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Judicial Quality, Incomplete Contract, and Quality of Trade

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Abstract：

This paper studies how judicial quality affects average quality of trade for industries with different dependence on contract enforcement environment. By alleviating hold-up problem, better judicial quality lowers production costs relatively more for contract-intensive industries that intensively use relationship-specific inputs. We build a simple model to incorporate hold-up problem and the consequent relatively higher input costs for contract-intensive industries into a firm heterogeneous model with endogenous quality choice. Our theory suggests that better judicial quality does not necessarily raise average export quality for contract-intensive industries relatively more due to two offsetting effects: quality upgrading of existing exporting firms and increasing entry of less-productive firms. In contrast, better judicial quality always raises average import quality relatively more for contract-intensive industries since only foreign firms with high enough productivities are able to compete in that market due to pro-competitive effect. By using bilateral unit value and quality index constructed by Feenstra and Romalis (2014), as well as contract intensity from Nunn (2007), we empirically confirm the predictions regarding judicial quality's impact on average quality of trade. Our results are robust to measurement issues, potential confounding factors, and possible reverse causality.

Keywords: Judicial Quality, Quality of Trade, Contract Intensity

Judicial Quality, Incomplete Contracts, and Quality of Trade*

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February 24, 2018

Abstract

How does a country's quality of trade relate to its ability to enforce contracts? This paper studies how judicial quality affects the average quality of trade for industries with different dependence on the contract enforcement environment. By alleviating the hold-up problem, better judicial quality lowers production costs relatively more for contract-intensive industries that intensively use relationship-specific inputs. The paper incorporates incomplete contracts and different levels of dependence on contract enforcement during the production process into a firm heterogeneous model with endogenous quality choice. The theory suggests that better judicial quality does not necessarily raise or lower average export quality for contract-intensive industries relatively more due to two offsetting forces: quality upgrading of existing exporting firms and increasing entry of low-quality firms. In contrast, better judicial quality always raises average import quality relatively more for contract-intensive industries, because increasing entry of domestic firms intensifies competition and only high-quality foreign firms can sell in such a market. Using bilateral unit value and constructed quality index, the paper empirically confirms the predictions of the impact of judicial quality on the average quality of trade and documents suggestive evidence supporting the mechanisms described by the theory. The results are robust to alternative measures of the key variables, potential confounding factors, and possible reverse causality.

Key words: Judicial Quality, Quality of Trade, Contract Intensity

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1 Introduction

A country's judicial quality significantly influences its pattern of trade by affecting its costs of production (Nunn, 2007; Levchenko, 2007; Nunn and Trefler, 2014). Contract-intensive industries, which concentrate their inputs on highly customized and relationship-specific goods, are more likely to suffer from higher production costs when judicial quality and the consequent contract enforcement are poor.[1] Because the efforts to produce customized and relationship-specific inputs are difficult to verify and contract, and because the values of these inputs are higher within the relationships, buyers of the inputs will have an incentive to renegotiate the transaction values and grab a share of the inputs after the suppliers make their relationship-specific efforts. In short, hold-up is likely to occur. Such hold-up problems increase the input costs of contract-intensive industries because suppliers of customized and relationship-specific inputs require extra returns for compensation or reduce their efforts (underinvestment) ex-ante. In the presence of hold-up frictions, better judicial quality and contract enforcement environment alleviate the hold-up problem and reduce input costs relatively more for these industries. Judicial quality, therefore, establishes a country's cost advantages in contract-intensive industries.

While existing studies focus on the effect of judicial quality on the value of trade (in particular, the value a country's exports in a particular industry), this paper pays particular attention to the effect of judicial quality on the quality of trade. Specifically, we study how judicial quality affects a country's average export quality and import quality in more contract-intensive industries relative to less contract-intensive industries by affecting the production costs of these industries. The quality of trade reflects a country's economic development, as high-income countries are more likely to produce and consume better quality goods. Therefore, it is of great importance to understand how the quality of trade is determined across countries and industries. We take advantage of the fact that industries vary in contract intensity, and study how variation in judicial quality across countries yields heterogeneous impacts on the average quality of trade across industries.

In the spirit of previous studies that underline the hold-up mechanism, we introduce incomplete contracts and different levels of dependence on contract enforcement in a stylized model of international trade. The model features endogenous quality choice among heterogeneous firms. In the first stage of production, where composite inputs are produced under incomplete contracts, better judicial quality

[1] For example, the production of smartphones requires inputs such as LED screen, camera module, and software, which are often highly customized for a particular type of smartphone. In contrast, the production of blue jeans requires rather standardized inputs such as denim, zipper, and button.

effectively lowers input costs more for more contract-intensive industries due to the less severe hold-up problem, similar to Levchenko (2007) and Nunn and Trefler (2014). In the second stage of production in which final goods are produced, heterogeneous final goods producers decide their optimal quality choices for different markets, as in Feenstra and Romalis (2014). Optimal quality minimizes the total cost of production and shipping, and a producer's quality choice is decreasing in input cost, which is determined in the first stage of production.

Our stylized model predicts an ambiguous effect of judicial quality on average export quality in more contract-intensive industries relative to less contract-intensive industries. Better judicial quality lowers composite input costs more for more contract-intensive industries in the exporting country. On the one hand, lower input costs induce quality upgrading of existing producers and increase average export quality. On the other hand, lower input costs decrease the threshold of exporting and allow relatively low-quality firms to export. The two effects interact so that the exact impact of judicial quality on average export quality in more contract-intensive industries relative to less contract-intensive industries is ambiguous.

In contrast, better judicial quality is predicted to yield a positive impact on average import quality in more contract-intensive industries relative to less contract-intensive industries. Relatively lower composite input costs in more contract-intensive industries facilitate more entry of domestic firms and increase the threshold for other countries to sell in that market. Consequently, only high-quality foreign firms can sell in that market. This selection effect increases average import quality in more contract-intensive industries relative to less contract-intensive industries.

We test the two major predictions using cross-sectional bilateral trade data from 1997 at the SITC Revision 2 4-digit level combined with measures of judicial quality and contract intensity. We use two measures of the quality of trade to ensure the robustness of our results. The first measure is the unit value of the flow of trade.[2] The second measure is the quality index constructed by Feenstra and Romalis (2014) based on an endogenous quality theoretical framework. In our main results, we do not use quality measured by demand-side approaches, as in Khandelwal (2010), Khandelwal, Schott and Wei (2013), and Fan, Li and Yeaple (2015), because these measures of quality are not directly comparable across destinations.[3] We identify the effect of judicial quality on the export quality of

[2] Previous literature usually interprets variation in unit value as variation in the quality of traded goods, for example, Schott (2004), Hallak (2006), Manova and Zhang (2012), Fan, Li and Yeaple (2015), and others.

[3] The measured quality index generated by demand-side approaches is obtained by comparing the variations in market shares conditional on prices in a particular destination. This is equivalent to normalizing the mean quality in a destination to 1 and identifying the quality of all varieties relative to the mean quality. As a result, levels of quality across destinations

industries with different levels of dependence on contract enforcement by exploiting the variation across source countries conditional on a particular destination-product pair. Similarly, we identify the effect of judicial quality on the import quality of industries with different levels of dependence on contract enforcement by exploiting the variation across destination countries conditional on a particular source-product pair. Different countries might export to very different sets of destination countries and import from very different sets of source countries. Therefore, our identification strategy avoids the potential bias that would be induced by treating all destinations as homogeneous for a source country or all sources as homogeneous for a destination country.

The empirical results are consistent with our model predictions. Given a particular destination, a country with better judicial quality does not export goods of significantly better or worse quality in more contract-intensive industries relative to less contract-intensive industries. Given a particular source, a country with better judicial quality imports goods of significantly better quality in more contract-intensive industries relative to less contract-intensive industries. These results are robust when we control for effects related to factor endowments and income differences and use alternative measures of the key variables. We also use a country's legal origin as an instrument for judicial quality to alleviate the concern about endogeneity. The instrumental variable estimation produces consistent results. We finally document suggestive evidence that supports the mechanisms described by our theory.

This paper joins the strand of literature highlighting the role of the quality of institutions, contract enforcement, and judicial quality in shaping the patterns of international trade. Berkowitz, Moenius and Pistor (2006) find that by affecting production costs and transaction costs, institutional quality in a country boosts its exports in complex products but dampens its imports in complex products. Levchenko (2007) introduces incomplete contracts into a Heckscher-Ohlin model. If relationship-specific investments are required in production, under incomplete contracts, parties in the contract must negotiate to assign the residual rights to compensate for the relationship-specific investment. Poorer judicial quality thus raises the required compensation and increases the cost of production.

Nunn (2007) tests whether a country's ability in enforcing contracts determines its comparative advantage in more contract-intensive industries. By constructing a measure of contract intensity using the U.S. input-output table, he finds that a country with better judicial quality specializes in more

are not directly comparable. Therefore, we do not use quality measures generated by this approach in our main results, but rather use them in our robustness checks.

contract-intensive industries. According to his estimates, contract enforcement explains more of the variation in the value of trade compared with capital and skill endowments. Similar patterns are documented by firm-level empirical studies, namely that better judicial quality tends to increase exports among firms intensively using customized inputs (Ma, Qu and Zhang 2010; Wang, Wang and Li 2014). Moreover, Feenstra, Hong, Ma and Spencer (2013) exploit various ownership and contractual modes among Chinese exporters and find that the comparative advantage effect is more pronounced in foreign-own firms and processing exporters, which are presumably more dependent on contract enforcement.

Essaji and Fujiwara (2012) find that countries with better judicial quality tend to export better-quality goods in more contract-intensive industries. Meanwhile, Yu (2010) finds that democracy in exporting and importing countries fosters bilateral trade. Most existing literature primarily focuses on the impact of judicial quality on the total value of exports, at industry or firm level, while the impact on imports is rarely explored. In contrast, we pay particular attention to an important margin of trade: the quality of exported and imported goods. Our analysis describes how judicial quality shapes the average relative quality of trade. We also provide a framework to study the impacts of judicial quality in the exporting country and importing country across industries with different levels of contract intensity and generate testable propositions.

In a general sense, this paper is also closely related to the determinants of the quality of trade. Hallak (2006) finds that richer countries import better-quality goods, where quality is proxied by unit value. Crino and Ogliari (2017) find that financial imperfection affects average export quality mainly via the intensive margin, and quality is an important margin through which financial development shapes trade flows. Khandelwal (2010) predicts that the quality of goods is increasing in producers' productivity. Amiti and Khandelwal (2013) document that products respond differently to intensified competition, depending on their positions relative to the quality frontier. For products close to the frontier, the incentive to escape from competition dominates, so these products tend to upgrade quality, but vice versa for products that are further from the frontier, due to the Schumpeterian effect of competition which depresses the motive for upgrading.

Martin and Mejean (2014) show that competition from low-wage countries in the international market pushes French exporters to specialize in high-quality products. At the firm level, Fan, Li and Yeaple (2015) predict that input tariff reductions result in quality upgrading and find that Chinese firms' export prices increased for differentiated goods but decreased for homogeneous goods when input tariffs dropped substantially upon China's accession to the World Trade Organization. Fan, Li and Yeaple (2018) shed light on how exporters make quality choices based on their productivity and emphasize that the least productive Chinese exporters rather than those close to the frontier, show the most aggressive incentive in quality upgrading. Our paper stresses the role of a country's endowment in shaping the quality of exports and imports in industries with various contract intensities and offers an alternative perspective in understanding quality variation across sources, destinations, and sectors.

The rest of the paper is organized as follows. Section 2 presents a model that combines incomplete contracts with endogenous quality choice to illustrate the main predictions on how judicial quality in a country affects average export and import quality in industries with different contract intensities. These predictions guide our empirical analysis. Section 3 discusses the empirical specifications, identification, measures of the variables of interest, and data. Section 4 reports our baseline results, the robustness tests, discussion of the channels, and the instrumental variables (IV) estimation results. Section 5 concludes.

2 Endogenous Quality and Contract Enforcement: A Stylized Model

In our model, the production of final goods takes place in two stages. In the first stage of production, capital and labor are used by two types of producers who produce homogeneous inputs and differentiated inputs, respectively. A homogeneous input producer (H producer henceforth) and a differentiated input producer (D producer henceforth) enter an incomplete contract for joint production of composite inputs, which are used for final goods production. Incomplete contracts and relationship specificity give rise to a one-sided hold-up problem suffered by differentiated input producers. In the presence of hold-up friction, a D producer requires extra return for compensation to enter the contract or reduces effort (underinvestment) ex-ante, thus raising the price of the composite inputs. Better judicial quality thus alleviates the hold-up problem and reduces the composite input prices more for industries whose production of composite inputs intensively uses differentiated inputs. The first-stage specification is motivated by Levchenko (2007) and generates the implication that countries with better judicial quality enjoy relatively lower composite input costs in more contract-intensive industries, hence forming comparative advantage in producing and exporting more contract-intensive products.[4]

[4] In our paper, hold-up problems exist due to the customization of differentiated inputs, which could be due to the invisible quality of input material or due to the requirement on a particular attribute of the input used. There is no need for us to discuss further the sources of hold-up problems, as in any cases our fundamental finding that the prices (or quality-adjusted prices if with invisible quality) of contract-intensive composite inputs would reduce more with an improvement in judicial quality still holds.

Taking the composite input price as given, heterogeneous final goods producers determine whether to enter a particular destination and the optimal quality to supply that destination. Optimal quality is such that the total cost to supply one unit of quality-adjusted output is minimized. The total cost includes the production cost and per-unit shipping cost. Since the per-unit shipping cost introduces increasing returns to scale in quality upgrading, the optimal quality is increasing in shipping cost relative to production cost. As a result, higher productivity and lower composite input price induce a firm to produce better-quality goods.

Judicial quality affects average export quality through two offsetting forces. On the one hand, lower composite input prices in more contract-intensive industries facilitate quality upgrading for final goods producers that are already active and increase average export quality relatively more via the intensive margin for these industries. On the other hand, lower composite input prices in more contract-intensive industries allow less-productive firms to enter a particular market, depressing average export quality relatively more via the extensive margin for these industries. Hence, the relative effect of judicial quality on average export quality is ambiguous. In contrast, judicial quality always raises average import quality relatively more in more contract-intensive industries. Lower composite input prices in more contract-intensive industries induce more entry of domestic firms and increase the productivity thresholds for foreign firms. As a consequence, only substantially productive foreign firms can make a profit in a destination with high judicial quality, and this effect is more pronounced for more contract-intensive industries. The selection effect thus raises average import quality relatively more for more contract-intensive industries.

In the following subsections, we first describe how we introduce incomplete contracts in the production of composite inputs and highlight the interaction between judicial quality and contract intensity in determining composite input prices. We then discuss how we connect the prices of composite inputs to the average quality of trade in the final goods sector and generate the two predictions that guide our empirical analysis.

2.1 First-Stage Production: Composite Inputs

Inspired by Levchenko (2007), we assume there are three sectors in each country: K, L and M. The K sector produces goods using only capital, and the K goods are freely traded across the world with perfect competition. The L sector has the same features as the K sector, except that the L sector only uses labor in its production. Factor price equalization thus pins down the worldwide price of capital r

and price of labor w.

An H producer and a D producer enter a contract for jointly producing composite inputs in M sector. To illustrate the effect of input cost on firms' quality choice, throughout our analysis, we assume that these composite inputs are non-tradable. This assumption ensures that better judicial quality results in lower composite input prices, as we show below.[5] We also assume that composite inputs are homogeneous in quality, to focus our attention on the price of the composite inputs. An H producer uses labor to produce homogeneous inputs with cost w. A D producer uses capital to produce differentiated inputs with cost r. The production of composite inputs is characterized by a Cobb-Douglas technology:

$$y_M = (y_D)^{\eta}(y_H)^{1-\eta},$$

where y_H and y_D are the quantities of homogeneous and differentiated inputs being used. Cost minimization implies

$$\frac{w \cdot y_H}{r \cdot y_D} = \frac{1-\eta}{\eta}.$$

The input requirement for one unit of y_M is therefore

$$y_H^* = (\frac{1-\eta}{\eta}\frac{r}{w})^{\eta};\ y_D^* = (\frac{\eta}{1-\eta}\frac{w}{r})^{1-\eta}.$$

Similar to Levchenko (2007) and Nunn and Trefler (2014), we assume that an H producer and a D producer enter a contract to provide jointly one unit of the composite input. The H producer is committed to providing y_H^* units of homogeneous inputs, and the D producer is committed to providing y_D^* units of differentiated inputs. However, the relationship is subject to a one-sided hold-up problem. An H producer can grab a portion ϕ of a D producer's return ($0 < \phi < 1$). The surplus of the contract relationship per unit of y_M is thus

$$s = c_M - w \cdot y_H^* - (1-\phi)r \cdot y_D^*,$$

where c_M is the price of the composite inputs jointly produced by the two producers.

Assume the two producers, H and D, bargain over the surplus with parameter β. β measures the bargaining power of a D producer in the contract. To attract a D producer to enter the contract, the return of employing capital to produce one unit of y_M, $\beta \cdot s + (1-\phi)r \cdot y_D^*$, should be equal to $r \cdot y_D^*$, the

[5] If we allow composite inputs to be tradable between different countries, and if the trade costs of composite inputs are high enough, a country with higher composite input price in autarky will typically face a higher composite input price in the trade equilibrium. This is because when trade costs are substantially high, trade in composite inputs does not change the relative ranking of composite input prices across countries.

outside option of the same amount of capital in the K sector. Intuitively, a D producer's return after being grabbed by an H producer should be at least equal to its outside option $r \cdot y_D^*$. Therefore, $\beta \cdot s$ is the compensation return to a D producer. Alternatively, this is equivalent to a D producer's reduction in effort or underinvestment because when the compensation $\beta \cdot s$ is not available, a D producer is only willing to provide $(1-\phi)y_D^*$ units of differentiated inputs.

The price of the composite inputs c_M can thus be determined:

$$c_M = [\frac{1}{\eta} + \phi(\frac{1}{\beta} - 1)]ry_D^* = [\frac{1}{\eta} + \phi(\frac{1}{\beta} - 1)](\frac{\eta}{1-\eta})^{1-\eta}(w)^{1-\eta}(r)^{\eta}.$$

If the contract is complete and $\phi = 0$, the price of the composite inputs $(\frac{w}{1-\eta})^{1-\eta}(\frac{r}{\eta})^{\eta}$ reflects the cost to produce one unit of y_M. If ϕ is positive, the hold-up problem arises and bids up the price of the composite inputs. It is straightforward to show that

$$\frac{\mathrm{d}\ln c_M}{\mathrm{d}\phi} = \frac{(1-\beta)}{[\frac{\beta}{\eta} + \phi(1-\beta)]} > 0. \tag{1}$$

Better judicial quality lowers ϕ and makes it more difficult for an H producer to grab the return from its counterpart. Higher ϕ can be regarded as lower efficiency in enforcing the contract and completing the judicial procedure. The intuition is that, if ϕ fraction of the return has to be lost (as an iceberg cost) because of the low efficiency of the judicial system before a D producer can reclaim its return, in the equilibrium, the H producer will always grab ϕ fraction of the D producer's return. Lower efficiency of the judicial system therefore incurs higher cost of a lawsuit and worsens the hold-up problem.

