, Nigeria, Uganda and Zambia.
See Appendix B for detailed description of the variables.

Table 4: Regression Results for Exports to the Rest of the World (Robustness)

This table performs robustness checks for the reduced-form regressions in Table 3.

Dependent Variable: (ln) exports from i to the rest of the world by sector: ln(X_{is})						
Panel A: OLS Estimation	(1)	(2)	(3)	(4)	(5)	(6)
Labor x Spec.	0.080***	0.057*	0.067**	0.071**	0.062**	0.098***
	(2.71)	(1.97)	(2.18)	(2.42)	(2.06)	(3.70)
ln(K/L) x Spec.	-0.315**					-0.858*
	(-2.54)					(-1.97)
ln(H/L) x Spec.		-0.117**				-0.039
		(-2.63)				(-0.65)
ln(Resource/L) x Spec.			0.133			0.462***
			(1.12)			(3.69)
Ln(RGDP) x Spec.				-0.294**		0.566
				(-2.34)		(1.26)
Judicial Quality x Spec.					-0.112**	-0.065
					(-2.51)	(-0.89)
Additional Controls	ln(K/L)xCapital Intensity; ln(H/L)xSkill Intensity; ln(Res/L)xMat. Intensity					
Country Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Sector Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Num. of Observations	3009	3009	3009	3009	2966	2966
Num. of Countries	57	57	57	57	55	55
Num. of SIC Sectors	62	62	62	62	62	62
R^2	0.78	0.78	0.78	0.78	0.79	0.79
Panel B: 2SLS Estimation						
Labor x Spec.	0.164***	0.133***	0.138***	0.155***	0.133***	0.153***
	(3.36)	(2.87)	(3.03)	(3.21)	(2.90)	(3.55)

Standardized beta coefficients are reported.
t-statistics based on standard errors clustered at the country level are in parentheses.
Exporting country and sector fixed effects are always included.
Instruments for *Labor x Spec.* in the 2SLS estimation are the four legal origin dummies (British, French, German and Socialist) interacted respectively with Spec. The results for the first stage and other interaction terms are suppressed to save space.
***, ** and * denote 1%, 5% and 10% significance levels.
See Appendix B for detailed description of the variables.

Table 5: Labor Protection and Export Volumes (OLS)

This table examines the effects of labor protection on bilateral exports volumes, based on regression specification (11).

Dependent Variable: (ln) bilateral exports from i to j by sector: $\ln(X_{ijs})$

	(1)	(2)	(3)	(4)	(5)	(6)
	Baseline	with P_{ijs}	+ K/L & H/L Endowments	+ Natural Resources	Controlling # Exporting Firms	beta coeffs. for (5)
Labor x Spec.	**0.759*** **	**0.765*** **	**1.024*** **	**1.048*** **	**1.001*** **	**0.076*** **
	(7.79)	**(7.57)**	**(9.83)**	**(9.76)**	**(8.83)**	**(8.83)**
ln(distance)	-0.627***	-0.629***	-0.635***	-0.647***	-0.664***	-0.312***
	(-27.25)	(-26.71)	(-26.41)	(-26.79)	(-27.06)	(-27.06)
Ever Colony	0.534***	0.505***	0.507***	0.522***	0.525***	0.064***
	(8.57)	(7.79)	(7.71)	(7.85)	(7.79)	(7.79)
Common Language	0.0882**	0.0592	0.0551	0.0479	0.0709*	0.017*
	(2.23)	(1.50)	(1.38)	(1.17)	(1.67)	(1.67)
Common Border	0.703***	0.721***	0.702***	0.704***	0.700***	0.077***
	(9.04)	(8.88)	(8.03)	(7.90)	(7.55)	(7.55)
Common Legal Origin	0.194***	0.181***	0.184***	0.188***	0.185***	0.045***
	(6.56)	(6.23)	(6.18)	(6.07)	(5.81)	(5.81)
RTA Members	0.422	-0.0232	-0.0422	-0.0280	-0.177	-0.005
	(1.31)	(-0.07)	(-0.13)	(-0.09)	(-0.47)	(-0.47)
Currency Union	0.216***	0.207***	0.208***	0.198***	0.195***	0.044***
	(5.53)	(5.27)	(5.10)	(4.63)	(4.44)	(4.44)
Any Landlocked	0.497*	0.504**	0.465**	0.469**	0.913***	0.024***
	(1.96)	(1.99)	(2.16)	(2.15)	(3.06)	(3.06)
Any Island	-0.0844	-0.118	-0.143	-0.222**	-0.224**	-0.017**
	(-0.84)	(-1.29)	(-1.54)	(-2.00)	(-2.00)	(-2.00)
ln(K/L) x Capital Intensity			-0.029***	-0.059***	-0.014	-0.061
			(-2.62)	(-5.19)	(-1.23)	(-1.23)
ln(H/L) x Skill Intensity			2.230***	2.283***	1.859***	0.417***
			(25.24)	(25.51)	(20.33)	(20.33)
ln(M/L) x Mat. Intensity				0.144***	0.132***	0.429***
				(9.53)	(8.80)	(8.80)
ln(Num. of Est.)					0.202***	0.195***
					(21.66)	(21.66)
R^2	0.471	0.475	0.472	0.479	0.485	0.485
Num. of exporters	84	84	60	57	53	53
Num. of clusters	4363	3987	3701	3595	3496	3496
Num. of observations	102501	95107	87009	82734	78728	78728

All regressions include exporter, importer and sector fixed effects.
t-statistics based on standard errors clustered by importer-exporter pair are in parentheses.
***, ** and * denote 1%, 5% and 10% significance levels respectively.
See Appendix B for detailed description of the variables.

Table 6: Labor Protection and Firm Selection into Exporting (First-Stage Probit Est.)

This table examines the effects of labor protection on the extensive margin of trade, using the Probit model specified in (12). The columns in this table correspond to those in Table 5. Two additional trade barrier variables – (i) Procedures to Start Businesses and (ii) Days to Start Businesses, are included in the first stage, but will be excluded in all second-stage estimations in the next table.

Dependent Variable: (ln) bilateral exports from i to j by sector: $\ln(X_{ijs})$					
	(1)	(2)	(3)	(4)	(5)
	Baseline	with P_{ijs}	+ K/L & H/L Endowments	+ Natural Resources	+ Num. Firms
Labor x Spec.	**0.746*** **	**0.760*** **	**0.807*** **	**0.765*** **	**0.689*** **
	(10.24)	**(10.19)**	**(10.52)**	**(9.88)**	**(8.48)**
ln(distance)	-0.697***	-0.713***	-0.738***	-0.743***	-0.756***
	(-42.38)	(-41.89)	(-40.77)	(-39.12)	(-38.39)
Ever Colony	0.578***	0.589***	0.616***	0.620***	0.614***
	(9.46)	(9.26)	(8.96)	(8.87)	(8.62)
Common Language	0.195***	0.193***	0.185***	0.199***	0.233***
	(7.80)	(7.42)	(6.82)	(7.13)	(7.88)
Common Border	0.240**	0.241**	0.247**	0.254**	0.200
	(2.25)	(2.21)	(2.09)	(2.13)	(1.64)
Common Legal Origin	0.135***	0.138***	0.139***	0.139***	0.135***
	(6.70)	(6.67)	(6.44)	(6.15)	(5.79)
RTA Members	0.044*	0.042*	0.034	0.023	0.014
	(1.91)	(1.77)	(1.35)	(0.87)	(0.51)
Currency Union	0.255	0.286	0.282	0.285	0.163
	(0.86)	(0.88)	(0.84)	(0.84)	(0.36)
Any Landlocked	0.0610	0.0532	-0.0203	-0.0389	0.132
	(0.69)	(0.59)	(-0.23)	(-0.43)	(1.17)
Any Island	0.107	0.136*	0.130	0.0585	0.0472
	(1.50)	(1.75)	(1.59)	(0.65)	(0.52)
Procedures to Start Businesses	-0.624***	-0.638***	-0.697***	-0.660***	-0.650***
	(-4.82)	(-4.88)	(-5.18)	(-4.80)	(-4.61)
Days to Start Businesses	-0.087***	-0.078***	-0.094***	-0.118***	-0.126***
	(-3.82)	(-3.37)	(-3.92)	(-4.66)	(-4.87)
ln(K/L) x Capital Intensity			0.026***	0.006	0.031***
			(4.22)	(0.96)	(4.49)
ln(H/L) x Skill Intensity			1.834***	1.864***	1.629***
			(36.19)	(36.06)	(31.87)
ln(Resource/L) x Mat. Intensity				0.114***	0.110***
				(14.25)	(13.37)
ln(Number of Establishments)					0.155***
					(27.29)
Log-likelihood	-102725	-98362	-89811	-84785	-79941
Num. of exporters	71	71	60	57	53
Num. of clusters	7739	7526	6360	6042	5618
Num. of observations	479818	466612	394320	374604	338032