Industries vary by their intensities in using differentiated inputs for production. We define this intensity as contract intensity. A direct measure of contract intensity is η, the share of expenditure spent on differentiated inputs in the total production cost of the composite inputs in the absence of the hold-up problem. The impact of judicial quality thus varies across industries. Particularly,

$$\frac{\mathrm{d}^2 \ln c_M}{\mathrm{d}\phi \mathrm{d}\eta} = \frac{\beta(1-\beta)}{[\beta + \phi\eta(1-\beta)]^2} > 0. \tag{2}$$

When judicial quality worsens, more contract-intensive industries experience larger increases in composite input prices. Judicial quality thus acts as a comparative advantage similar to capital endowment or skill endowment. Better judicial quality makes it relatively cheaper for a country to produce in more contract-intensive industries.

2.2 Second-Stage Production: Final Goods

In this subsection, we discuss quality choices of final goods regarding changes in composite input prices caused by judicial quality, under the theoretical framework of Feenstra and Romalis (2014).

2.2.1 Consumer

A representative consumer in market k has a CES preference over final goods:

$$U_k = \{\int_i \int_j [q_{ki,j} \cdot (z_{ki,j})^{\alpha_k}]^{\frac{\sigma-1}{\sigma}} \mathrm{d}j \mathrm{d}i\}^{\frac{\sigma}{\sigma-1}}.$$

i denotes a source country and j denotes a firm. $q_{ki,j}$ and $z_{ki,j}$ are the physical quantity and quality of the variety produced by firm j from country i. α_k measures the consumer's willingness to substitute quantity for quality. If α_k is large, then a one-unit decrease in quality requires more units of increase in quantity to compensate for the utility loss. $\frac{\partial \alpha_k}{\partial y_k} > 0$ guarantees that a high-income country exhibits a higher preference for quality.[6]

Under the budget constraint $\int_i \int_j (p_{ki,j} \cdot q_{ki,j}) \mathrm{d}j \mathrm{d}i = I_k$ where $p_{ki,j}$ is the consumer price of variety ij (produced by firm j in country i) and I_k is the expenditure the consumer spends on final goods, the demand function for $q_{ki,j}$ is

$$q_{ki,j} = I_k(\Phi_k)^{\sigma-1}(p_{ki,j})^{-\sigma}(z_{ki,j})^{\alpha_k(\sigma-1)}.$$

$\Phi_k = [\int_i \int_j (P_{ki,j})^{1-\sigma} \mathrm{d}j \mathrm{d}i]^{\frac{1}{1-\sigma}}$ is the quality-adjusted exact price index. Defining quality-adjusted demand as $Q_{ki,j} = q_{ki,j} \cdot (z_{ki,j})^{\alpha_k}$, we have

$$Q_{ki,j} = I_k(\Phi_k)^{\sigma-1}(P_{ki,j})^{-\sigma},$$

where $P_{ki,j} = \frac{p_{ki,j}}{(z_{ki,j})^{\alpha_k}}$ is the quality-adjusted consumer price.

2.2.2 Final Goods Producer

The market structure of final goods in each destination is monopolistic competition. For a firm j from i and selling at k with production efficiency φ_j, the technology to produce quality level $z_{ki,j}$ for each unit of physical output is

$$z_{ki,j} = (\varphi_j \cdot l_{ki,j})^{\theta}.$$

[6] Hallak (2006) and Feenstra and Romalis (2014) adopt a similar setup in characterizing the preference for quality associated with income level.

Quality is costly to produce. $0 < \theta < 1$ measures the diminishing return of input in producing quality.[7] With composite input price c_{Mi} given, the production cost for one unit of physical output is

$$c_{Mi} l_{ki,j} = c_{Mi} \frac{(z_{ki,j})^{\frac{1}{\theta}}}{\varphi_j}.$$

The firm is subject to per-unit shipping cost T_{ki} and iceberg trade cost τ_{ki}. Consumer price $p_{ki,j}$ and producer price $p^*_{ki,j}$ satisfy $p_{ki,j} = \tau_{ki}(p^*_{ki,j} + T_{ki})$. tar_{ki} is the *ad valorem* tariffs for imports. Conditional on selling to k, the firm's profit maximization problem is

$$\max_{p^*_{ki,j}; z_{ki,j}} \pi_{ki,j} = [p^*_{ki,j} - c_{Mi} \frac{(z_{ki,j})^{\frac{1}{\theta}}}{\varphi_j}] \frac{\tau_{ki} q_{ki,j}}{tar_{ki}}.$$

The firm's problem can be written as

$$\max_{p^*_{ki,j}; z_{ki,j}} \pi_{ki,j} = [\frac{p^*_{ki,j} + T_{ki}}{(z_{ki,j})^{\alpha_k}} - \frac{c_{Mi} \frac{(z_{ki,j})^{\frac{1}{\theta}}}{\varphi_j} + T_{ki}}{(z_{ki,j})^{\alpha_k}}] \frac{\tau_{ki} Q_{ki,j}}{tar_{ki}},$$

$$\Rightarrow \max_{P_{ki,j}; z_{ki,j}} \pi_{ki,j} = \frac{1}{tar_{ki}} [P_{ki,j} - \tau_{ki} \frac{c_{Mi} \frac{(z_{ki,j})^{\frac{1}{\theta}}}{\varphi_j} + T_{ki}}{(z_{ki,j})^{\alpha_k}}] I_k (\Phi_k)^{\sigma-1} (P_{ki,j})^{-\sigma}.$$

The optimal quality-adjusted consumer price is the total cost of one unit of quality-adjusted output times the constant markup $\frac{\sigma}{\sigma-1}$:

$$P_{ki,j} = \frac{\sigma}{\sigma - 1} \tau_{ki} \frac{c_{Mi} \frac{(z_{ki,j})^{\frac{1}{\theta}}}{\varphi_j} + T_{ki}}{(z_{ki,j})^{\alpha_k}}.$$

It remains to solve the optimal quality that minimizes the total cost of one unit of quality-adjusted output:

$$\min_{z_{ki,j}} \frac{c_{Mi} \frac{(z_{ki,j})^{\frac{1}{\theta}}}{\varphi_j} + T_{ki}}{(z_{ki,j})^{\alpha_k}}.$$

On the one hand, quality upgrading features decreasing returns to scale, since the average production cost is increasing in $z_{ki,j}$ ($\partial[\frac{c_{Mi}}{\varphi_j}(z_{ki,j})^{\frac{1}{\theta}-\alpha_k}]/\partial z_{ki,j} > 0$). On the other hand, quality upgrading also features increasing returns to scale, since average shipping cost is decreasing in $z_{ki,j}$ ($\partial T_{ki}(z_{ki,j})^{-\alpha_k}/\partial z_{ki,j} < 0$). These two opposite forces thus interact to pin down the firm's optimal quality choice. The firm's optimal quality is

$$z_{ki,j} = (\frac{\alpha_k \theta}{1 - \alpha_k \theta} \frac{T_{ki}}{c_{Mi}} \varphi_j)^{\theta}. \tag{3}$$

[7] That production of quality requires higher productivity is a common specification, consistent with Khandelwal (2010), Johnson (2012), Kugler and Verhoogen (2012), and others.

The optimal quality decision depends on the firm's cost of shipping relative to cost of production.[8] If the per-unit shipping cost T_{ki} is high, the firm tends to embed more quality units into one single physical unit and avoid incurring too much shipping cost.[9] An increase in φ_j and a decrease in c_{Mi} induce similar effect, since they both increase shipping cost relative to production cost. More productive firms thus produce better-quality goods, consistent with the findings of Kugler and Verhoogen (2012), Manova and Zhang (2012), and Fan, Li and Yeaple (2018). The optimal quality is also increasing in market k's preference for quality α_k.[10]

With optimal quality $z_{ki,j}$ solved, we can further solve for the quality-adjusted price $P_{ki,j}$ and quality-adjusted output $Q_{ki,j}$:

$$P_{ki,j} = \frac{p_{ki,j}}{(z_{ki,j})^{\alpha_k}} = \frac{\sigma}{\sigma-1}\tau_{ki}(\frac{c_{Mi}}{\alpha_k\theta\varphi_j})^{\alpha_k\theta}(\frac{T_{ki}}{1-\alpha_k\theta})^{1-\alpha_k\theta},$$
$$Q_{ki,j} = I_k(\Phi_k)^{\sigma-1}[\frac{\sigma}{\sigma-1}\tau_{ki}(\frac{c_{Mi}}{\alpha_k\theta\varphi_j})^{\alpha_k\theta}(\frac{T_{ki}}{1-\alpha^k\theta})^{1-\alpha_k\theta}]^{-\sigma}.$$

The resulting sales $X_{ki,j}$ and operating profit $\pi_{ki,j}$ of firm j selling from i to k are

$$X_{ki,j} = P_{ki,j}Q_{ki,j} = I_k(\Phi_k)^{\sigma-1}[\frac{\sigma}{\sigma-1}\tau_{ki}(\frac{c_{Mi}}{\alpha_k\theta\varphi_j})^{\alpha_k\theta}(\frac{T_{ki}}{1-\alpha_k\theta})^{1-\alpha_k\theta}]^{1-\sigma},$$
$$\pi_{ki,j} = \frac{\omega}{tar_{ki}}[\tau_{ki}(\frac{c_{Mi}}{\alpha_k\theta\varphi_j})^{\alpha_k\theta}(\frac{T_{ki}}{1-\alpha_k\theta})^{1-\alpha_k\theta}]^{1-\sigma}I_k(\Phi_k)^{\sigma-1},$$

where $\omega = (\frac{1}{\sigma-1})(\frac{\sigma}{\sigma-1})^{-\sigma}$.

2.3 Aggregation

As in Melitz (2003), we assume that a firm selling from i to k must incur a fixed cost F_{ki}. Since operating profit $\pi_{ki,j}$ is increasing in φ_j, only firms from i with nonnegative operating profits after netting out fixed cost F_{ki} can sell at k. The cutoff productivity for firms selling from i to k, $\widehat{\varphi}_{ki}$, is therefore

$$\frac{\omega}{tar_{ki}}[\tau_{ki}(\frac{c_{Mi}}{\alpha_k\theta\widehat{\varphi}_{ki}})^{\alpha_k\theta}(\frac{T_{ki}}{1-\alpha_k\theta})^{1-\alpha_k\theta}]^{1-\sigma}I_k(\Phi_k)^{\sigma-1} = F_{ki},$$
$$\Rightarrow \widehat{\varphi}_{ki} = \frac{c_{Mi}}{\alpha_k\theta}(\frac{T_{ki}}{1-\alpha_k\theta})^{\frac{1-\alpha_k\theta}{\alpha_k\theta}}[\frac{F_{ki}(\tau_{ki})^{\sigma-1}tar_{ki}}{\omega I_k(\Phi_k)^{\sigma-1}}]^{\frac{1}{(\sigma-1)\alpha_k\theta}}.$$

[8] We also require $0 < \alpha_k\theta < 1$ to ensure the solution is well-defined.

[9] This generates the "Washington apple effect," the fact that an exporter tends to ship better-quality goods to more distant markets. For empirical evidence, see Hummels and Skiba (2004), Baldwin and Harrigan (2011), Manova and Zhang (2012), Harrigan, Ma and Shlychkov (2015), and Dingel (2017).

[10] This conclusion is also aligned with Hallak (2006), Fajgelbaum, Grossman and Helpman (2011), and Manova and Zhang (2012), who study the positive relationship between a destination's per capita income level and its import price.

Assume the firm's productivity φ_j is drawn from a distribution $G(\varphi)$. Then firms from i with a draw higher than $\widehat{\varphi}_{ki}$ will sell at k. We assume the productivity distribution $G(\varphi)$ is identical across different countries, to simplify our analysis and restrict our attention to the differences in input prices resulting from variation in judicial quality across countries.

The aggregate trade flow from i to k is

$$X_{ki} = N_i \int_{\widehat{\varphi}_{ki}}^{\infty} X_{ki,j} \mathrm{d}G(\varphi) = \frac{N_i I_k (\Phi_k)^{\sigma-1} \int_{\widehat{\varphi}_{ki}}^{\infty} \varphi^{(\sigma-1)\alpha_k\theta} \mathrm{d}G(\varphi)}{[\frac{\sigma}{\sigma-1}\tau_{ki}(\frac{c_{Mi}}{\alpha_k\theta})^{\alpha_k\theta}(\frac{T_{ki}}{1-\alpha_k\theta})^{1-\alpha_k\theta}]^{\sigma-1}}, \tag{4}$$

where N_i is the total mass of potential final goods producers in i.

The average quality of trade flow from i to k is

$$\widetilde{z}_{ki} = \int_{\widehat{\varphi}_{ki}}^{\infty} z_{ki,j} \mathrm{d}\frac{G(\varphi)}{1-G(\widehat{\varphi}_{ki})} = (\frac{\alpha_k\theta}{1-\alpha_k\theta}\frac{T_{ki}}{c_{Mi}}\widetilde{\varphi}_{ki})^{\theta}, \tag{5}$$

where

$$\widetilde{\varphi}_{ki} = [\int_{\widehat{\varphi}_{ki}}^{\infty} \varphi^{\theta} \mathrm{d}\frac{G(\varphi)}{1-G(\widehat{\varphi}_{ki})}]^{\frac{1}{\theta}}.$$

$\widetilde{\varphi}_{ki}$ is the "average" productivity of firms selling from i to k. The following lemma states that average productivity $\widetilde{\varphi}_{ki}$ is monotonically increasing in the cutoff productivity $\widehat{\varphi}_{ki}$.

Lemma 1 *Average productivity from i to k, $\widetilde{\varphi}_{ki}$, is increasing in the cutoff productivity from i to k, $\widehat{\varphi}_{ki}$.*

Proof. See Appendix I. ■

Lemma 1 ensures that any changes in cutoff productivity translate to changes in average productivity in the same direction. Combined with the solution for average quality $\widetilde{z}_{ki}$, this result ensures that any selection effects resulting in increases in $\widehat{\varphi}_{ki}$ always increase the average quality of trade flow.

The exact price index in destination k, Φ_k, is

$$\begin{aligned}(\Phi_k)^{1-\sigma} &= \sum_s N_s \int_{\widehat{\varphi}_{ks}}^{\infty} [\frac{\sigma}{\sigma-1}\tau_{ks}(\frac{c_{Ms}}{\alpha_k\theta\varphi})^{\alpha_k\theta}(\frac{T_{ks}}{1-\alpha_k\theta})^{1-\alpha_k\theta}]^{1-\sigma} \mathrm{d}G(\varphi) \\ &= \frac{[(\alpha_k\theta)^{\alpha_k\theta}(1-\alpha_k\theta)^{1-\alpha_k\theta}]^{\sigma-1}}{[\frac{\sigma}{\sigma-1}]^{\sigma-1}} \sum_s N_s \frac{\int_{\widehat{\varphi}_{ks}}^{\infty} \varphi^{\alpha_k\theta(\sigma-1)} \mathrm{d}G(\varphi)}{[\tau_{ks}(c_{Ms})^{\alpha_k\theta}(T_{ks})^{1-\alpha_k\theta}]^{\sigma-1}}.\end{aligned}$$

Changes in composite input prices in any country s, c_{Ms}, can impact the price index in k via two channels. First, by affecting the production costs of firms currently selling from s to k, Φ_k reacts directly to the variation in c_{Ms} (the intensive margin). Second, changes in c_{Ms} affect the cutoff productivity $\widehat{\varphi}_{ks}$, which affects the distribution of firms that export from s to k. The changing composition of exporting firms hence affects the exact price index Φ_k (the extensive margin). The following lemma describes this effect.

Lemma 2 *An increase in the composite input price c_{Ms} in a particular country s always increases the exact price index Φ_k in any destination country k:*

$$\frac{d\ln \Phi_k}{d\ln c_{Ms}} = \frac{\alpha_k\theta + \frac{1}{(\sigma-1)\overline{\varphi}_{ks}}}{\frac{1}{S_{ks}} + \frac{1}{\alpha_k\theta(\sigma-1)\overline{\varphi}_{ks}}}, \tag{6}$$

where the market share of s in k, S_{ks}, is

$$S_{ks} = \frac{N_s \int_{\widehat{\varphi}_{ks}}^{\infty} [\frac{\sigma}{\sigma-1}\tau_{ks}(\frac{c_{Ms}}{\alpha_k\theta\varphi})^{\alpha_k\theta}(\frac{T_{ks}}{1-\alpha_k\theta})^{1-\alpha_k\theta}]^{1-\sigma}\, dG(\varphi)}{(\Phi_k)^{1-\sigma}},$$

and

$$\overline{\varphi}_{ks} = \int_{\widehat{\varphi}_{ks}}^{\infty} (\frac{\varphi}{\widehat{\varphi}_{ks}})^{\alpha_k\theta(\sigma-1)}\, d\frac{G(\varphi)}{g(\widehat{\varphi}_{ks})\widehat{\varphi}_{ks}}.$$

Proof. See Appendix I. ■

Lemma 2 states that decreases in the composite input price in any source country s lower the exact price index in any destination country k through a pro-competitive effect. The pro-competitive effect operates to raise the cutoff productivities for any countries selling at k. Intuitively, the magnitude of the pro-competitive effect on the exact price index crucially depends on i's market share in k, S_{ks}. If the market share is very small, the impact of c_{Ms} on Φ_k is negligible and $\frac{\mathrm{d}\ln \Phi_k}{\mathrm{d}\ln c_{Ms}}$ converges to zero. In contrast, if the market share S_{ks} is close to 1, c_{Ms} has a significant impact on the price index and $\frac{\mathrm{d}\ln \Phi_k}{\mathrm{d}\ln c_{Ms}}$ converges to $\alpha_k\theta$. We can determine how changes in c_{Mi} and c_{Mk} affect the cutoff productivity from i to k.

Proposition 1 *The cutoff productivity of selling from i to k is increasing in c_{Mi} but decreasing in c_{Mk}:*

$$\frac{d\ln \widehat{\varphi}_{ki}}{d\ln c_{Mi}} = \frac{1 - S_{ki}}{1 + \frac{S_{ki}}{\alpha_k\theta(\sigma-1)\overline{\varphi}_{ki}}} > 0, \tag{7}$$

$$\frac{d\ln \widehat{\varphi}_{ki}}{d\ln c_{Mk}} = -\frac{1 + \frac{1}{\alpha_k\theta(\sigma-1)\overline{\varphi}_{kk}}}{\frac{1}{S_{kk}} + \frac{1}{\alpha_k\theta(\sigma-1)\overline{\varphi}_{kk}}} < 0. \tag{8}$$

Proof. See Appendix I. ■

A decrease in the composite input price in i ($i \neq k$) affects the productivity cutoff $\widehat{\varphi}_{ki}$ in two opposite ways. The first effect is that lower c_{Mi} allows less productive firms in i to serve country k and decreases $\widehat{\varphi}_{ki}$. The second effect is that lower c_{Mi} lowers the exact price index in k, Φ_k, according to Lemma 2, and increases $\widehat{\varphi}_{ki}$ because competition in market k tightens. As we illustrate in Lemma 2, the magnitude of the second effect crucially depends on the i's market share in k. Proposition 1 shows that as long as i's market share in k, S_{ki}, is less than 1, the first effect always dominates the second effect and a decrease in the composite input price in i always leads to lower $\widehat{\varphi}_{ki}$. Thus, lower c_{Mi} always allows less productive firms in i to be able to serve market k. Moreover, the magnitude of $\frac{\mathrm{d}\ln\widehat{\varphi}_{ki}}{\mathrm{d}\ln c_{Mi}}$ decreases with S_{ki}.

In contrast, if the composite input price in k, c_{Mk}, falls, more domestic firms in k will be able to enter and compete in k. This pro-competitive effect always increases the threshold for firms from other countries to enter k and, as a result, $\widehat{\varphi}_{ki}$ increases.

2.4 Impact of Judicial Quality on the Quality of Trade

We discuss how variation in judicial quality in the export country i and import country k affects the average quality of trade in industries with different contract intensities. As the first-stage production model is the same for all exporters and importers, the country subscripts are omitted. But in this section, we use ϕ_i and ϕ_k to differentiate variant influences of exporters' and importers' judicial quality. Our analysis focuses on the mechanism that improvement in judicial quality induces reductions in composite input prices in industries with different contract intensities, and how these reductions in costs affect the average quality of trade flows. Therefore, we pay particular attention to the following derivatives:[11]

$$\frac{\mathrm{d}\ln\widetilde{z}_{ki}}{\mathrm{d}\ln c_{Mi}}\frac{\mathrm{d}^2\ln c_{Mi}}{\mathrm{d}\phi_i\mathrm{d}\eta};\ \frac{\mathrm{d}\ln\widetilde{z}_{ki}}{\mathrm{d}\ln c_{Mk}}\frac{\mathrm{d}^2\ln c_{Mk}}{\mathrm{d}\phi_k\mathrm{d}\eta}.$$

Proposition 2 *Given a destination k, an increase in judicial quality in country i increases average export quality relatively more for more contract-intensive industries via the cost reduction effect but decreases average export quality relatively more for more contract-intensive industries via the selection*

[11] Here we pay attention to $\frac{\mathrm{d}\ln\widetilde{z}_{ki}}{\mathrm{d}\ln c_{Mi}}\frac{\mathrm{d}^2\ln c_{Mi}}{\mathrm{d}\phi_i\mathrm{d}\eta}$ and $\frac{\mathrm{d}\ln\widetilde{z}_{ki}}{\mathrm{d}\ln c_{Mk}}\frac{\mathrm{d}^2\ln c_{Mk}}{\mathrm{d}\phi_k\mathrm{d}\eta}$, rather than $\frac{\mathrm{d}^2\ln\widetilde{z}_{ki}}{\mathrm{d}\phi_i\mathrm{d}\eta}$ and $\frac{\mathrm{d}^2\ln\widetilde{z}_{ki}}{\mathrm{d}\phi_k\mathrm{d}\eta}$, as the former could be divided into cost reduction and selection parts in a straightforward way. Above all, the former derivatives move in the same direction with the latter ones, and will not change our main conclusions, given that judicial quality only influences the quality of trade through the price of the composite input.

effect. Hence, the net effect is ambiguous.

$$\frac{d\ln \widetilde{z}_{ki}}{d\ln c_{Mi}}\frac{d^2\ln c_{Mi}}{d\phi_i d\eta} = \{\underbrace{-\theta}_{Cost\ Reduction} + \underbrace{\frac{\widehat{\varphi}_{ki} g(\widehat{\varphi}_{ki})[1-(\frac{\widehat{\varphi}_{ki}}{\overline{\varphi}_{ki}})^{\theta}]}{1-G(\widehat{\varphi}_{ki})}\frac{1-S_{ki}}{1+\frac{S_{ki}}{\alpha_k\theta(\sigma-1)\overline{\varphi}_{ki}}}}_{Selection}\}\frac{\beta(1-\beta)}{[\beta+\phi_i\eta(1-\beta)]^2}. \tag{9}$$

Proof. See Appendix I. ■

On the one hand, better judicial quality in source country i lowers the production cost of existing exporters and facilitates quality upgrading of these firms. The cost-reduction effect is due to the optimal quality choice of individual exporters and increases the average export quality via the intensive margin. On the other hand, better judicial quality in i lowers the cutoff productivity of exporting and allows less-productive firms to export. The selection effect decreases average export quality via the extensive margin. The two effects interact and result in an ambiguous net effect.

Proposition 3 *Given source i, an increase in judicial quality in country k increases average import quality relatively more for more contract-intensive industries via the selection effect.*

$$\frac{d\ln \widetilde{z}_{ki}}{d\ln c_{Mk}}\frac{d^2\ln c_{Mk}}{d\phi_k d\eta} = \underbrace{-\frac{\widehat{\varphi}_{ki} g(\widehat{\varphi}_{ki})[1-(\frac{\widehat{\varphi}_{ki}}{\overline{\varphi}_{ki}})^{\theta}]}{1-G(\widehat{\varphi}_{ki})}\frac{1+\frac{1}{\alpha_k\theta(\sigma-1)\overline{\varphi}_{kk}}}{\frac{1}{S_{kk}}+\frac{1}{\alpha_k\theta(\sigma-1)\overline{\varphi}_{kk}}}\frac{\beta(1-\beta)}{[\beta+\phi_k\eta(1-\beta)]^2}} < 0. \tag{10}$$

Proof. See Appendix I. ■

Better judicial quality in destination country k induces increasing domestic entry and intensifies the competition in k faced by foreign firms. As a result, the cutoff productivity of selling at k increases for exporting country i, eliminating a set of low-productivity firms. The selection effect hence increases average import quality.

2.5 Special Case: Pareto Distribution of Productivity

Unbounded Pareto distribution is widely used in the trade literature due to its analytical tractability and its ability to approximate the right tail of the productivity distribution (Chaney, 2008; Melitz and Ottaviano, 2008; Arkolakis, 2010; Eaton, Kortum and Kramarz, 2011; Feenstra, 2015). Therefore, we examine our theoretical results under the Pareto assumption. Under this parametric assumption, we can obtain closed-form solutions to the marginal responses of export and import quality to judicial quality. To be specific, assume φ is drawn from $G(\cdot)$ whose cumulative distribution function is

$$G(\varphi) = 1 - \varphi^{-\gamma},\ \varphi \in [1, \infty).$$

We impose $\gamma > \theta$ to ensure that our solutions are well-defined. Plugging $G(\varphi)$ into equation (5), it is straightforward to show:

$$\ln \widetilde{z}_{ki} = \theta \ln(\frac{\alpha_k \theta}{1-\alpha_k \theta}) + \theta \ln T_{ki} - \theta \ln c_{Mi} + \theta \ln \widehat{\varphi}_{ki} + \ln \frac{\gamma}{\gamma - \theta}. \tag{11}$$

The results under the Pareto assumption are summarized in the following proposition.

Proposition 4 *Under the distribution assumption that*

$$G(\varphi) = 1 - \varphi^{-\gamma},\ \varphi \in [1, \infty)$$

increases in judicial quality in i and k affect the average quality of trade with different contract intensities in the following ways:

$$\frac{d \ln \widetilde{z}_{ki}}{d \ln c_{Mi}} \frac{d^2 \ln c_{Mi}}{d\phi_i d\eta} = -\frac{\frac{\gamma}{\alpha_k(\sigma-1)}}{\frac{1}{S_{ki}} - 1 + \frac{\gamma}{\alpha_k \theta(\sigma-1)}} \frac{\beta(1-\beta)}{[\beta + \phi_i \eta(1-\beta)]^2} < 0, \tag{12}$$

$$\frac{d \ln \widetilde{z}_{ki}}{d \ln c_{Mk}} \frac{d^2 \ln c_{Mk}}{d\phi_k d\eta} = -\frac{\frac{\gamma}{\alpha_k(\sigma-1)}}{\frac{1}{S_{kk}} - 1 + \frac{\gamma}{\alpha_k \theta(\sigma-1)}} \frac{\beta(1-\beta)}{[\beta + \phi_k \eta(1-\beta)]^2} < 0. \tag{13}$$

Proof. See Appendix I. ■

Under the Pareto distribution assumption, better judicial quality in destination country k and source country i induces higher quality of more contract-intensive goods. An increase in judicial quality influences the average quality $\ln \widetilde{z}_{ki}$ only by affecting the exact price index in destination k. This is because under the Pareto assumption, the cost reduction effect and selection effect due to the direct effect of c_{Mi} on $\widetilde{\varphi}_{ki}$ (rather than the indirect effect of c_{Mi} on $\widetilde{\varphi}_{ki}$ via Φ_k) exactly offset each other. As we suggest in Lemma 2, i's market share in k is important in pinning down the magnitudes of $\frac{\mathrm{d} \ln \widetilde{z}_{ki}}{\mathrm{d} \ln c_{Mi}} \frac{\mathrm{d}^2 \ln c_{Mi}}{\mathrm{d}\phi_i \mathrm{d}\eta}$ and $\frac{\mathrm{d} \ln \widetilde{z}_{ki}}{\mathrm{d} \ln c_{Mk}} \frac{\mathrm{d}^2 \ln c_{Mk}}{\mathrm{d}\phi_k \mathrm{d}\eta}$. When $S_{ki} \to 0$ and $S_{kk} \to 1$, we have

$$\frac{\mathrm{d} \ln \widetilde{z}_{ki}}{\mathrm{d} \ln c_{Mi}} \frac{\mathrm{d}^2 \ln c_{Mi}}{\mathrm{d}\phi_i \mathrm{d}\eta} \to 0,$$

$$\frac{\mathrm{d} \ln \widetilde{z}_{ki}}{\mathrm{d} \ln c_{Mk}} \frac{\mathrm{d}^2 \ln c_{Mk}}{\mathrm{d}\phi_k \mathrm{d}\eta} \to -\frac{\theta \beta(1-\beta)}{[\beta + \phi_k \eta(1-\beta)]^2}.$$

We conjecture that on average S_{ki} is small and close to 0 while S_{kk} is large and close to 1, and that a market is generally occupied by its domestic producers. Under these conditions, $\frac{\mathrm{d} \ln \widetilde{z}_{ki}}{\mathrm{d} \ln c_{Mi}} \frac{\mathrm{d}^2 \ln c_{Mi}}{\mathrm{d}\phi_i \mathrm{d}\eta}$ should be close to 0 and $\frac{\mathrm{d} \ln \widetilde{z}_{ki}}{\mathrm{d} \ln c_{Mk}} \frac{\mathrm{d}^2 \ln c_{Mk}}{\mathrm{d}\phi_k \mathrm{d}\eta}$ should be unambiguously negative.

3 Specification, Measures, and Data

3.1 Specification and Identification

Our empirical analysis focuses on how judicial quality in source and destination countries yields different impacts on the quality of trade in industries with different contract intensities. We exploit the variation in different exporter-importer product pairs to identify these effects. Specifically, to test Propositions 2 and 3, we estimate:

$$\ln \widetilde{z}_{ki}^{g} = \beta_E \cdot ci^g \cdot JQ_i + \mu_k^g + \mu_i + \Psi_i^g + \varepsilon_{1ki}^g, \tag{14}$$

$$\ln \widetilde{z}_{ki}^{g} = \beta_I \cdot ci^g \cdot JQ_k + \mu_i^g + \mu_k + \Psi_k^g + \varepsilon_{2ki}^g. \tag{15}$$

$\widetilde{z}_{ki}^{g}$ is the average quality of goods g from i to k. JQ_i and JQ_k are the measures of judicial quality in source country i and destination country k, and should be inversely associated with ϕ_i and ϕ_k. ci^g is the measure of the contract intensity of goods g, the empirical counterpart of η^g. We include destination-product fixed effects μ_k^g in (14) to ensure that the variation used to identify β_E comes solely from the variation across source-product pairs. Source country fixed effects μ_i are also included in (14) to absorb any effects associated with the source country's characteristics, such as the level of contract enforcement and income. A similar consideration leads to the inclusion of fixed effects μ_i^g and μ_k in (15). Inclusion of μ_k^g and μ_i^g also prevents us from mis-specification when estimating β_E and β_I separately. To see this, notice that when estimating (15), μ_i^g capture any product-specific effects from the supply side that might affect the quality of trade, including $\beta_E \cdot ci^g \cdot JQ_i + \mu_i + \Psi_i^g$. Analogously, when estimating (14), μ_k^g capture any product-specific effects from the demand side that might affect the quality of trade, including $\beta_I \cdot ci^g \cdot JQ_k + \mu_k + \Psi_k^g$. Ψ_i^g and Ψ_k^g are source-product and destination-product specific covariates, respectively.

The specifications in (14) and (15) are similar to Rajan and Zingales (1998), Romalis (2004), and Nunn (2007). Rajan and Zingales (1998) use such a specification to test whether industries that are more dependent on external finance grow faster in countries with better financial development. Romalis (2004) adopts a similar specification to test whether countries that are abundant in a factor endowment specialize in industries intensively using that factor endowment in production. Nunn (2007) uses the same specification to study whether countries with better judicial quality and hence contract enforcement environment specialize in industries requiring more relationship-specific inputs, namely, more contract-intensive industries. In (14), a positive β_E implies that countries with better judicial quality on average export better-quality goods in industries that are more dependent on relationship-specific inputs, fixing a particular destination k. By the same token, a positive β_I implies that countries with better judicial quality on average import better-quality goods in industries that are more dependent on relationship-specific inputs, fixing a particular source i. According to Propositions 2 and 3, the sign of β_E is ambiguous due to two offsetting forces: cost reduction and selection. The sign of β_I is strictly positive.

However, our specification still differs from that used by Rajan and Zingales (1998), Romalis (2004), and Nunn (2007). Although other studies tend to aggregate across destinations and use the total value of exports from country c in a particular product or industry g as the dependent variable, we retain the bilateral feature of the trade data and use the quality of bilateral trade flows as the dependent variable. Two reasons motivate our adoption of such specification. First, as our theory offers predictions on how the quality of bilateral trade flow varies with the judicial quality of the exporting and importing countries in industries with different contract intensities, studying variation in bilateral trade quality keeps our empirical analysis aligned with our theory. Second, aggregating across destinations and sources might suffer from potential bias. For example, two source countries may sell to very different sets of destinations in one product g, and the associated demand-side factors that might drive the quality of trade are neglected in the analysis if we merely focus on the total exports of a country in product g. The same argument applies to destinations as well. By using destination-product fixed effects μ_k^g in (14) and source-product fixed effects μ_i^g in (15), we make sure that the comparison takes place between sources selling to a common destination-product pair kg, and destinations buying from a common source-product pair ig.

We also include a series of control variables that may impact the quality of trade as well. We first control a set of interactions related to various types of factor endowments or comparative advantages. These "comparative advantage" interactions include the product's skill intensity times the country's skill endowment $h^g \cdot H_i$ ($h^g \cdot H_k$), the product's capital intensity times the country's capital endowment $k^g \cdot K_i$ ($k^g \cdot K_k$), and the product's external financial dependence times the country's financial development $f^g \cdot \ln CR_i$ ($f^g \cdot \ln CR_k$).[12] However, since measures of skill intensity, capital intensity, and external financial dependence at the product level are extremely difficult to obtain, we rely on industry-level measures of these variables as proxies. Moreover, bilateral distance and *ad valorem* tar-

[12] Manova (2008) argues that countries with better financial development have a comparative advantage in industries with higher external financial dependence.

iffs are found to be important determinants of product quality (Hummels and Skiba, 2004), so we also include log distance $\ln dist_{ki}$ and log of one plus tariff $\ln(1 + tar^g_{ki})$ as controls.

In addition, we include the interaction between log per capita income y_i (y_k) and other industrial or product characteristics to account for the possibility that high-income countries might have an advantage in producing or a particular preference over better-quality goods in certain industries or products. Specifically, high-income countries might tend to export or import better-quality goods in differentiated products (measured by the classification from Rauch (1999) D^g), high value-added products (measured by share of value-added va^g), products with a more fragmented production process (measured by intra-industry trade iit^g), products with rapid technology advancement (measured by total factor productivity growth Δtfp^g), or sophisticated products with many input varieties (measured by one minus the Herfindahl index of input concentration $1 - hi^g$). These interaction terms enter Ψ^g_i in (14) and Ψ^g_k (15) to ensure that our estimates of β_E and β_I are not subject to omitted variable bias.

3.2 Measures and Data

3.2.1 Quality of Trade

We use two indicators to measure the quality of trade flows from i to k in product g. The first indicator is the unit value of good g that i sells to k. The unit value measure is widely used in the previous studies. For example, Hallak (2006) investigates how the destination's per capita income affects the quality of imports. Specifically, the unit value is constructed as

$$\ln uv^g_{ki} = \ln \frac{V^g_{ki}}{q^g_{ki}};\ \ln uv^{*g}_{ki} = \ln \frac{V^{*g}_{ki}}{q^g_{ki}}$$

where V^g_{ki} (V^{*g}_{ki}) and q^g_{ki} are the CIF (FOB) dollar value and quantity of trade from i to k in product category g. g is defined by the combination of the SITC revision 2 4-digit and the unit of measurement (for example, kilogram). We can accordingly construct the FOB unit value and CIF unit value.

The second indicator comes from Feenstra and Romalis (2014), who provide estimates of the relative quality of trade between two countries for each SITC 4-digit-unit combination (FR quality henceforth). Since our theoretical model of quality choice is built on Feenstra and Romalis (2014), the estimation procedure and resulting quality estimates are consistent with our theoretical framework. The key merit of the FR approach in measuring product quality is that it endogenizes product quality by incorporating the firm's optimal quality choice behavior, hence generating more robust estimates of product quality compared with the pure demand-side approach.[13] The detailed derivation and implementation of the estimation procedure are provided in Appendix II. To summarize, given a product g and destination k, country i's export quality to k in product g, relative to the average export quality to destination k in product g, $\ln \widetilde{z}_{ki}^{g,FR} - \ln \widetilde{z}_{k,world}^{g}$, is

$$\ln \widetilde{z}_{ki}^{g,FR} - \ln \widetilde{z}_{k,world}^{g} = \frac{\kappa_{1k}^{g}}{\sigma^{g}-1}[(\sigma^{g}-1)\ln uv_{ki}^{g} + \ln uv_{ki}^{*g} + \beta^{g\prime} f_{ki} + \sigma^{g}\ln tar_{ki}^{g}] - \ln \widetilde{z}_{k,world}^{g}, \tag{16}$$

where f_{ki} is a vector of variables that affect the fixed cost of exporting F_{ki}^{g} and tar_{ki}^{g} is the tariff rate. The average export quality from worldwide countries to k in product g, $\widetilde{z}_{k,world}^{g}$, is used to cancel out any unquantifiable destination- and product-specific variables, and it reveals that $\ln \widetilde{z}_{ki}^{g,FR} - \ln \widetilde{z}_{k,world}^{g}$ measures the export quality of product g from source i relative to the mean quality of country k's imports. The presence of the mean quality also justifies the inclusion of destination-product fixed effects in (14).