All regressions include exporter, importer and sector fixed effects.
z-statistics based on standard errors clustered by importer-exporter pair are in parentheses.
***, ** and * denote 1%, 5% and 10% significance levels respectively.
See Appendix B for detailed description of the variables.

Table 7: Labor Protection and Firm Selection into Exporting (Second-Stage Est.)

This table reports the second-stage gravity estimation results parallel to the first-stage results in Table 5. δ (from w_{ijs}) is the variable controlling for the extensive margin of trade. e_{ijs} is the inverse Mills' ratio correcting the Heckman selection bias. See section 4.2 for details. Panel A reports the second-stage estimation results using maximum likelihood, while Panel B reports the corresponding results using OLS with 50 dummy variables denoting the percentiles of the predict probability of exporting. The columns in this table correspond to those in Table 6.

Dependent Variable: (ln) bilateral exports from i to j by sector: $\ln(X_{ijs})$	(1)	(2)	(3)	(4)	(5)	(6)
	Baseline	with P_{ijs}	+ K/L & H/L Endow.	+ Natural Resources	+ Num. Firms	OLS Coeffs. for (5)
Panel A: Maximum Likelihood Estimation						
Labor x Spec.	0.947***	0.979***	0.989***	1.011***	0.970***	1.079***
	(5.30)	(5.64)	(5.26)	(5.69)	(5.78)	(9.06)
ln(K/L) x Capital Intensity			-0.012	-0.041	0.005	-0.00239
			(-1.01)	(-3.63)	(0.42)	(-0.20)
ln(H/L) x Skill Intensity			2.256***	2.247***	1.842***	1.964***
			(6.32)	(6.46)	(6.18)	(20.34)
ln(Resource/L) x Mat. Intensity				0.129***	0.117***	0.134***
				(5.02)	(4.72)	(8.60)
e_{ijs}	1.577***	1.513***	1.431***	1.391***	1.413***	
	(7.68)	(7.95)	(7.05)	(7.18)	(7.60)	
δ(from w_{ijs})	0.749***	0.693***	0.746***	0.761***	0.734***	
	(2.88)	(2.83)	(2.93)	(3.14)	(3.11)	
Panel B: Flexible specification: OLS using 50 bins for predicted probability						
Labor x Spec.	1.178***	1.182***	1.207***	1.242***	1.147***	1.079***
	(10.78)	(10.78)	(10.97)	(11.01)	(9.76)	(9.06)
ln(K/L) x Capital Intensity			-0.006	-0.039***	0.013	-0.00239
			(-0.53)	(-3.44)	(1.11)	(-0.20)
ln(H/L) x Skill Intensity			2.743***	2.810***	2.244***	1.964***
			(22.05)	(21.61)	(18.05)	(20.34)
ln(Resource/L) x Mat. Intensity				0.160***	0.141***	0.134***
				(9.53)	(8.49)	(8.60)
R^2	0.506	0.510	0.525	0.533	0.540	0.485
Num. of exporters	71	71	60	57	53	53
Num. of clusters	3194	3,047	2927	2852	2777	2777
Num. of observations	86311	83448	79994	75969	72204	72204