Given a product g and source i, country k's import quality from i in product g, relative to the average import quality from source i in product g, $\ln \widetilde{z}_{ki}^{g,FR} - \ln \widetilde{z}_{world,i}^{g}$, is

$$\begin{aligned}\ln \widetilde{z}_{ki}^{g,FR} - \ln \widetilde{z}_{world,i}^{g} \quad = \quad & \frac{\overline{\alpha}^{g}\theta^{g}}{1+\gamma^{g}}[(1+\gamma^{g})\ln(\kappa_{1k}^{g} uv_{ki}^{*g}) - \ln\frac{X_{ki}^{g}}{tar_{ki}^{g}} + \beta_{0}^{g}\ln\frac{Y_k}{p_k} + \beta^{g\prime} f_{ki}] \\ & + [\frac{\overline{\alpha}^{g}\theta^{g}}{1+\gamma^{g}} + \frac{1}{\sigma^{g}-1}]\ln \kappa_{2k}^{g} - \ln \widetilde{z}_{world,i}^{g}, \end{aligned} \tag{17}$$

where Y_k and p_k are k's total expenditure and price index, respectively. $\overline{\alpha}^{g}$ is the average "preference for quality" across all countries importing product g. γ^{g} is the dispersion parameter of the Pareto distribution of product g producer's productivity draw. Again, $\ln \widetilde{z}_{ki}^{g,FR} - \ln \widetilde{z}_{world,i}^{g}$ measures the import quality in product g to destination k relative to the mean quality of country i's exports. Hence, inclusion of source-production fixed effects μ_{i}^{g} in (15) is also essential.

To ensure that our results are not subject to measurement error, we use both measures in our empirical analysis.

3.2.2 Judicial Quality

Our preferred measure of judicial quality, JQ_i and JQ_k, is initially provided by Kaufmann, Kraay, and Mastruzzi (2004). We use the "rule of law" indicator, which measures a country's efficiency and

[13] The pure demand-side approach estimates product quality as a demand shifter in a demand function without specifying the source of variation in product quality. Khandelwal (2010), Hallak and Schott (2011), and Khandelwal, Schott, and Wei (2013) all adopt a demand-side approach to estimate product quality.

consistency in judicial procedures and practice during 1997-98. The "rule of law" measure also takes into account the situation of contract enforcement.

Gwartney and Lawson (2006) and the World Bank's "Doing Business Survey" also provide measures on judicial quality and contract enforcement in each country. These two alternative variables are used to ensure that our results are robust.

3.2.3 Contract Intensity

In our theory, η measures the intensity with which an industry uses differentiated inputs to produce composite inputs. Since differentiated input producers are more likely to suffer from the hold-up problem, the cost of producing differentiated inputs heavily relies on the judicial quality and contract enforcement of the host country. η is thus defined as the contract intensity of an industry or product. Nunn (2007) constructs a measure of contract intensity ci^g. Specifically,

$$ci^g = \sum_s R^s \cdot \rho^{gs},$$

where R^s is a dummy defining whether product s is differentiated or not (if yes, then $R^s = 1$; otherwise, $R^s = 0$). ρ^{gs} is the input expenditure share spent on product s during the production of product g.

R^s can be defined at the SITC 4-digit product level according to the classification in Rauch (1999). Rauch (1999) defines an SITC product as "sold on an organized exchange," "reference priced," or "neither" according to a "conservative" standard and a "liberal" standard.[14] We define SITC products s that are classified as "neither" by a "liberal" standard as differentiated. We also experiment with the "conservative" standard to ensure the robustness of our results.

The ideal ci^g should be constructed at the SITC 4-digit level. However, the availability of information on input-output linkage allows us to obtain ρ^{gs} only at the industry level rather than the product level. Therefore, we decide to construct ci^g at the industry level, the most disaggregate measure of contract intensity available, and map it to the product level. To be specific, we follow Nunn (2007) and obtain ρ^{gs} from the 1997 U.S. input-output table from the Bureau of Economic Analysis for 342 input-output (I/O) industry classifications. We follow Nunn (2007) and assign equal weight to each SITC product within the same I/O industry. We then aggregate R^s at the SITC 4-digit to each I/O

[14] Rauch (1999) admits that when classifying SITC products into "sold on an organized exchange," "reference priced," or "neither," ambiguities arise when aggregating the classification from SITC 5-digit to SITC 4-digit due to multiple categories within one 4-digit product. "Conservative" and "liberal" standards are provided to define the reasonable range of each classification.

industry. Now we can construct ci^g at the U.S. I/O industry level. The industry-level measure is then mapped to the SITC 4-digit level to concord with the unit value and FR quality data.

A country's contract environment could potentially shape producers' tendency to use relationship-specific inputs in that country. Our usage of the U.S. I/O table hence ensures the exogeneity of ci^g to JQ. A similar practice is adopted by Rajan and Zingales (1998), who construct industry-level external financial dependence using data on U.S. publicly listed firms.

3.2.4 Data Description

We collect bilateral trade data on value and quantity for each SITC revision 2 4-digit product (with the unit of measurement) in 1997 to calculate unit values. The data are from the United Nations Comtrade data set. The variables used to calculate the FR quality measure are also for 1997. The sample contains 158 countries and 1,292 SITC 4-digit products with the unit of measurement.

JQ_i (JQ_k), ci^g and most of the control variables in our empirical parts are from public papers. There is no need for us to collect these indicators respectively, as Nunn (2007) offers a public online data set of these key variables. For the measure of dependence on external financing f^g, the construction follows Rajan and Zingales (1998).[15] Measures of contract intensity ci^g, other factor intensities (h^g, k^g, f^g), intra-industry trade share iit^g, share of value-added va^g, technology advancement Δtfp^g, and input complexity $1 - hi^g$ are only available at the U.S. I/O industry level, rather than at the SITC 4-digit product level. So, we map these measures at the U.S. I/O industry level to the SITC 4-digit product level and use the industry-level measures in our analysis. The only exception is D^g, the measure of whether an SITC 4-digit product is a differentiated product or not. We use the classification from Rauch (1999) to define differentiated products at the SITC 4-digit product level.[16] Other factor endowment variables H, K and CR, and per capita income y, are drawn from Nunn (2007). Table 1 summarizes the definitions and sources of the key variables and control variables.

[Table 1 here]

To motivate our empirical analysis, we present several descriptive figures that illustrate the impact of judicial quality on the quality of trade for products with different contract intensities. We first

[15] Specifically, using the COMPUSTAT data set, we calculate a firm's share of capital expenditure financed externally in 1997. We then take the median value of this external finance share within each U.S. I/O industry to generate an industry-level measure of dependence on external financing f^g.

[16] If product g is defined as "sold on an organized exchange" or "reference priced" according to the classification in Rauch (1999), it is "not differentiated" and $D^g = 0$. If product g is defined as "neither," it is "differentiated" and $D^g = 1$.

construct a raw export price index for each country for each product g (defined by the combination of SITC 4-digit and unit of measurement) using unit value data.[17] We demean the export price index using the world average of the export price index for product g to make the price index comparable across products.

We sort 1,292 products into 10 groups of equal size according to their contract intensities. We calculate the average demeaned export price indexes for the groups with the highest and lowest contract intensities, respectively, then we obtain the ratio of the two indexes. This procedure gives us a measure of country i's relative export quality of the most contract-intensive products versus the least contract-intensive products (relative export quality for short), using unit value as the measure of quality. Similarly, we can construct country k's relative import quality of the most contract-intensive products versus the least contract-intensive products (relative import quality for short). We plot the two measures in logs against judicial quality (normalized so that the mean is zero) in Figure 1.

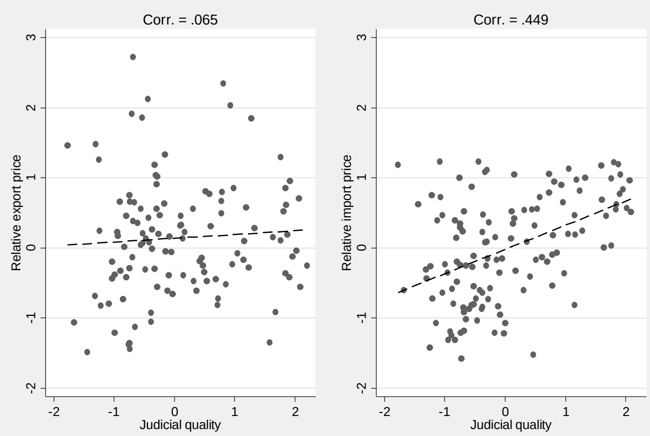

Figure 1 Contract intensity, top 10% vs bottom 10%

Note: In the left panel of Figure 1, the vertical axis is the ratio between the export unit value of the most contract-intensive goods (top 10% in contract intensity) and export unit value of the least contract-intensive goods (bottom 10% in contract intensity), while the horizontal axis is the judicial quality of the country. In the right panel of Figure 1, the vertical axis is the ratio between import unit value of the most contract-intensive goods (top 10% in contract intensity) and import unit value of the least contract-intensive goods (bottom 10% in contract intensity), while the horizontal axis is the judicial quality of the country.

The left panel of Figure 1 shows the relationship between the log of relative export quality and

[17] The construction procedure follows Feenstra and Romalis (2014). Please see Appendix II for details.

judicial quality. As predicted by the theory, this log of relative export quality does not increase or decrease in judicial quality. The correlation is close to zero (0.065). The reason is that better judicial quality results in a cost reduction effect that increases the average export quality of more contract-intensive products, and a selection effect that depresses the average export quality for more contract-intensive products. In the data, these two opposite effects appear to offset each other and result in a weak correlation when we use unit value to measure quality.

Turning to the right panel of Figure 1, we find a much stronger relationship between the log of relative import quality and judicial quality. Consistent with the theory, this log of relative import quality is increasing in judicial quality, with a strong correlation of 0.449. The selection effect allows only high-quality foreign firms to sell in countries with high judicial quality, increasing the average import quality of more contract-intensive products.

Analogously, we calculate FR export quality index and import quality index for each country for each product.[18] Following the same procedure, we can construct the relative FR export quality index and relative FR import quality index, which are measures of a country's relative export and import quality for the most contract-intensive products versus the least contract-intensive products, using FR quality index to measure quality.

Figure 2 plots the log of the relative FR export quality index and the log of the relative FR import quality index against judicial quality. The main message remains. The left panel of Figure 2 shows a positive correlation between relative export quality and judicial quality (0.218). A stronger positive correlation appears between relative import quality and judicial quality (0.476). The selection effect offsets part of the cost reduction effect, resulting in a weaker positive correlation between export quality and judicial quality.

[18] The procedure in constructing the export and import FR quality indexes follows Feenstra and Romalis (2014) and is described in Appendix II in detail.

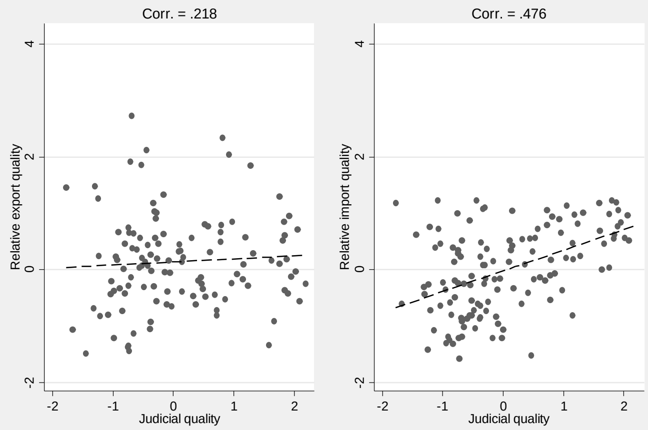

Figure 2 Contract intensity, top 10% vs bottom 10%

Note: In the left panel of Figure 2, the vertical axis is the ratio between FR export quality of the most contract-intensive goods (top 10% in contract intensity) and FR export quality of the least contract-intensive goods (bottom 10% in contract intensity), while the horizontal axis is the judicial quality of the country. In the right panel of Figure 2, the vertical axis is the ratio between FR import quality of the most contract-intensive goods (top 10% in contract intensity) and FR import quality of the least contract-intensive goods (bottom 10% in contract intensity), while the horizontal axis is the judicial quality of the country.

4 Empirical Results

4.1 Baseline Results

We first estimate (14) using various measures of the quality of traded goods. The results are reported in Table 2A. In columns 1 to 3 $\ln \widetilde{z}_{ki}^{g}$ are measured by the log FOB unit value $\ln uv_{ki}^{*g}$, log CIF unit value $\ln uv_{ki}^{g}$, and FR export quality index $\ln \widetilde{z}_{ki}^{g,FR} - \ln \widetilde{z}_{k,world}^{g}$ respectively. We cluster the standard errors at the exporter level to account for any correlation among ε_{1ki}^{g} within the same exporter. Our focus is on the coefficient of the interaction term $ci^{g}JQ_i$, β_E. The dependent and independent variables are all standardized.

[Table 2A here]

In Panel I of Table 2A, we include skill interaction, capital interaction, and finance interaction as controls. In all three specifications, β_E is estimated to be positive but insignificant at the 10% level. When we incorporate firm heterogeneity in the theory, the insignificant impact of $ci^{g}JQ_i$ on average export quality can be rationalized. On the one hand, better judicial quality in the exporting country lowers the production cost more for more contract-intensive sectors and thus increases the export quality of firms that are already able to export (cost reduction effect). On the other hand, better judicial quality lowers the production cost more for more contract-intensive sectors and hence allows for relatively more entry of low-quality firms (selection effect). These two effects turn out to be equally important in magnitude and offset each other in our sample. This result remains when we include a full set of control variables (Panel II of Table 2A). The point estimates of β_E turn negative but are still insignificant at the 10% level. The estimates of β_E are consistent with our theory's prediction under the assumption of Pareto distribution. When we control the importer-product-specific fixed effect μ_k^g (including the aggregated price indexes Φ_k^g), the estimate of β_E should not be statistically different from zero.[19]

Turning to the estimation of (15), we again use $\ln uv_{ki}^{*g}$, $\ln uv_{ki}^{g}$ and FR import quality index $\ln \widetilde{z}_{ki}^{g,FR} - \ln \widetilde{z}_{world,i}^{g}$ to measure the quality of trade. Our focus is now on β_I, and we cluster the standard errors at the importer level. The results are reported in Table 2B.

[Table 2B here]

In Panel I of Table 2B, we again include skill interaction, capital interaction, and finance interaction as controls. In all three specifications, β_I is estimated to be positive and significant at the 1% level. When different measures of $\ln \widetilde{z}_{ki}^{g}$ are used, a one standard deviation increase in the judicial quality interaction increases the log of import quality by 0.023 to 0.041 standard deviations. The results again lend support to the theory. Better judicial quality in the importing country allows for relatively more entry of domestic firms in more contract-intensive sectors and increases the competition faced by foreign firms selling in these sectors. This pro-competitive effect raises the productivity cutoffs for foreign countries to enter relatively more contract-intensive sectors and selects foreign firms with higher production efficiencies. Since individual product quality is increasing in production efficiency, better judicial quality in the importing country raises average import quality in more contract-intensive sectors via a pro-composition effect. Panel II of Table 2B shows the results when we include the full set of controls. The point estimates of β_I remain positive and significant at the 1% level, ranging

[19] The influence of Φ_k^g on average quality will be completely absorbed by μ_k^g in the regressions. In the theoretical part, we use Φ_k to denote the aggregated price index in destination country k, which corresponds to Φ_k^g. It is straightforward to extend our model to a multi-sector version to be in line with the empirical part, and all the theoretical results still hold.

from 0.028 to 0.039. Based on the estimates in column 3 of Panel II, if Bolivia (the country at the 25% percentile of the judicial quality distribution) improves its judicial quality to equal France's level (the country at the 75% percentile of the judicial quality distribution), its import quality index would increase by 6.73 percent.[20] These findings are also consistent with Proposition 4 when on average a destination (or a market) is mainly occupied by domestic producers (so S_{ki} is close to 0 and S_{kk} is large). Therefore, our baseline results also support the predictions generated by the Pareto assumption.

The point estimates of the coefficients of skill interaction and finance interaction are insignificant for export quality. An increase in capital interaction even results in a significant decrease in the log of export quality. According to the previous model, this means the selection effect overtakes the cost reduction effect of an increase in capital endowment. For import quality, the coefficient of finance interaction is significantly positive and consistent with Crino and Ogliari (2017). But capital interaction still has a negative influence on import quality, which might not be in line with our theoretical prediction. This could be due to the measurement of capital. As found by Kugler and Verhoogen (2012) and Fan, Li and Yeaple (2015), product quality is highly related to the quality of inputs across firms. However, an overall increase in the value of capital endowment in a country does not necessarily correspond to the quality upgrading of capital inputs used by individual firms. Identification of the effect of capital thus requires data measuring the quality of capital inputs at the disaggregate level, which we do not have in hand.

Tables 2A and 2B report the results based on bilateral measures of export and import quality. By aggregating export quality (and unit values) across destinations or import quality (and unit values) across sources for each product, we can generate export quality and unit values for export country i in

[20] This is calculated as follows. Bolivia's judicial quality index is 0.434 and France's is 0.789. Electronic computer manufacturing's fraction of differentiated inputs is 0.956. Bolivia's initial value of the import quality index, denoted as x_{kig}, ranges from 0.297 (from France) to 1.621 (from the United States). The β coefficient of 0.028 for β_I corresponds to a coefficient of 0.192. If Bolivia improved its rule of law to France's level, its import quality of electronic computer manufacturing (defined as x'_{kig}) would be given by:

$$\ln x'_{kig} = \ln x_{kig} + 0.192 \times 0.956 \times (0.789 - 0.434).$$

This yields the change in the import quality index:

$$\Delta \ln x_{kig} = \ln \frac{x'_{kig}}{x_{kig}} = 0.065.$$

Therefore

$$\frac{x'_{kig}}{x_{kig}} - 1 = 6.73\%.$$

product g. Those aggregated measures for import country k in product g are similar.[21] This aggregation procedure generates alternative measures of export and import quality, $\ln \widetilde{z}_i^{g,FR}$ and $\ln \widetilde{z}_k^{g,FR}$, and the corresponding unit value measures $\ln uv_i^g$ and $\ln uv_k^g$.

These alternative measures can be used to test Propositions 2 and 3. Particularly, we specify

$$\ln uv_i^g = \beta_E \cdot ci^g \cdot JQ_i + \mu^g + \mu_i + \Psi_i^g + \varepsilon_{1i}^g, \tag{18}$$

$$\ln uv_k^g = \beta_I \cdot ci^g \cdot JQ_k + \mu^g + \mu_k + \Psi_k^g + \varepsilon_{1k}^g, \tag{19}$$

$$\ln \widetilde{z}_i^{g,FR} = \beta_E \cdot ci^g \cdot JQ_i + \mu^g + \mu_i + \Psi_i^g + \varepsilon_{1i}^g, \tag{20}$$

$$\ln \widetilde{z}_k^{g,FR} = \beta_I \cdot ci^g \cdot JQ_k + \mu^g + \mu_k + \Psi_k^g + \varepsilon_{2k}^g. \tag{21}$$

We focus on the estimates of β_E and β_I. Product fixed effects μ^g and country fixed effects μ_c are included, as well as other control variables, as in Tables 2A and 2B. Standard errors are clustered at the country level. The results are reported in Table 3. The estimate of β_E is negative and significant at the 10% level when unit value is used to measure quality and the full set of controls is included. In other specifications, the estimates of β_E are insignificant. In contrast, the estimates of β_I are all positive and significant at least at the 5% level in all specifications, and the point estimates range from 0.079 to 0.122. The country-product-level evidence is consistent with our theory's predictions.

[Table 3 here]

One may argue that contract intensity captures the nature of relationship specificity embedded in the output, rather than in the input that we underline. Countries with better judicial quality have greater capacities to resolve contracting conflicts and can reduce the potential hold-up problems associated with international transactions. Greater judicial capacity thus lowers the transaction costs associated with exports or imports and affects the average quality of trade relatively more for differentiated goods. Therefore, it is critical to control for this potential channel. We do so by including the interaction between the differentiated dummy and judicial quality $D^g JQ_i$ in (14), and $D^g JQ_k$ in (15).

Other country characteristics, for instance, factor endowments, might also interact with contract intensity to drive our baseline results. Controlling for these potential channels is essential in identifying the impact of $ci^g JQ_i$ ($ci^g JQ_k$) on $\ln \widetilde{z}_{ki}^g$. We thus interact contract intensity ci^g with skill endowment

[21] The aggregation procedure follows Feenstra and Romalis (2014) and is described in detail in Appendix II.

H_i (H_k), capital endowment K_i (K_k), and financial development CR_i (CR_k) and include these interactions in our baseline regression, respectively, in Table 4A (for export quality) and Table 4B (for import quality). Compared with Tables 2A and 2B, the main results barely change qualitatively or quantitatively. Moreover, most of the additional interactions are statistically insignificant at the 10% level, suggesting that other factor endowments are unlikely to interact with contract intensity and alter our baseline results.[22]

[Table 4A & 4B here]

4.2 Robustness

This subsection performs a series of robustness tests to ensure that our baseline results are not affected by any choice of specification or measurement.

4.2.1 Measures of Judicial Quality and Contract Intensity

We experiment with other measures of judicial quality and contract intensity to alleviate the concern about measurement error in the key independent variables $ci^g JQ_i$ and $ci^g JQ_k$. Our preferred measure of JQ_i and JQ_k is the "rule of law" indicator from Kaufmann, Kraay, and Mastruzzi (2004). An alternative measure of JQ can be obtained from Gwartney and Lawson (2006), who provide an index to measure a country's legal quality. The World Bank's "Doing Business Survey" constructs a measure of the judicial system's efficiency in a country in collecting an overdue debt, by measuring the number of procedures involved, official costs, and total time required. We also use the number of procedures involved and official cost to measure a country's judicial quality. In addition, another measure of institutional quality from Hall and Jones (1999) is also used. Hall and Jones (1999) create an index of government anti-diversion policies based on data from a firm that provided political risk assessments of 130 countries according to 24 categories.[23]

We turn to the measurement of contract intensity ci. Rauch (1999) provides "liberal" and "conservative" standards in classifying products into "sold on an organized exchange," "reference priced," or "neither." In the baseline results, we define the "neither" category as differentiated products based on

[22] The only exception is the interaction of financial development and contract intensity, which is negative and significant at the 5% level in the export quality regression and positive and significant at least at the 10% level in the import quality regression.

[23] Hall and Jones (1999) take an average of five of these categories for the years 1986-1995 to create this index. These five categories are (i) law and order, (ii) bureaucratic quality, (iii) corruption, (iv) risk of expropriation, and (v) government repudiation of contracts.

the "liberal" standard and construct ci accordingly. We also use the "conservative" standard to define differentiated products and construct an alternative measure of ci.

Table 5 reports the results when we use other measures of JQ and ci, for (14) and (15). The baseline results remain. For the export quality regression, all 30 estimates of β_E are insignificant at the 10% level, although their signs vary. For the import quality regression, all 30 estimates of β_I are positive, and 25 of them are significant at least at the 10% level. The results show that our baseline results are unlikely to be driven by the measurement of JQ and ci.

[Table 5 here]

4.2.2 Consumption Goods and Non-Consumption Goods

In this subsection, we study whether our theory could be applied to different types of goods by dividing the sample into consumption goods and non-consumption goods. Because in our theory all final goods are directly consumed by consumers, it is less clear whether our theoretical results apply to non-consumption goods. We expect that similar empirical regularities should still hold for non-consumption goods, but the economic magnitude of the interaction term $ci^g JQ_k$ might be smaller. We hence divide all SITC 4-digit products g into non-consumption and consumption subsamples based on the classification by Broad Economic Categories (BEC henceforth) and estimate (14) and (15). As shown in Table 6, the estimates of β_E are statistically insignificant in both product groups, while the estimates of β_I are all positive and mostly significant at the 5% level. Consistent with our conjecture, estimates of β_I in the consumption product group are larger than those in the non-consumption group.

[Table 6 here]

4.2.3 Demand-Side Approach to Estimate Quality

We turn to the measurement of $\ln \tilde{z}^g_{ki}$. So far, we have used unit values and FR quality indicator to measure the quality of trade. Another widely used approach in estimating product quality is the so-called demand-side approach. The demand-side approach models product quality as a demand shifter for consumer, estimates the demand function, and backs out the residuals as measures of product quality. We adopt this estimation procedure under a CES preference, similar to Khandelwal, Schott and Wei (2013) and Fan, Li and Yeaple (2015):

$$U_k = [\int_i (q_{ki} \cdot z_{ki})^{\frac{\sigma-1}{\sigma}} \mathrm{d}i]^{\frac{\sigma}{\sigma-1}}.$$

With a budget constraint $\int_i (p_{ki} \cdot q_{ki}) \mathrm{d}i = I_k$, country k's consumer demand for variety from i is

$$q_{ki} = I_k \Phi_k^{\sigma-1} (p_{ki})^{-\sigma} (z_{ki})^{\sigma-1},$$

where $\Phi_k = [\int_i (\frac{p_{ki}}{z_{ki}})^{1-\sigma} \mathrm{d}i]^{\frac{1}{1-\sigma}}$ is the quality-adjusted exact price index. With product superscript g, manipulation yields:

$$(\sigma^g - 1) \ln z_{ki}^g = \ln q_{ki}^g + \sigma^g \ln p_{ki}^g - \ln I_k^g - (\sigma^g - 1) \ln \Phi_k^g.$$

The intuition is that conditional on prices, the variety with higher sales should be assigned to better quality. To generate the estimation equation, notice that

$$\frac{\ln q_{ki}^g + \sigma^g \ln p_{ki}^g}{\sigma^g - 1} = \frac{\ln I_k^g}{\sigma^g - 1} + \ln \Phi_k^g + \ln z_{ki}^g = \mu_k^g + \zeta_{ki}^g \tag{22}$$

μ_k^g are destination-product fixed effects to absorb country k's aggregate expenditure on product g, I_k^g, and the exact price index of country k in product g, Φ_k^g. Given a destination k, the variation in $\frac{\ln q_{ki}^g + \sigma^g \ln p_{ki}^g}{\sigma^g - 1}$ across different sources i identifies variation in quality. Following Khandelwal, Schott and Wei (2013) and Fan, Li and Yeaple (2015), we use estimates of σ^g from existing studies and estimate (22). The regression residuals $\widehat{\zeta}_{ki}^g$ are taken as estimates for product quality. We therefore estimate (14) using $\widehat{\zeta}_{ki}^g$ as the dependent variable. The results are reported in Table 7.

[Table 7 here]

Broda and Weinstein (2006) estimate σ^g for each SITC product and each country. We take the U.S. value of σ^g to construct $\widehat{\zeta}_{ki}^g$ in Table 7.[24] The results are broadly consistent with the baseline results. According to columns 1 and 2, better judicial quality does not lead to any increase in average export quality in more contract-intensive sectors. As Khandelwal, Schott and Wei (2013) and Fan, Li and Yeaple (2015) take $\widehat{\zeta}_{ki}^g$ as the quality of goods g imported by country k from sources i, it could also reflect import quality in some sense. Therefore, we also estimate the import quality regressions using ζ_{ki}^g and find consistent results, that is, better judicial quality leads to a significant increase in average import quality in more contract-intensive sectors. However, a caveat should be noted here. Since the usage of destination-product fixed effects μ_k^g absorb the average product quality of product g in destination k, ζ_{ki}^g only identifies quality variation relative to the destination-product mean, $\ln \widetilde{z}_{ki}^g - \ln \widetilde{z}_{k,world}^g$, and hence might not be directly comparable across destinations.

[24] In Table 7, we control importer-product-specific fixed effects to estimate ζ_{ki}^g based on equation (22). The results are similar if we also control exporter-specific fixed effects.

4.3 Endogeneity

The baseline results have established a series of patterns regarding judicial quality, contract intensity, and quality of trade. However, we should be cautious about any causal interpretation, because the quality of trade might also affect judicial quality in the source or destination. If a country tends to produce or consume more contract-intensive goods of better quality, it might have greater incentive to improve and maintain better contract enforcement and thus better judicial quality to foster domestic production in more contract-intensive industries.

To tackle this potential reverse causality, we pursue an IV strategy. Following Nunn (2007), we instrument the level of judicial quality in a country using the legal origin of the country. A valid instrument should satisfy the exclusion restriction and relevance restriction. For the exclusion restriction, the legal origin was predetermined centuries ago and is unlikely to affect the quality of trade in 1997. For the relevance restriction, the legal origin of a country affects the efficiency and consistency of its judicial system, hence isolating the exogenous variation in JQ (La Porta, Lopez-de-Silanes, Shleifer and Vishny, 1999). By including interactions between log per capita income and industry characteristics, we also control for other potential channels through which judicial quality might yield any impacts on the quality of trade.

Specifically, we instrument the judicial quality interaction $ci^g JQ_i$ (and $ci^g JQ_k$) using $ci^g B_i$, $ci^g F_i$ and $ci^g G_i$ ($ci^g B_k$, $ci^g F_k$ and $ci^g G_k$), where B, F and G are dummies indicating if a country's legal origin is British common law, French civil law, or German civil law. The omitted category is Scandinavian civil law.[25] Previous studies have shown that legal origin is an important determinant of a country's judicial quality (La Porta, Lopez-de-Silanes, Shleifer and Vishny, 1999; Acemoglu and Johnson, 2005). Tables 8A and 8B report the results of the IV estimation for export quality and import quality, respectively.

[Table 8A & 8B here]

We find that the second-stage results are consistent with our baseline results. $ci^g JQ_i$ does not yield any significant impact on average export quality, while $ci^g JQ_k$ exerts a positive and significant effect on average import quality. According to the first-stage results, countries with Scandinavian

[25] In fact, there are five categories of legal origins: British common law, French civil law, German civil law, Scandinavian civil law, and Socialist law. However, all countries with Socialist law legal origin are dropped due to missing values of skill and capital interactions.

legal origin are associated with the highest rank in rule of law. Countries with German legal origin and British legal origin follow, while countries with French legal origin are associated with the lowest rank in rule of law. The instrument set produces large Kleibergen-Paap LM values, ruling out the possibility of under-identification. The Kleibergen-Paap F value is greater than 10, suggesting that the possibility of weak instruments is not a first-order concern. The Hansen J value is significant at the 5% level in all the specifications for the export quality regression, but insignificant in all the specifications for the import quality regression. However, as noted by Angrist and Pischke (2008), the rejection of the over-identification test need not point to an identification failure, but potentially treatment effect heterogeneity. Since our estimates of β_E (and β_I) are averages across all country pairs, treatment effect heterogeneity seems a plausible explanation for the significant Hansen J values. Overall, our IV estimation results support our baseline results and our theory regarding how the judicial quality of the source and destination affects the quality of trade in sectors with different contract intensities.

4.4 Mechanisms

We proceed to discern the exact channels through which the quality of exports and imports responds to changes in judicial quality. According to (9) and (10), the cost reduction and selection effects work for export quality, but for import quality only the latter channel exists. Ideally, we can directly calculate the average quality index of incumbent exporters to a destination, as well as those of entering exporters and exiting exporters using disaggregated data. If the judicial quality of exporting and importing countries exhibits substantial variation across time, we can exploit this variation to examine these two channels. To be specific, we can test whether improvement in judicial quality in the exporting country is associated with a larger increase in the average quality index of incumbent exporters, and more entry of low-quality exporters (and products) in more contract-intensive industries. Similarly, we can test whether improvement in judicial quality in the importing country is associated with more exit of low-quality exporters (and products) in more contract-intensive industries.

Unfortunately, such a test requires wide access to disaggregated trade and production data in all countries, which so far are not available to researchers. Moreover, such a test demands substantial variation in judicial quality over time, while in contrast judicial quality and other proxies for contract enforcement are rather stable within a short period. Therefore, directly testing the two channels embedded in our theory is extremely difficult.

We adopt an indirect test by turning to the implications of our model. To be specific, since in Proposition 2 the magnitude of the selection effect is increasing in the elasticity of substitution between varieties (measured by σ), we expect coefficient β_E to be more negative when σ becomes larger.[26] Similarly, we expect coefficient β_I to be less positive with a larger σ according to Proposition 3.[27] The intuition associated with these theoretical results is that when production cost changes, more entry and exit occur in more substitutable industries (thus higher σ) and the selection effects are larger.

We use the estimates of σ from Feenstra and Romalis (2014) to divide the sample into "high σ" and "low σ" subsamples based on whether σ^g is higher than the median value among all SITC 4-digit products in the sample.[28] We then conduct the main regressions for the subsamples separately. The results are reported in Tables 9A and 9B. In general, the signs and magnitudes are consistent with our theory. Regardless of the indicator we use, estimates of β_E for the high σ group are significantly negative at the 10% level, while estimates of β_E for the low σ group are positive and insignificant. This suggests that the selection effect is stronger for the high σ group. Estimates of β_I for the subsample regressions are all positive and significant at least at the 5% level, in the low σ and high σ product groups. Additionally, the point estimates of β_I in the low σ product group are generally higher than those in the high σ group. In general, the evidence shows that the pro-competition effect is more pronounced for goods with higher substitution elasticity and is consistent with the mechanism suggested by our theory.

[Table 9A & 9B here]

In Tables 10A and 10B, we use our IV strategy to tackle potential reverse causality in the mechanism analysis for export and import quality, respectively. We estimate IV regressions for the low and high σ groups, respectively. The IV estimates for β_E are now insignificant in both subsamples, while the IV estimates for β_I are still positive and significant at least at the 10% level. Moreover, the estimates of β_I in the low σ product group are generally larger than those in the high σ product group, consistent with the prediction of our theory. However, for the export quality regression, the Hansen J values are generally significant. This again might be due to parameter heterogeneity, as suggested by Angrist and Pischke (2008).

[26] According to Proposition 2, the direct effect of an increase in σ is to push $\frac{\mathrm{d}\ln\tilde{z}_{ki}}{\mathrm{d}\ln c_{Mi}}\frac{\mathrm{d}^2\ln c_{Mi}}{\mathrm{d}\phi_i \mathrm{d}\eta}$ toward positive and therefore β_E toward negative.

[27] According to Proposition 3, the direct effect of an increase in σ is to push $\frac{\mathrm{d}\ln\tilde{z}_{ki}}{\mathrm{d}\ln c_{Mk}}\frac{\mathrm{d}^2\ln c_{Mk}}{\mathrm{d}\phi_k \mathrm{d}\eta}$ toward 0, resulting in a lower positive value of β_I.

[28] Feenstra and Romalis (2014) provide consistent and robust estimates of the model parameters, including σ. These parameters are consistent and compatible with our data set.

[Table 10A & 10B here]

5 Concluding Remarks

Previous studies have established that judicial quality and contract enforcement are important determinants of trade patterns. In this paper, we focus on the quality margin of trade and investigate how judicial quality affects the quality of trade for industries with different intensities in using relationship-specific inputs. Our theoretical analysis shows that judicial quality lowers composite input prices for more contract-intensive industries relatively more, by alleviating the hold-up problem in the production of composite inputs. Composite inputs are then used to produce final goods by heterogeneous producers making quality choices. Our theory suggests that better judicial quality does not necessarily raise average export quality for more contract-intensive industries relatively more due to two offsetting forces: quality upgrading of existing exporting firms and increasing entry of less-productive firms. In contrast, better judicial quality always raises average import quality relatively more for more contract-intensive industries, because the increasing entry of domestic firms intensifies competition and only foreign firms with substantially high productivity can compete in the market.

We use bilateral unit value data and quality index data constructed by Feenstra and Romalis (2014) and exploit variation across bilateral trade pairs and different products to test the predictions of our model. Our identification ensures that we are making comparisons across sources conditional on a destination-product pair, and comparisons across destinations conditional on a source-product pair. We thus mitigate potential aggregation bias. Our empirical results confirm the predictions of our model. We deal with potential reverse causality and the main message of the baseline results remains. We also document suggestive evidence that supports the mechanism described by our theory. Overall, judicial quality and contract enforcement are key to understand variation in the quality of trade across countries and industries.

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6 Appendix I: Proofs

6.1 Proof of Lemma 1

Proof. According to Lebniz's rule, the average productivity from i to k is also increasing in the cutoff productivity from i to k.

$$\begin{aligned}\frac{\partial(\widetilde{\varphi}_{ki})^\theta}{\partial\widehat{\varphi}_{ki}} &= \int_{\widehat{\varphi}_{ki}}^{\infty}\varphi^\theta g(\varphi)\frac{g(\widehat{\varphi}_{ki})}{[1-G(\widehat{\varphi}_{ki})]^2}\mathrm{d}\varphi-(\widehat{\varphi}_{ki})^\theta\frac{g(\widehat{\varphi}_{ki})}{1-G(\widehat{\varphi}_{ki})}\\ &= [\int_{\widehat{\varphi}_{ki}}^{\infty}\varphi^\theta\frac{g(\varphi)}{1-G(\widehat{\varphi}_{ki})}\mathrm{d}\varphi-(\widehat{\varphi}_{ki})^\theta]\frac{g(\widehat{\varphi}_{ki})}{1-G(\widehat{\varphi}_{ki})}\\ &= \frac{g(\widehat{\varphi}_{ki})}{1-G(\widehat{\varphi}_{ki})}\int_{\widehat{\varphi}_{ki}}^{\infty}[\varphi^\theta-(\widehat{\varphi}_{ki})^\theta]\mathrm{d}\frac{G(\varphi)}{1-G(\widehat{\varphi}_{ki})}>0.\end{aligned}$$

■

6.2 Proof of Lemma 2

Proof. The elasticity of Φ_k with respect to c_{Ms} is

$$\frac{\mathrm{d}\ln\Phi_k}{\mathrm{d}\ln c_{Ms}}=\alpha_k\theta S_{ks}+\frac{S_{ks}}{(\sigma-1)\overline{\varphi}_{ks}}\frac{\mathrm{d}\ln\widehat{\varphi}_{ks}}{\mathrm{d}\ln c_{Ms}},$$

where

$$S_{ks}=\frac{N_s\int_{\widehat{\varphi}_{ks}}^{\infty}[\frac{\sigma}{\sigma-1}\tau_{ks}(\frac{c_{Ms}}{\alpha_k\theta\varphi})^{\alpha_k\theta}(\frac{T_{ks}}{1-\alpha_k\theta})^{1-\alpha_k\theta}]^{1-\sigma}\mathrm{d}G(\varphi)}{(\Phi_k)^{1-\sigma}},$$

$$\overline{\varphi}_{ks}=\int_{\widehat{\varphi}_{ks}}^{\infty}(\frac{\varphi}{\widehat{\varphi}_{ks}})^{\alpha_k\theta(\sigma-1)}\mathrm{d}\frac{G(\varphi)}{g(\widehat{\varphi}_{ks})\widehat{\varphi}_{ks}},$$

and S_{ks} is market k's expenditure share spent on product from source s.