All regressions include exporter, importer and sector fixed effects, as well as the 9 trade frictions variables listed in Table 5.
Standard errors are clustered by importer-exporter pair. z-statistics (besides column (6)) are reported in parentheses in Panel A, t-statistics in panel B.
***, ** and * denote 1%, 5% and 10% significance levels respectively.
See Appendix B for detailed description of the variables.

Table 8: Sensitivity Analysis

This table repeats the analysis for column (4) in Table 7 over different subsamples. Only the second-stage regression results, estimated using maximum likelihood, are reported.

Dependent Variable: (ln) bilateral exports from i to j by sector: $\ln(X_{ijs})$					
	(1)	(2)	(3)	(4)	(5)
Sample	OECD	Non-OECD	Non Oil Exporters	Exclude Oil (SIC = 291)	Exclude Top 2 & Bottom 2 Sectors
Labor x Spec.	0.694***	2.677***	1.008***	0.830***	0.549***
	(6.00)	(3.12)	(5.69)	(4.99)	(3.35)
# exporters	23	34	56	57	57
# clusters	1926	1547	2844	2849	2823
# observations	54253	21716	75897	74807	70057

Controls include exporter, importer and sector fixed effects; Interactions between 1) capital endowment and capital intensity; 2) human capital endowment and human capital intensity; 3) resource endowment and material intensity; 4) importers' CPI and sector dummies; and 9 trade frictions variables listed in Table 5.
z-statistics, based on standard errors are clustered by importer-exporter pair, are reported in parentheses.
***, ** and * denote 1%, 5% and 10% significance levels respectively.
See Appendix B for detailed description of the variables

Table 9: Labor Protection and Other Sources of Comparative Advantage

This table repeats the analysis for column (4) in Table 7, including interaction terms for other channels through which labor market or contracting institutions can affect trade patterns. Only the second-stage regression results, estimated using maximum likelihood, are reported.

Dependent Variable: (ln) bilateral exports from i to j by sector: $\ln(X_{ijs})$

	(1)	(2)	(3)	(4)	(5)	(6)
	Labor Law x Volatility	Labor Law x Volatility	Legal Inst. x Contract	Contract & Vol.	Contract & Vol.	Beta coeff. for (5)
Measure of Volatility	Sales Volatility	Gross Job Flows	-	Sales Volatility	Gross Job Flows	Gross Job Flows
Labor x Spec.	1.010***	0.860***	0.972***	0.953***	0.816***	0.060***
	(5.69)	(5.48)	5.49)	(5.41)	(5.05)	(5.05)
Labor x Volatility	-0.791*	-0.027***		-0.848**	-0.024***	-0.066***
	(-1.87)	(-3.92)		(-2.01)	(-3.46)	(-3.46)
Judicial x Contract Dep.			2.427***	2.434***	1.253**	0.115**
			(4.10)	(4.11)	(2.11)	(2.11)
# exporters	57	57	56	56	56	56
# clusters	2852	2852	2840	2840	72207	72207
# observations	75969	75969	75851	75851	72205	72205

Controls include exporter, importer and sector fixed effects; Interactions between 1) capital endowment and capital intensity; 2) human capital endowment and human capital intensity; 3) resource endowment and material intensity; 4) importers' CPI and sector dummies; and 9 trade frictions variables listed in Table 5.
z-statistics, based on standard errors are clustered by importer-exporter pair, are reported in parentheses.
***, ** and * denote 1%, 5% and 10% significance levels respectively.
See Appendix B for detailed description of the variables

Table 10: Labor Protection and Bilateral Export Volumes (Controlling for Country Characteristics)

This table repeats the analysis for column (4) in Table 7, including interaction terms between different country characteristics and specific skill intensity of the sector. Only the second-stage regression results, estimated using maximum likelihood, are reported.