Furthermore

$$\frac{\mathrm{d}\ln\widehat{\varphi}_{ks}}{\mathrm{d}\ln c_{Ms}}=1-\frac{1}{\alpha_k\theta}\frac{\mathrm{d}\ln\Phi_k}{\mathrm{d}\ln c_{Ms}}.$$

Plugging in $\frac{\mathrm{d}\ln\widehat{\varphi}_{ks}}{\mathrm{d}\ln c_{Ms}}$, we have

$$(1+\frac{S_{ks}}{(\sigma-1)\overline{\varphi}_{ks}}\frac{1}{\alpha_k\theta})\frac{\mathrm{d}\ln\Phi_k}{\mathrm{d}\ln c_{Ms}}=\alpha_k\theta S_{ks}+\frac{S_{ks}}{(\sigma-1)\overline{\varphi}_{ks}}.$$

Manipulation yields

$$\frac{\mathrm{d}\ln\Phi_k}{\mathrm{d}\ln c_{Ms}}=\frac{\alpha_k\theta+\frac{1}{(\sigma-1)\overline{\varphi}_{ks}}}{\frac{1}{S_{ks}}+\frac{1}{\alpha_k\theta(\sigma-1)\overline{\varphi}_{ks}}}.$$

■

6.3 Proof of Proposition 1

Proof.

$$\ln\widehat{\varphi}_{ki} = \ln c_{Mi} - \frac{1}{\alpha_k\theta}\ln\Phi_k + \ln\{\frac{1}{\alpha_k\theta}(\frac{T_{ki}}{1-\alpha_k\theta})^{\frac{1-\alpha_k\theta}{\alpha_k\theta}}[\frac{F_{ki}(\tau_{ki})^{\sigma-1}tar_{ki}}{\omega I_k}]^{\frac{1}{(\sigma-1)\alpha_k\theta}}\}.$$

Hence

$$\frac{\mathrm{d}\ln\widehat{\varphi}_{ki}}{\mathrm{d}\ln c_{Ms}} = \begin{array}{c} 1-\frac{1}{\alpha_k\theta}\frac{\mathrm{d}\ln\Phi_k}{\mathrm{d}\ln c_{Ms}}, \text{ if } s=i \\ -\frac{1}{\alpha_k\theta}\frac{\mathrm{d}\ln\Phi_k}{\mathrm{d}\ln c_{Ms}}, \text{ if } s\neq i \end{array}.$$

Substitute the expression of $\frac{\mathrm{d}\ln\Phi_k}{\mathrm{d}\ln c_{Ms}}$, we have

$$\frac{\mathrm{d}\ln\widehat{\varphi}_{ki}}{\mathrm{d}\ln c_{Ms}} = \begin{array}{c} \frac{\frac{1}{S_{ks}}-1}{\frac{1}{S_{ks}}+\frac{1}{\alpha_k\theta(\sigma-1)\overline{\varphi}_{ks}}}, \text{ if } s=i \\ -\frac{1+\frac{1}{\alpha_k\theta(\sigma-1)\overline{\varphi}_{ks}}}{\frac{1}{S_{ks}}+\frac{1}{\alpha_k\theta(\sigma-1)\overline{\varphi}_{ks}}}, \text{ if } s\neq i \end{array}.$$

For exporter i

$$\frac{\mathrm{d}\ln\widehat{\varphi}_{ki}}{\mathrm{d}\ln c_{Mi}} = \frac{1-S_{ki}}{1+\frac{S_{ki}}{\alpha_k\theta(\sigma-1)\overline{\varphi}_{ki}}}.$$

For importer k

$$\frac{\mathrm{d}\ln\widehat{\varphi}_{ki}}{\mathrm{d}\ln c_{Mk}} = -\frac{1+\frac{1}{\alpha_k\theta(\sigma-1)\overline{\varphi}_{kk}}}{\frac{1}{S_{kk}}+\frac{1}{\alpha_k\theta(\sigma-1)\overline{\varphi}_{kk}}}.$$

If trade frictions are substantially high, then

$$S_{ki}\to 0;\ \lim S_{kk}\to 1.$$

In this case,

$$\frac{\mathrm{d}\ln\widehat{\varphi}_{ki}}{\mathrm{d}\ln c_{Mi}}\to 1;\ \frac{\mathrm{d}\ln\widehat{\varphi}_{ki}}{\mathrm{d}\ln c_{Mk}}\to -1.$$

■

6.4 Proof of Proposition 2

Proof.

$$\begin{aligned}
\frac{\mathrm{d}\ln\widetilde{z}_{ki}}{\mathrm{d}\ln c_{Mi}} &= -\theta+\theta\frac{\mathrm{d}\ln\widetilde{\varphi}_{ki}}{\mathrm{d}\ln c_{Mi}} = -\theta+\theta\frac{\mathrm{d}\ln\widetilde{\varphi}_{ki}}{\mathrm{d}\ln\widehat{\varphi}_{ki}}\frac{\mathrm{d}\ln\widehat{\varphi}_{ki}}{\mathrm{d}\ln c_{Mi}} \\
&= -\theta+\frac{\widehat{\varphi}_{ki}g(\widehat{\varphi}_{ki})}{1-G(\widehat{\varphi}_{ki})}\int_{\widehat{\varphi}_{ki}}^{\infty}[1-(\frac{\widehat{\varphi}_{ki}}{\widetilde{\varphi}_{ki}})^{\theta}]\mathrm{d}\frac{G(\varphi)}{1-G(\widehat{\varphi}_{ki})}\frac{\mathrm{d}\ln\widehat{\varphi}_{ki}}{\mathrm{d}\ln c_{Mi}} \\
&= -\theta+\frac{\widehat{\varphi}_{ki}g(\widehat{\varphi}_{ki})[1-(\frac{\widehat{\varphi}_{ki}}{\widetilde{\varphi}_{ki}})^{\theta}]}{1-G(\widehat{\varphi}_{ki})}\frac{1-S_{ki}}{1+\frac{S_{ki}}{\alpha_k\theta(\sigma-1)\overline{\varphi}_{ki}}}.
\end{aligned}$$

Then it is straightforward that

$$\frac{\mathrm{d}\ln\widetilde{z}_{ki}}{\mathrm{d}\ln c_{Mi}}\frac{\mathrm{d}^2\ln c_{Mi}}{\mathrm{d}\phi_i\mathrm{d}\eta}=\{-\theta+\frac{\widehat{\varphi}_{ki}g(\widehat{\varphi}_{ki})[1-(\frac{\widehat{\varphi}_{ki}}{\widetilde{\varphi}_{ki}})^{\theta}]}{1-G(\widehat{\varphi}_{ki})}\frac{1-S_{ki}}{1+\frac{S_{ki}}{\alpha_k\theta(\sigma-1)\overline{\varphi}_{ki}}}\}\frac{\beta(1-\beta)}{[\beta+\phi_i\eta(1-\beta)]^2}.$$

■

6.5 Proof of Proposition 3

Proof.

$$\begin{aligned}\frac{\mathrm{d}\ln\widetilde{z}_{ki}}{\mathrm{d}\ln c_{Mk}} &= \theta\frac{\mathrm{d}\ln\widetilde{\varphi}_{ki}}{\mathrm{d}\ln c_{Mk}}=\theta\frac{\mathrm{d}\ln\widetilde{\varphi}_{ki}}{\mathrm{d}\ln\widehat{\varphi}_{ki}}\frac{\mathrm{d}\ln\widehat{\varphi}_{ki}}{\mathrm{d}\ln c_{Mk}}\\ &= \frac{\widehat{\varphi}_{ki}g(\widehat{\varphi}_{ki})}{1-G(\widehat{\varphi}_{ki})}\int_{\widehat{\varphi}_{ki}}^{\infty}[1-(\frac{\widehat{\varphi}_{ki}}{\widetilde{\varphi}_{ki}})^{\theta}]\mathrm{d}\frac{G(\varphi)}{1-G(\widehat{\varphi}_{ki})}\frac{\mathrm{d}\ln\widehat{\varphi}_{ki}}{\mathrm{d}\ln c_{Mk}}\\ &= -\frac{\widehat{\varphi}_{ki}g(\widehat{\varphi}_{ki})[1-(\frac{\widehat{\varphi}_{ki}}{\widetilde{\varphi}_{ki}})^{\theta}]}{1-G(\widehat{\varphi}_{ki})}\frac{1+\frac{1}{\alpha_k\theta(\sigma-1)\overline{\varphi}_{kk}}}{\frac{1}{S_{kk}}+\frac{1}{\alpha_k\theta(\sigma-1)\overline{\varphi}_{kk}}}.\end{aligned}$$

Then it is straightforward that

$$\frac{\mathrm{d}\ln\widetilde{z}_{ki}}{\mathrm{d}\ln c_{Mk}}\frac{\mathrm{d}^2\ln c_{Mk}}{\mathrm{d}\phi_k\mathrm{d}\eta}=-\frac{\widehat{\varphi}_{ki}g(\widehat{\varphi}_{ki})[1-(\frac{\widehat{\varphi}_{ki}}{\widetilde{\varphi}_{ki}})^{\theta}]}{1-G(\widehat{\varphi}_{ki})}\frac{1+\frac{1}{\alpha^k\theta(\sigma-1)\overline{\varphi}_{kk}}}{\frac{1}{S_{kk}}+\frac{1}{\alpha^k\theta(\sigma-1)\overline{\varphi}_{kk}}}\frac{\beta(1-\beta)}{[\beta+\phi_k\eta(1-\beta)]^2}.$$

■

6.6 Proof of Proposition 4

Proof. Under the Pareto distribution,

$$\begin{aligned}\widetilde{\varphi}_{ki} &= [\int_{\widehat{\varphi}_{ki}}^{\infty}\varphi^{\theta}\mathrm{d}\frac{G(\varphi)}{1-G(\widehat{\varphi}_{ki})}]^{\frac{1}{\theta}}\\ &= [\int_{\widehat{\varphi}_{ki}}^{\infty}\varphi^{\theta}\frac{\gamma\varphi^{-\gamma-1}\mathrm{d}\varphi}{(\widehat{\varphi}_{ki})^{-\gamma}}]^{\frac{1}{\theta}}\\ &= (\frac{\gamma}{\gamma-\theta})^{\frac{1}{\theta}}\widehat{\varphi}_{ki}.\end{aligned}$$

We can also obtain a close-form solution to $\overline{\varphi}_{ks}$:

$$\begin{aligned}\overline{\varphi}_{ks} &= \int_{\widehat{\varphi}_{ks}}^{\infty}(\frac{\varphi}{\widehat{\varphi}_{ks}})^{\alpha_k\theta(\sigma-1)}\mathrm{d}\frac{G(\varphi)}{g(\widehat{\varphi}_{ks})\widehat{\varphi}_{ks}}\\ &= \frac{\widehat{\varphi}_{ks}^{\gamma-\alpha_k\theta(\sigma-1)}}{\gamma}\int_{\widehat{\varphi}_{ks}}^{\infty}\varphi^{\alpha_k\theta(\sigma-1)}\mathrm{d}G(\varphi)\\ &= \frac{1}{\gamma-\alpha_k\theta(\sigma-1)}.\end{aligned}$$

Plugging $\widetilde{\varphi}_{ki}$ and $\overline{\varphi}_{ki}$ into $\frac{\mathrm{d}\ln\widetilde{z}_{ki}}{\mathrm{d}\ln c_{Mi}}\frac{\mathrm{d}^2\ln c_{Mi}}{\mathrm{d}\phi_i\mathrm{d}\eta}$, we have

$$
\begin{aligned}
\frac{\mathrm{d}\ln\widetilde{z}_{ki}}{\mathrm{d}\ln c_{Mi}}\frac{\mathrm{d}^2\ln c_{Mi}}{\mathrm{d}\phi_i\mathrm{d}\eta} &= \{-\theta+\frac{\widehat{\varphi}_{ki}g(\widehat{\varphi}_{ki})[1-(\frac{\widehat{\varphi}_{ki}}{\widetilde{\varphi}_{ki}})^{\theta}]}{1-G(\widehat{\varphi}_{ki})}\frac{1-S_{ki}}{1+\frac{S_{ki}}{\alpha_k\theta(\sigma-1)\overline{\varphi}_{ki}}}\}\frac{\beta(1-\beta)}{[\beta+\phi_i\eta(1-\beta)]^2} \\
&= \{-\theta+\frac{\widehat{\varphi}_{ki}\gamma\widehat{\varphi}_{ki}^{-\gamma-1}[1-\frac{\gamma-\theta}{\gamma}]}{\widehat{\varphi}_{ki}^{-\gamma}}\frac{1-S_{ki}}{1+\frac{S_{ki}}{\alpha_k\theta(\sigma-1)\overline{\varphi}_{ki}}}\}\frac{\beta(1-\beta)}{[\beta+\phi_i\eta(1-\beta)]^2} \\
&= \{-\theta+\theta\frac{1-S_{ki}}{1+\frac{S_{ki}}{\alpha_k\theta(\sigma-1)\overline{\varphi}_{ki}}}\}\frac{\beta(1-\beta)}{[\beta+\phi_i\eta(1-\beta)]^2} \\
&= \{-\theta+\theta\frac{1-S_{ki}}{1+\frac{\gamma-\alpha_k\theta(\sigma-1)}{\alpha_k\theta(\sigma-1)}S_{ki}}\}\frac{\beta(1-\beta)}{[\beta+\phi_i\eta(1-\beta)]^2} \\
&= -\frac{\frac{\gamma}{\alpha_k\theta(\sigma-1)}S_{ki}}{1+\frac{\gamma-\alpha_k\theta(\sigma-1)}{\alpha_k\theta(\sigma-1)}S_{ki}}\frac{\theta\beta(1-\beta)}{[\beta+\phi_i\eta(1-\beta)]^2} \\
&= -\frac{\frac{\gamma}{\alpha_k\theta(\sigma-1)}}{\frac{1}{S_{ki}}-1+\frac{\gamma}{\alpha_k\theta(\sigma-1)}}\frac{\theta\beta(1-\beta)}{[\beta+\phi_i\eta(1-\beta)]^2}.
\end{aligned}
$$

Similarly, plugging $\widetilde{\varphi}_{ki}$ into $\frac{\mathrm{d}\ln\widetilde{z}_{ki}}{\mathrm{d}\ln c_{Mi}}\frac{\mathrm{d}^2\ln c_{Mi}}{\mathrm{d}\phi_k\mathrm{d}\eta}$, we have

$$
\begin{aligned}
\frac{\mathrm{d}\ln\widetilde{z}_{ki}}{\mathrm{d}\ln c_{Mi}}\frac{\mathrm{d}^2\ln c_{Mi}}{\mathrm{d}\phi_k\mathrm{d}\eta} &= -\frac{\widehat{\varphi}_{ki}g(\widehat{\varphi}_{ki})[1-(\frac{\widehat{\varphi}_{ki}}{\widetilde{\varphi}_{ki}})^{\theta}]}{1-G(\widehat{\varphi}_{ki})}\frac{1+\frac{1}{\alpha^k\theta(\sigma-1)\overline{\varphi}_{kk}}}{\frac{1}{S_{kk}}+\frac{1}{\alpha^k\theta(\sigma-1)\overline{\varphi}_{kk}}}\frac{\beta(1-\beta)}{[\beta+\phi_k\eta(1-\beta)]^2} \\
&= -\frac{\widehat{\varphi}_{ki}\gamma\widehat{\varphi}_{ki}^{-\gamma-1}[1-\frac{\gamma-\theta}{\gamma}]}{\widehat{\varphi}_{ki}^{-\gamma}}\frac{1+\frac{1}{\alpha^k\theta(\sigma-1)\overline{\varphi}_{kk}}}{\frac{1}{S_{kk}}+\frac{1}{\alpha^k\theta(\sigma-1)\overline{\varphi}_{kk}}}\frac{\beta(1-\beta)}{[\beta+\phi_k\eta(1-\beta)]^2} \\
&= -\theta\frac{1+\frac{1}{\alpha^k\theta(\sigma-1)\overline{\varphi}_{kk}}}{\frac{1}{S_{kk}}+\frac{1}{\alpha^k\theta(\sigma-1)\overline{\varphi}_{kk}}}\frac{\beta(1-\beta)}{[\beta+\phi_k\eta(1-\beta)]^2} \\
&= -\theta\frac{1+\frac{\gamma-\alpha_k\theta(\sigma-1)}{\alpha^k\theta(\sigma-1)}}{\frac{1}{S_{kk}}+\frac{\gamma-\alpha_k\theta(\sigma-1)}{\alpha^k\theta(\sigma-1)}}\frac{\beta(1-\beta)}{[\beta+\phi_k\eta(1-\beta)]^2} \\
&= -\frac{\frac{\gamma}{\alpha^k\theta(\sigma-1)}}{\frac{1}{S_{kk}}-1+\frac{\gamma}{\alpha^k\theta(\sigma-1)}}\frac{\theta\beta(1-\beta)}{[\beta+\phi_k\eta(1-\beta)]^2}.
\end{aligned}
$$

Therefore

$$
\begin{aligned}
\frac{\mathrm{d}\ln\widetilde{z}_{ki}}{\mathrm{d}\ln c_{Mi}}\frac{\mathrm{d}^2\ln c_{Mi}}{\mathrm{d}\phi_i\mathrm{d}\eta} &= -\frac{\frac{\gamma}{\alpha^k\theta(\sigma-1)}}{\frac{1}{S_{ki}}-1+\frac{\gamma}{\alpha_k\theta(\sigma-1)}}\frac{\theta\beta(1-\beta)}{[\beta+\phi_i\eta(1-\beta)]^2}<0, \\
\frac{\mathrm{d}\ln\widetilde{z}_{ki}}{\mathrm{d}\ln c_{Mk}}\frac{\mathrm{d}^2\ln c_{Mk}}{\mathrm{d}\phi_k\mathrm{d}\eta} &= -\frac{\frac{\gamma}{\alpha^k\theta(\sigma-1)}}{\frac{1}{S_{kk}}-1+\frac{\gamma}{\alpha_k\theta(\sigma-1)}}\frac{\theta\beta(1-\beta)}{[\beta+\phi_k\eta(1-\beta)]^2}<0.
\end{aligned}
$$

The market share S_{ki} is key to determine the magnitude of the impact. If $S_{ki}\to 0$, then $\frac{\mathrm{d}\ln\widetilde{z}_{ki}}{\mathrm{d}\ln c_{Mi}}\frac{\mathrm{d}^2\ln c_{Mi}}{\mathrm{d}\phi_i\mathrm{d}\eta}\to 0$. If $S_{kk}\to 1$, then $\frac{\mathrm{d}\ln\widetilde{z}_{ki}}{\mathrm{d}\ln c_{Mk}}\frac{\mathrm{d}^2\ln c_{Mk}}{\mathrm{d}\phi_k\mathrm{d}\eta}\to\frac{-\theta\beta(1-\beta)}{[\beta+\phi\eta(1-\beta)]^2}$. ■

7 Appendix II: Quality Estimation in Feenstra and Romalis (2014)

In addition to unit value, we use a quality index estimated according to the procedure in Feenstra and Romalis (2014). This procedure is based on an endogenous quality theory consistent with our framework and yields quality measured at the product level (up to SITC revision 2 4-digit) for bilateral trade flows, which are comparable across sources given a destination or comparable across destinations given a source. This appendix describes their approach.

7.1 Average Unit Value and Average Quality-Adjusted Price

The closed-form solution of optimal quality for firm j in i selling to k is:

$$z_{ki,j} = (\frac{\alpha_k \theta}{1-\alpha_k \theta} \frac{T_{ki}}{c_{Mi}} \varphi_j)^{\theta}. \tag{A2.1}$$

We can easily solve the FOB price $p^*_{ki,j}$ and CIF price $p_{ki,j}$:

$$\begin{aligned} p^*_{ki,j} &= T_{ki}(\frac{1}{1-\alpha_k\theta}\frac{\sigma}{\sigma-1} - 1) \equiv \overline{p}^*_{ki}, \\ p_{ki,j} &= \tau_{ki} T_{ki}(\frac{1}{1-\alpha_k\theta}\frac{\sigma}{\sigma-1}) \equiv \overline{p}_{ki}. \end{aligned} \tag{A2.2}$$

Notice that in Feenstra and Romalis (2014), the FOB price and CIF price do not vary across firms. We thus define the average FOB price and CIF from i to k as $\overline{p}^*_{ki}$ and $\overline{p}_{ki}$. Hence for any $ki - j$ combination, the CIF quality-adjusted price can be expressed as:

$$P^j_{ki} = \overline{p}_{ki}[\frac{c_{Mi}/\varphi_{ij}}{\kappa_{1k}\overline{p}^*_{ki}}], \text{ with } \kappa_{1k} = \frac{\alpha_k\theta(\sigma-1)}{1+\alpha_k\theta(\sigma-1)}. \tag{A2.3}$$

A parametric assumption regarding the distribution of φ_{ij} in each country i is needed to derive a closed-form solution for the average quality-adjusted price.

Assumption A2.1: *In particular, φ_{ij} is assumed to be distributed as Pareto with lower bound φ_i and dispersion γ:*

$$G_i(\varphi) = 1 - (\frac{\varphi}{\varphi_i})^{-\gamma}. \tag{A2.4}$$

Aggregate trade flow from i to k, X_{ki}, is

$$X_{ki} = N_i \int_{\widehat{\varphi}_{ki}}^{\infty} X_{ki,j} \mathrm{d}G_i(\varphi) = \kappa_{2k} N_i \widehat{X}_{ki}(\frac{\widehat{\varphi}_{ki}}{\varphi_i})^{-\gamma}, \text{ with } \kappa_{2k} = \frac{\gamma}{\gamma - \alpha_k\theta(\sigma-1)} > 1, \tag{A2.5}$$

where $\widehat{\varphi}_{ki}$ and $\widehat{X}_{ki}$ are the productivity and sales of the cutoff firm selling from i to k:

$$\widehat{\varphi}_{ki} = \frac{c_{Mi}}{\alpha_k\theta}(\frac{T_{ki}}{1-\alpha_k\theta})^{\frac{1-\alpha_k\theta}{\alpha_k\theta}}[\frac{F_{ki}(\tau_{ki})^{\sigma-1}tar_{ki}}{\omega I_k(\Phi_k)^{\sigma-1}}]^{\frac{1}{(\sigma-1)\alpha_k\theta}}, \tag{A2.6}$$

$$\widehat{X}_{ki} = I_k(\Phi_k)^{\sigma-1}[\frac{\sigma}{\sigma-1}\tau_{ki}(\frac{c_{Mi}}{\alpha_k\theta\widehat{\varphi}_{ki}})^{\alpha_k\theta}(\frac{T_{ki}}{1-\alpha_k\theta})^{1-\alpha_k\theta}]^{1-\sigma}, \tag{A2.7}$$

where F_{kij} is the fixed cost for firm j in i to enter j. Differing from our theory, for a particular firm j, Feenstra and Romalis (2014) specify the functional form of fixed-cost selling from i to k to be

$$F_{kij} = (\frac{c_{Mi}}{\varphi})(\frac{Y_k}{p_k})^{\beta_0}e^{\beta'\cdot f_{ki}}, \text{ with } \beta_0, \beta' > 0. \tag{A2.8}$$

Therefore, more productive firms also have lower fixed cost, in addition to their advantage in variable cost. Moreover, $\frac{Y_k}{p_k}$ is the real expenditure in destination k, as a smaller market might have a lower fixed cost, since it is easier to reach all customers there, an intuition motivated by Arkolakis (2010). Finally, the fixed cost also depends on a series of bilateral variables in f_{ki}. Feenstra and Romalis (2014) use language similarity data as a proxy for f_{ki}.

Deviating from F_{ki} in our theory, which is constant across firms, to in our theory, to F_{kij} in theirs does not lead to any qualitative changes in our theory's predictions. Our theoretical results rely on more productive firm being more likely to overcome the fixed-cost hurdle in a destination market, and allowing the fixed cost to be decreasing in productivity only reinforces this sorting pattern. Therefore, our theoretical predictions are robust to the specification of fixed cost, as long as this sorting pattern is preserved.

The zero-cutoff condition implies

$$\frac{\widehat{X}_{ki}}{\sigma tar_{ki}} = (\frac{c_{Mi}}{\widehat{\varphi}_{ki}})(\frac{Y_k}{p_k})^{\beta_0}e^{\beta'\cdot f_{ki}}. \tag{A2.9}$$

The CIF average quality-adjusted price from i to k, $\overline{P}_{ki}$, can be calculated as

$$\overline{P}_{ki} = [\int_{\widehat{\varphi}_{ki}}^{\infty}\frac{(P_{ki,j})^{1-\sigma}g_i(\varphi)}{N_i[1-G_i(\widehat{\varphi}_{ki})]}\mathrm{d}\varphi]^{\frac{1}{1-\sigma}} = \kappa_{2k}^{\frac{1}{1-\sigma}}\overline{p}_{ki}[\frac{w_i/\widehat{\varphi}_{ki}}{\kappa_{1k}\overline{p}^{*}_{ki}}]^{\alpha_k\theta}. \tag{A2.10}$$

Substituting (A2.5) and (A2.9) into (A2.10), we have

$$\overline{P}_{ki} = \frac{\kappa_{2k}{}^{\frac{1}{1-\sigma}}\overline{p}_{ki}}{(\kappa_{1k}\overline{p}^{*}_{ki})^{\alpha_k\theta}}[\frac{X_{ki}/\kappa_{2k}tar_{ki}}{N_i(\frac{\varphi_i}{c_{Mi}})^{\gamma}}(\frac{Y_k}{p_k})^{-\beta_0}e^{-\beta'\cdot f_{ki}}]^{\frac{\alpha_k\theta}{1+\gamma}}. \tag{A2.11}$$

Feenstra and Romalis (2014) further show that $\frac{X_{ki}}{N_i(\frac{\varphi_i}{c_{Mi}})^{\gamma}}$ is close to a gravity equation:

$$\frac{X_{ki}}{N_i(\frac{\varphi_i}{c_{Mi}})^{\gamma}} = [(\frac{\overline{P}_{ki}}{\Phi_k})^{-(\sigma-1)}Y_k]^{(1+\gamma)}[\sigma\kappa_{2k}tar_{ki}(\frac{Y_k}{p_k})^{\beta_0}e^{\beta'\cdot f_{ki}}]^{-\gamma}. \tag{A2.12}$$

Combining the gravity equation expression with (A2.11) we have:

$$\overline{P}_{ki} = \{\frac{\kappa_{2k}^{\frac{1}{1-\sigma}}\overline{p}_{ki}}{(\kappa_{1k}\overline{p}^*_{ki})^{\alpha_k\theta}}[[(\Phi_k)^{(\sigma-1)}Y_k]^{(1+\gamma)}[\sigma\kappa_{2k}tar_{ki}(\frac{Y_k}{p_k})^{\beta_0}e^{\beta'\cdot f_{ki}}]^{-\gamma-1}\sigma]^{\frac{\alpha_k\theta}{1+\gamma}}\}^{\frac{1}{1+(\sigma-1)\alpha_k\theta}}. \qquad \text{(A2.13)}$$

7.2 Average Quality of Export and Import

Using (A2.13), the average quality of i's exports, given a particular destination k, is defined as

$$\begin{aligned} \ln\widetilde{z}_{ki} - \ln\widetilde{z}_{k,world} &= \ln\overline{p}^*_{ki} - \ln\overline{P}^*_{ki} = \ln\overline{p}_{ki} - \ln\overline{P}_{ki} \\ &= \frac{\kappa_{1k}}{\sigma-1}[(\sigma-1)\ln\overline{p}_{ki} + \ln\overline{p}^*_{ki} + \sigma\ln tar_{ki} + \beta'\cdot f_{ki}] - \ln\widetilde{z}_{k,world}, \quad \text{(A2.14)} \end{aligned}$$

where $\ln\widetilde{z}_{k,world}$ denotes the world average export quality to k.

Similarly, using (A2.11), the average quality of k's imports, given a particular source i, is defined as

$$\begin{aligned} \ln\widetilde{z}_{ki} - \ln\widetilde{z}_{world,i} &= \ln\overline{p}_{ki} - \ln\overline{P}_{ki} = \frac{\alpha_k\theta}{1+\gamma}[(1+\gamma)\ln(\kappa_{1k}\overline{p}^*_{ki}) - \ln\frac{X_{ki}}{tar_{ki}} + \beta_0\ln(\frac{Y_k}{p_k}) \\ &\quad +\beta'\cdot f_{ki}] + (\frac{1}{\sigma-1} + \frac{\alpha_k\theta}{1+\gamma})\ln\kappa_{2k} - \ln\widetilde{z}_{world,i}, \quad \text{(A2.15)} \end{aligned}$$

where $\ln\widetilde{z}_{world,i}$ denotes the world average import quality from i.

To construct these measures using available data, for each product g, the average FR quality of exports from i to k given k becomes:

$$\ln\widetilde{z}^{g,FR}_{ki} - \ln\widetilde{z}^g_{k,world} = \frac{\kappa^g_{1k}}{\sigma^g-1}[(\sigma^g-1)\ln uv^g_{ki} + \ln uv^{*g}_{ki} + \sigma^g\ln tar^g_{ki} + \beta^{g\prime}\cdot f_{ki}] - \ln\widetilde{z}^g_{k,world}, \quad \text{(A2.16)}$$

where Feenstra and Romalis (2014) use CIF unit value times tariff $uv^g_{ki}\cdot tar^g_{ki}$ to measure $\overline{p}^g_{ki}$ and FOB unit value uv^{*g}_{ki} to measure $\overline{p}^{*g}_{ki}$. f_{ki} is the measure of language similarity between i and k.[29] The world average export quality to k in product g acts as a destination-product fixed effect. Therefore $\ln\widetilde{z}^{g,FR}_{ki} - \ln\widetilde{z}^g_{k,world}$ are only comparable across sources i given a destination k.

The average FR quality of imports from i to k given i becomes:

$$\begin{aligned} \ln\widetilde{z}^{g,FR}_{ki} - \ln\widetilde{z}^g_{world,i} &= \frac{\overline{\alpha}^g\theta^g}{1+\gamma^g}[(1+\gamma^g)\ln(\kappa^g_{1k}uv^{*g}_{ki}) - \ln\frac{X^g_{ki}}{tar^g_{ki}} + \beta^g_0\ln(\frac{Y_k}{p_k}) \\ &\quad +\beta^{g\prime}\cdot f_{ki}] + (\frac{1}{\sigma^g-1} + \frac{\overline{\alpha}^g\theta^g}{1+\gamma^g})\ln\kappa^g_{2k} - \ln\widetilde{z}^g_{world,i}. \quad \text{(A2.17)} \end{aligned}$$

[29] See Feenstra and Romalis (2014), Appendix C, for the details of the language similarity measures.

Comparing with (A2.15), the parameter α_k^g measuring "preference for quality" is replaced by $\overline{\alpha}^g$, the average value of α^g across all countries importing product g. This implementation is motivated by Feenstra and Romalis (2014) to avoid average quality being dependent on preferences across countries. The world average import quality from i in product g acts as a source-product fixed effect. Therefore $\ln \widetilde{z}_{ki}^{g,FR} - \ln \widetilde{z}_{world,i}^{g}$ are only comparable across destinations k given a source i.

$\ln \widetilde{z}_{ki}^{g,FR} - \ln \widetilde{z}_{k,world}^{g,FR}$ and $\ln \widetilde{z}_{ki}^{g,FR} - \ln \widetilde{z}_{world,i}^{g,FR}$, together with unit value $\ln uv_{ki}^g$ and $\ln uv_{ki}^{*g}$, are the main measures for quality of traded goods in our empirical examinations. With data uv_{ki}^g, uv_{ki}^{*g}, tar_{ki}^g, f_{ki}, X_{ki}^g, $\frac{Y_k}{p_k}$ and parameters σ^g, θ^g, α_k^g, γ^g, β_0^g, $\beta^{g\prime}$ in hand, we can construct $\widetilde{z}_{ki}^{g,FR}/\widetilde{z}_{k,world}^{g}$ and $\widetilde{z}_{ki}^{g,FR}/\widetilde{z}_{world,i}^{g}$.[30]

7.3 Aggregation across Sources and Destinations

To give explicit interpretation to the export and import quality variation across countries, Feenstra and Romalis (2014) further provide an aggregation procedure to generate a country-product-level measure of the export and import quality indexes, $\widetilde{z}_{i}^{g,FR}$ and $\widetilde{z}_{k}^{g,FR}$. Whereas $\widetilde{z}_{ki}^{g,FR}/\widetilde{z}_{k,world}^{g,FR}$ and $\widetilde{z}_{ki}^{g,FR}/\widetilde{z}_{world,i}^{g,FR}$ and bilateral-product specific, $\widetilde{z}_{i}^{g,FR}$ and $\widetilde{z}_{k}^{g,FR}$ are unilateral-product specific.

To aggregate export quality for a source country i, given a destination country k and a base country b and compare the relative average (FOB) quality-adjusted export price in product g:

$$\ln(\frac{\overline{P}_{ki}^{*g}}{\overline{P}_{kb}^{*g}}) = \ln(\frac{\overline{p}_{ki}^{*g}}{\overline{p}_{kb}^{*g}}) - \ln(\frac{\widetilde{z}_{ki}^{g}}{\widetilde{z}_{kb}^{g}}).$$

Similarly, we have relative average (FOB) export price in product g, $\ln(\frac{\overline{p}_{ki}^{*g}}{\overline{p}_{kb}^{*g}})$.

To aggregate $\frac{\overline{P}_{ki}^{*g}}{\overline{P}_{kb}^{*g}}$ and $\frac{\overline{p}_{ki}^{*g}}{\overline{p}_{kb}^{*g}}$ across destinations k, Feenstra and Romalis (2014) construct a Laspeyres export price index $p\_ex\_Las_{ib}^g$ and quality-adjusted export price index $P\_ex\_Las_{ib}^g$ as well as Passeche export price index $p\_ex\_Pas_{ib}^g$ and quality-adjusted export price index $P\_ex\_Pas_{ib}^g$ as the following:

$$p\_ex\_Las_{ib}^g = \sum_k s_{kb}^{*g}(\frac{\overline{p}_{ki}^{*g}}{\overline{p}_{kb}^{*g}});\ P\_ex\_Las_{ib}^g = \sum_k s_{kb}^{*g}(\frac{\overline{P}_{ki}^{*g}}{\overline{P}_{kb}^{*g}}), \tag{A2.18}$$

$$p\_ex\_Pas_{ib}^g = \sum_k s_{ki}^{*g}(\frac{\overline{p}_{ki}^{*g}}{\overline{p}_{kb}^{*g}});\ P\_ex\_Pas_{ib}^g = \sum_k s_{ki}^{*g}(\frac{\overline{P}_{ki}^{*g}}{\overline{P}_{kb}^{*g}}), \tag{A2.19}$$

where $s_{kb}^{*g} = \frac{X_{kb}^{*g}}{\sum_{k'} X_{k'b}^{*g}}$ and $s_{ki}^{*g} = \frac{X_{ki}^{*g}}{\sum_{k'} X_{k'i}^{*g}}$.

[30] For the estimation procedures for all the parameters, please see Feenstra and Romalis (2014) and their appendix. All parameters are available on Prof. Feenstra's website.

The Fisher ideal export price index and quality-adjusted export price index are constructed as the geometric average of the Laspeyres and Passeche price indexes:

$$
\begin{aligned}
p\_ex\_Fis_{ib}^{g} &= (p\_ex\_Las_{ib}^{g} \cdot p\_ex\_Pas_{ib}^{g})^{0.5}, \\
P\_ex\_Fis_{ib}^{g} &= (P\_ex\_Las_{ib}^{g} \cdot P\_ex\_Pas_{ib}^{g})^{0.5}.
\end{aligned}
$$

The final step is to construct the GEKS export price index and quality-adjusted export price index, which are the geometric mean over all Fisher ideal indexes for exports of country i relative to exports of s times the Fisher ideal index for exports of s relative to exports of b:

$$
\begin{aligned}
p\_ex\_GEKS_{ib}^{g} &= \Pi_{s}^{C}(p\_ex\_Fis_{is}^{g} \cdot p\_ex\_Fis_{sb}^{g})^{\frac{1}{C}}, \\
P\_ex\_GEKS_{ib}^{g} &= \Pi_{s}^{C}(P\_ex\_Fis_{is}^{g} \cdot P\_ex\_Fis_{sb}^{g})^{\frac{1}{C}}.
\end{aligned}
$$

Choosing the United States as the base country (let $b = US$), we arrive at a measure of source country i's export price (unit value) uv_{i}^{g} and FR export quality index $\widetilde{z}_{i}^{g,FR}$ in product g:

$$
uv_{i}^{g} = p\_ex\_GEKS_{i,US}^{g}, \tag{A2.20}
$$

$$
\widetilde{z}_{i}^{g,FR} = \frac{p\_ex\_GEKS_{i,US}^{g}}{P\_ex\_GEKS_{i,US}^{g}}. \tag{A2.21}
$$

By a similar aggregation procedure, we can also construct the destination country k's import price (unit value) uv_{k}^{g} and FR import quality index $\widetilde{z}_{k}^{g,FR}$ in product g.