Dependent Variable: (ln) bilateral exports from i to j by sector: $\ln(X_{ijs})$

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Exporters' Characteristics:	Income	Human Capital	Capital	Judicial Quality	Fin. Dev.	All (w/ sales vol.)	All (w/ job flows)
Labor x Spec.	1.018***	0.772***	1.098***	0.946***	0.730***	0.635***	0.521***
	(5.59)	(4.72)	(5.73)	(5.43)	(4.66)	(3.51)	(3.08)
ln(rgdp per cap.) x Spec.	-0.176***					1.049***	1.054***
	(-3.75)					(3.79)	(3.82)
ln(H/L) x Spec		-1.194***				-2.557***	-2.567***
		(-4.92)				(-6.58)	(-6.60)
ln(K/L) x Spec			-0.213***			-0.890***	-0.886***
			(-4.61)			(-4.21)	(-4.20)
Judicial x Spec				-0.792***		3.042***	3.016***
				(-3.27)		(6.79)	(6.74)
ln(credit/L) x Spec.					-0.498***	-0.794***	-0.786***
					(-4.90)	(-6.56)	(-6.53)
Labor x Volatility						-0.272	-0.022
						(-0.65)	(-3.33)
# exporters	57	57	57	56	56	56	56
# clusters	2852	2852	2852	2840	2777	2777	2777
# observations	75969	75969	75969	75851	72205	72205	72205

Controls include exporter, importer and sector fixed effects; Interactions between 1) capital endowment and capital intensity; 2) human capital endowment and human capital intensity; 3) resource endowment and material intensity; 4) importers' CPI and sector dummies; and 9 trade frictions variables listed in Table 5.

z-statistics, based on standard errors are clustered by importer-exporter pair, are reported in parentheses.

***, ** and * denote 1%, 5% and 10% significance levels respectively.

See Appendix B for detailed description of the variables

Table 11: Labor Protection and Bilateral Export Volumes (Controlling for Sector Characteristics)

This table repeats the analysis for column (4) in Table 7, including interaction terms between the country's index of labor protection and various sector characteristics. Only the second-stage regression results, estimated using maximum likelihood, are reported.

Dependent Variable: (ln) bilateral exports from i to j by sector: $\ln(X_{ijs})$							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Sectoral Characteristics:	VA	Skill Intensity	Capital Intensity	Contract Depend.	Ext. Fin. Dep.	TFP Growth	All
Labor x Spec.	1.042***	1.006***	0.875***	1.222***	0.859***	0.969***	0.882***
	(5.58)	(5.96)	(6.17)	(5.95)	(5.16)	(5.52)	(6.60)
Labor x Value added	0.337						-0.951***
	(1.51)						(-3.73)
Labor x Skill Intensity		0.150*					-0.093
		(1.89)					(-1.20)
Labor x Capital Intensity			0.115**				0.162**
			(2.40)				(2.81)
Labor x Contract Dep.				1.678***			2.521***
				(5.62)			(7.28)
Labor x Ext. Fin. Dep.					-0.188*		-0.224**
					(-1.80)		(-2.20)
Labor x TFP Growth						-5.306***	-10.422***
						(-4.51)	(-6.63)
# exporters	57	57	57	56	56	56	56
# clusters	2852	2852	2852	2777	2777	2777	2777
# observations	75969	75969	75969	72207	72207	72207	72207

Controls include exporter, importer and sector fixed effects; Interactions between 1) capital endowment and capital intensity; 2) human capital endowment and human capital intensity; 3) resource endowment and material intensity; 4) importers' CPI and sector dummies; and 9 trade frictions variables listed in Table 5.
z-statistics, based on standard errors are clustered by importer-exporter pair, are reported in parentheses.
***, ** and * denote 1%, 5% and 10% significance levels respectively.
See Appendix B for detailed description of the variables

Appendix Tables

Table A1: Summary Statistics of Sector-level Variables (SIC87 3-digit)

	Min	10th	25th	50th	75th	90th	Max	Std. Dev	No. Obs
Firm-Spec	0.000	0.261	0.317	0.410	0.470	0.656	1.000	0.180	62
Capital Intensity	2.306	3.012	3.666	4.022	4.575	5.369	6.773	0.860	118
Skill Intensity	-2.250	-1.832	-1.672	-1.377	-1.190	-0.888	-0.400	0.371	118
Material Intensity	2.903	3.617	3.912	4.251	4.839	5.311	7.424	0.717	118
Sales Volatility	0.084	0.124	0.141	0.157	0.187	0.225	0.336	0.044	118
Gross Job Flows	7.534	12.410	16.247	18.466	22.264	23.694	38.731	5.110	118
Contract Dep.	0.331	0.640	0.794	0.951	0.973	0.987	0.998	0.155	118
Ext. Fin. Dep.	-0.450	-0.025	0.110	0.240	0.450	0.770	0.960	0.296	118

Note: 118 of 140 sectors suffice to cover all SITC (rev. 2 4-digit) sectors in Feenstra's (2000) dataset of trade flows. Regressions in this paper include 62 of the 118 sectors, covering more than 60 percent of global exports in 1995.

Table A2: Correlation between Sector-level Variables (SIC87 3-digit)

	Firm-Spec	Capital Intensity	Skill Intensity	Material Intensity	Sales Volatility	Gross Job Flows	Contract Dep.
Capital Intensity	0.316						
Skill Intensity	0.073	0.143					
Material Intensity	0.438	0.758	-0.014				
Sales Volatility	-0.062	-0.111	0.002	-0.088			
Gross Job Flows	-0.203	-0.630	0.028	-0.388	0.277		
Contract Dep.	-0.238	-0.198	0.464	-0.388	0.011	0.283	
Ext. Fin. Dep.	-0.313	-0.137	0.263	-0.194	0.457	0.172	0.244

Table A3: Summary Statistics of Country Variables

	Min	10th	25th	50th	75th	90th	Max	Std. Dev	No. Obs.
Labor Protection	0	0.102	0.372	0.527	0.686	0.858	1	0.250	84
ln(real GDP/L)	6.448	7.097	8.105	8.880	9.872	10.187	10.817	1.097	82
ln(H/L)	0.092	0.469	0.594	0.827	1.005	1.088	1.224	0.270	61
ln(K/L)	6.054	7.554	8.984	10.290	11.604	11.813	11.996	1.611	65
ln(Resource/L)	6.666	7.197	7.564	8.298	8.981	9.482	10.912	0.983	62
ln(Credit/GDP)	-3.326	-2.433	-1.607	-0.974	-0.305	0.014	0.509	0.913	69
Judicial Quality	0.240	0.357	0.444	0.543	0.770	0.904	0.972	0.207	73

Table A4: Correlation between Country Variables

	Labor Protection	ln(real GDP/L)	ln(H/L)	ln(K/L)	ln(Resource/L)	ln(Credit/GDP)
ln(real GDP/L)	0.101	1				
ln(H/L)	-0.072	0.834	1			
ln(K/L)	0.124	0.971	0.860	1		
ln(Resource/L)	-0.007	0.666	0.632	0.660	1	
ln(Credit/GDP)	0.011	0.684	0.580	0.678	0.326	1
Judicial Quality	-0.015	0.838	0.773	0.812	0.549	0.682