Table 1 Variable Definitions

Variable	Definition	Data Source
uv_{ki}^{g}	Unit value of trade flow from k to i	UN Comtrade data
$\tilde{z}_{ki}^{g,FR}/\tilde{z}_{k,world}^{g}$	Quality of trade from i given destination k	Authors' calculation, see Appendix II
$\tilde{z}_{ki}^{g,FR}/\tilde{z}_{world,i}^{g}$	Quality of trade to k given source i	Authors' calculation, see Appendix II
uv_{i}^{g}	Average export unit value of i for product g	Authors' calculation, see Appendix II
uv_{k}^{g}	Average import unit value of k for product g	Authors' calculation, see Appendix II
$\tilde{z}_{i}^{g,FR}$	Average export quality of i for product g	Authors' calculation, see Appendix II
$\tilde{z}_{k}^{g,FR}$	Average import quality of k for product g	Authors' calculation, see Appendix II
JQ_i and JQ_k	Judicial quality in i and k	Nunn (2007)
ci^g	Contract intensity for product g	Nunn (2007)
H_i and H_k	Skill endowment in i and k	Nunn (2007)
h^g	Skill intensity for product g	Nunn (2007)
K_i and K_k	Capital endowment in i and k	Nunn (2007)
k^g	Capital intensity for product g	Nunn (2007)
CR_i and CR_k	Log of credit over GDP in i and k	Nunn (2007)
f^g	External financial dependence for product g	COMPUSTAT and authors' calculation
y_i and y_k	Per capita income in i and k	Nunn (2007)
D^g	Whether product g is differentiated	Rauch (1999)
va^g	Share of value-added for product g	Nunn (2007)
iit^g	Intra-industry trade for product g	Nunn (2007)
Δtfp^g	TFP growth for product g	Nunn (2007)
hi^g	HHI of input concentration for product g	Nunn (2007)

Note: This table reports the construction of the main variables and the direct sources to obtain these variables. The reason why most of our data are from Nunn (2007) is that Nunn (2007) collected a series of country- and product-specific indicators from other papers and provided public access to his regression samples. More details can be found in the section "Measures and Data."

Table 2A Baseline Results for Export Quality

Panel I: Basic controls	(1)	(2)	(3)
Dependent variable	$\ln uv_{ki}^{*g}$	$\ln uv_{ki}^{g}$	$\ln(\tilde{z}_{ki}^{g,FR}/\tilde{z}_{k,world}^{g})$
Judicial quality interaction: $ci^g JQ_i$	0.011	0.011	0.012
	(0.022)	(0.023)	(0.023)
Skill interaction: $h^g H_i$	0.007	0.007	0.008
	(0.008)	(0.008)	(0.008)
Capital interaction: $k^g K_i$	-0.087***	-0.089***	-0.092***
	(0.017)	(0.018)	(0.018)
Finance interaction: $f^g \ln CR_i$	-0.001	-0.001	-0.001
	(0.002)	(0.002)	(0.002)
Tariff: $\ln(1 + tar_{ki}^g)$	0.116	0.105	0.508***
	(0.099)	(0.101)	(0.098)
Log distance: $\ln dist_{ki}$	0.051***	0.056***	0.059***
	(0.006)	(0.006)	(0.006)
Number of obs.	463,720	463,720	463,720
Within R-squared	0.107	0.109	0.119
Panel II: Extended controls	(1)	(2)	(3)
Dependent variable	$\ln uv_{ki}^{*g}$	$\ln uv_{ki}^{g}$	$\ln(\tilde{z}_{ki}^{g,FR}/\tilde{z}_{k,world}^{g})$
Judicial quality interaction: $ci^g JQ_i$	-0.018	-0.018	-0.016
	(0.020)	(0.021)	(0.021)
Skill interaction: $h^g H_i$	0.005	0.004	0.005
	(0.009)	(0.009)	(0.009)
Capital interaction: $k^g K_i$	-0.057**	-0.057**	-0.058**
	(0.022)	(0.023)	(0.024)
Finance interaction: $f^g \ln CR_i$	-0.001	-0.001	-0.001
	(0.002)	(0.002)	(0.002)
Tariff: $\ln(1 + tar_{ki}^g)$	0.111	0.101	0.502***
	(0.097)	(0.099)	(0.097)
Log distance: $\ln dist_{ki}$	0.050***	0.055***	0.058***
	(0.006)	(0.006)	(0.006)
Log income×differentiated: $D^g \ln y_i$	0.072	0.073	0.078
	(0.077)	(0.080)	(0.082)
Log income×value added: $va^g \ln y_i$	0.153***	0.161***	0.174***
	(0.045)	(0.045)	(0.049)
Log income×intra-industry trade: $iit^g \ln y_i$	-0.098**	-0.104**	-0.091**
	(0.044)	(0.045)	(0.045)
Log income×TFP growth: $\Delta tfp^g \ln y_i$	0.155***	0.161***	0.137***
	(0.044)	(0.046)	(0.043)
Log income×input variety: $(1 - hi^g) \ln y_i$	0.032	0.030	0.035
	(0.047)	(0.047)	(0.048)
Number of obs.	438,416	438,416	438,416
Within R-squared	0.110	0.112	0.121

Note: Exporter fixed effects (FEs) and importer-SITC FEs are included in all specifications. Standard errors clustered at the exporter level are shown in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% levels.

Table 2B Baseline Results for Import Quality

Panel I: Basic controls	(1)	(2)	(3)
Dependent variable	$\ln uv_{ki}^{*g}$	$\ln uv_{ki}^{g}$	$\ln(\tilde{z}_{ki}^{g,FR}/\tilde{z}_{world,i}^{g})$
Judicial quality interaction: $ci^g JQ_k$	0.038***	0.041***	0.023***
	(0.008)	(0.008)	(0.008)
Skill interaction: $h^g H_k$	-0.001	0.000	0.008
	(0.005)	(0.005)	(0.005)
Capital interaction: $k^g K_k$	-0.043***	-0.034***	-0.041***
	(0.013)	(0.013)	(0.013)
Finance interaction: $f^g \ln CR_k$	0.005***	0.005***	0.003*
	(0.002)	(0.002)	(0.002)
Tariff: $\ln(1+tar_{ki}^g)$	-0.011	-0.005	0.019
	(0.028)	(0.028)	(0.027)
Log distance: $\ln dist_{ki}$	0.062***	0.067***	0.091***
	(0.004)	(0.004)	(0.004)
Number of obs.	412,440	412,440	412,440
Within R-squared	0.058	0.055	0.074
Panel II: Extended controls	(1)	(2)	(3)
Dependent variable	$\ln uv_{ki}^{*g}$	$\ln uv_{ki}^{g}$	$\ln(\tilde{z}_{ki}^{g,FR}/\tilde{z}_{world,i}^{g})$
Judicial quality interaction: $ci^g JQ_k$	0.038***	0.039***	0.028***
	(0.010)	(0.010)	(0.010)
Skill interaction: $h^g H_k$	-0.003	-0.002	0.005
	(0.005)	(0.006)	(0.006)
Capital interaction: $k^g K_k$	-0.034***	-0.025**	-0.032***
	(0.010)	(0.010)	(0.010)
Finance interaction: $f^g \ln CR_k$	0.005**	0.005***	0.003*
	(0.002)	(0.002)	(0.002)
Tariff: $\ln(1+tar_{ki}^g)$	0.002	0.004	0.023
	(0.029)	(0.029)	(0.027)
Log distance: $\ln dist_{ki}$	0.061***	0.067***	0.090***
	(0.004)	(0.004)	(0.004)
Log income×differentiated: $D^g \ln y_k$	0.015	0.021	-0.007
	(0.026)	(0.026)	(0.028)
Log income×value added: $va^g \ln y_k$	0.059***	0.055***	0.079***
	(0.020)	(0.020)	(0.020)
Log income×intra-industry trade: $iit^g \ln y_k$	-0.058***	-0.042***	-0.017
	(0.014)	(0.015)	(0.013)
Log income×TFP growth: $\Delta tfp^g \ln y_k$	0.000	-0.001	-0.020**
	(0.011)	(0.012)	(0.010)
Log income×input variety: $(1-hi^g)\ln y_k$	-0.050**	-0.038	-0.046**
	(0.023)	(0.024)	(0.021)
Number of obs.	389,310	389,310	389,310
Within R-squared	0.060	0.056	0.076

Note: Importer fixed effects (FEs) and exporter-SITC FEs are included in all specifications. Standard errors clustered at the importer level are shown in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% levels.

Table 3 Country-Product-Level Evidence

Panel I: Export quality	(1)	(2)	(3)	(4)
Dependent variable	$\ln uv_i^g$		$\ln \widetilde{z}_i^{g,FR}$	
Judicial quality interaction: $ci^g JQ_i$	0.008	-0.068*	0.071	-0.028
	(0.039)	(0.039)	(0.045)	(0.047)
Skill interaction: $h^g H_i$	-0.040	-0.047*	0.049	0.031
	(0.028)	(0.027)	(0.037)	(0.036)
Capital interaction: $k^g K_i$	-0.247***	-0.163***	-0.197***	-0.103*
	(0.033)	(0.045)	(0.052)	(0.056)
Finance interaction: $f^g \ln CR_i$	0.012	0.010	0.001	0.0003
	(0.010)	(0.010)	(0.013)	(0.013)
Full set of extended controls	No	Yes	No	Yes
Country FEs	Yes	Yes	Yes	Yes
SITC FEs	Yes	Yes	Yes	Yes
Number of obs.	30,710	28,513	30,710	28,513
Within R-squared	0.100	0.107	0.148	0.153
Panel II: Import quality	(1)	(2)	(3)	(4)
Dependent variable	$\ln uv_k^g$		$\ln \widetilde{z}_k^{g,FR}$	
Judicial quality interaction: $ci^g JQ_k$	0.122***	0.117***	0.079**	0.099***
	(0.033)	(0.038)	(0.031)	(0.035)
Skill interaction: $h^g H_k$	0.037**	0.024	0.013	0.005
	(0.018)	(0.018)	(0.016)	(0.016)
Capital interaction: $k^g K_k$	-0.150***	-0.130***	-0.164***	-0.155***
	(0.030)	(0.031)	(0.028)	(0.028)
Finance interaction: $f^g \ln CR_k$	0.017**	0.015*	0.012*	0.009
	(0.007)	(0.008)	(0.007)	(0.007)
Full set of extended controls	No	Yes	No	Yes
Country FEs	Yes	Yes	Yes	Yes
SITC FEs	Yes	Yes	Yes	Yes
Number of obs.	42,063	38,601	42,063	38,601
Within R-squared	0.059	0.061	0.046	0.049

Note: This table reports the estimation results of (18) and (20) in Panel I and (19) and (21) in Panel II. Standard errors clustered at the country level are shown in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% levels.

Table 4A Additional Controls for Export Quality

Dependent variable	$\ln uv_{ki}^{*g}$			
Judicial quality interaction: $ci^g JQ_i$	-0.055	-0.013	0.032	-0.027
	(0.038)	(0.026)	(0.029)	(0.020)
Skill endowment×contract intensity: $ci^g H_i$	0.074			
	(0.049)			
Capital endowment×contract intensity: $ci^g K_i$		-0.005		
		(0.012)		
Financial development×contract intensity: $ci^g \ln CR_i$			-0.043**	
			(0.019)	
Judicial quality×differentiated: $D^g JQ_i$				0.029
				(0.049)
Number of obs.	438,416	438,416	438,416	438,416
Within R-squared	0.110	0.110	0.111	0.110
Dependent variable	$\ln uv_{ki}^{g}$			
Judicial quality interaction: $ci^g JQ_i$	-0.056	-0.011	0.034	-0.028
	(0.039)	(0.027)	(0.029)	(0.020)
Skill endowment×contract intensity: $ci^g H_i$	0.076			
	(0.050)			
Capital endowment×contract intensity: $ci^g K_i$		-0.008		
		(0.013)		
Financial development×contract intensity: $ci^g \ln CR_i$			-0.045**	
			(0.020)	
Judicial quality×differentiated: $D^g JQ_i$				0.032
				(0.050)
Number of obs.	438,416	438,416	438,416	438,416
Within R-squared	0.112	0.112	0.113	0.112
Dependent variable	$\ln(\tilde{z}_{ki}^{g,FR}/\tilde{z}_{k,world}^{g})$			
Judicial quality interaction: $ci^g JQ_i$	-0.051	-0.009	0.035	-0.027
	(0.039)	(0.027)	(0.029)	(0.020)
Skill endowment×contract intensity: $ci^g H_i$	0.068			
	(0.050)			
Capital endowment×contract intensity: $ci^g K_i$		-0.007		
		(0.013)		
Financial development×contract intensity: $ci^g \ln CR_i$			-0.045**	
			(0.020)	
Judicial quality×differentiated: $D^g JQ_i$				0.034
				(0.051)
Number of obs.	438,416	438,416	438,416	438,416
Within R-squared	0.122	0.121	0.123	0.121

Note: This table reports the estimation results of (14) with additional interaction terms. The full set of extended controls, exporter fixed effects (FEs) and importer-SITC FEs are included in all specifications. Standard errors clustered at the exporter level are shown in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% levels.

Table 4B Additional Results for Import Quality

Dependent variable	$\ln uv_{ki}^{*g}$			
Judicial quality interaction: $ci^g JQ_k$	0.037**	0.038***	0.023*	0.036***
	(0.015)	(0.013)	(0.013)	(0.006)
Skill endowment×contract intensity: $ci^g H_k$	0.001			
	(0.015)			
Capital endowment×contract intensity: $ci^g K_k$		-0.000		
		(0.008)		
Financial development×contract intensity: $ci^g \ln CR_k$			0.017*	
			(0.009)	
Judicial quality×differentiated: $D^g JQ_k$				0.006
				(0.023)
Number of obs.	389,310	389,310	389,310	389,310
Within R-squared	0.060	0.060	0.061	0.060
Dependent variable	$\ln uv_{ki}^{g}$			
Judicial quality interaction: $ci^g JQ_k$	0.040**	0.041***	0.026*	0.036***
	(0.016)	(0.014)	(0.013)	(0.006)
Skill endowment×contract intensity: $ci^g H_k$	-0.000			
	(0.015)			
Capital endowment×contract intensity: $ci^g K_k$		-0.002		
		(0.009)		
Financial development×contract intensity: $ci^g \ln CR_k$			0.015*	
			(0.009)	
Judicial quality×differentiated: $D^g JQ_k$				0.010
				(0.023)
Number of obs.	389,310	389,310	389,310	389,310
Within R-squared	0.056	0.057	0.057	0.057
Dependent variable	$\ln(\tilde{z}_{ki}^{g,FR}/\tilde{z}_{world,i}^{g})$			
Judicial quality interaction: $ci^g JQ_k$	0.032**	0.032**	0.012	0.025***
	(0.016)	(0.014)	(0.013)	(0.006)
Skill endowment×contract intensity: $ci^g H_k$	-0.009			
	(0.015)			
Capital endowment×contract intensity: $ci^g K_k$		-0.006		
		(0.008)		
Financial development×contract intensity: $ci^g \ln CR_k$			0.018**	
			(0.008)	
Judicial quality×differentiated: $D^g JQ_k$				0.011
				(0.024)
Number of obs.	389,310	389,310	389,310	389,310
Within R-squared	0.076	0.076	0.076	0.076

Note: This table reports the estimation results of (15) with additional interaction terms. The full set of extended controls, importer fixed effects (FEs) and exporter-SITC FEs are included in all specifications. Standard errors clustered at the importer level are shown in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% levels.

Table 5 Alternative Measures of Judicial Quality and Contract Intensity

Panel I: Export						
Dependent variable:	$\ln uv_{ki}^{*g}$		$\ln uv_{ki}^{g}$		$\ln(\widetilde{z}_{ki}^{g,FR}/\widetilde{z}_{k,world}^{g})$	
ci^g based on:	lib	cons	lib	cons	lib	cons
JQ_i: Rule of law	-0.018	-0.020	-0.018	-0.021	-0.016	-0.019
	(0.020)	(0.022)	(0.021)	(0.023)	(0.021)	(0.023)
Number of obs.	438,416	438,416	438,416	438,416	438,416	438,416
JQ_i: Legal quality	0.016	0.018	0.016	0.018	0.018	0.021
	(0.023)	(0.025)	(0.024)	(0.026)	(0.024)	(0.026)
Number of obs.	438,223	438,223	438,223	438,223	438,223	438,223
JQ_i: Number of procedures	-0.036	-0.045	-0.039	-0.048	-0.039	-0.048
	(0.029)	(0.030)	(0.030)	(0.032)	(0.030)	(0.032)
Number of obs.	433,931	433,931	433,931	433,931	433,931	433,931
JQ_i: Official cost	0.019	0.022	0.019	0.022	0.020	0.024
	(0.030)	(0.033)	(0.031)	(0.034)	(0.032)	(0.034)
Number of obs.	433,931	433,931	433,931	433,931	433,931	433,931
JQ_i: Institutional quality	0.040	0.040	0.040	0.039	0.041	0.042
	(0.029)	(0.032)	(0.030)	(0.032)	(0.030)	(0.032)
Number of obs.	438,416	438,416	438,416	438,416	438,416	438,416
Panel II: Import						
Dependent variable:	$\ln uv_{ki}^{*g}$		$\ln uv_{ki}^{g}$		$\ln(\widetilde{z}_{ki}^{g,FR}/\widetilde{z}_{world,i}^{g})$	
ci^g based on:	lib	cons	lib	cons	lib	cons
JQ_k: Rule of law	0.038***	0.034***	0.039***	0.037***	0.028***	0.025**
	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)	(0.011)
Number of obs.	389,310	389,310	389,310	389,310	389,310	389,310
JQ_k: Legal quality	0.028**	0.024*	0.030**	0.027**	0.019	0.016
	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)
Number of obs.	387,327	387,327	387,327	387,327	387,327	387,327
JQ_k: Number of procedures	0.022**	0.021**	0.024**	0.022**	0.019*	0.017
	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)
Number of obs.	379,967	379,967	379,967	379,967	379,967	379,967
JQ_k: Official cost	0.030**	0.029**	0.031**	0.030**	0.017	0.016
	(0.013)	(0.014)	(0.014)	(0.014)	(0.014)	(0.014)
Number of obs.	379,967	379,967	379,967	379,967	379,967	379,967
JQ_k: Institutional quality	0.045***	0.042***	0.047***	0.045***	0.035***	0.033***
	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)
Number of obs.	389,310	389,310	389,310	389,310	389,310	389,310

Note: This table reports the estimation results of (14) in Panel I and (15) in Panel II with alternative measures of judicial quality (listed in rows) and alternative measures of contract intensity (listed in columns). The full set of extended controls is included in all specifications. Exporter fixed effects (FEs) and importer-SITC FEs are included for all estimates in Panel I. Importer FEs and exporter-SITC FEs are included for all estimates in Panel II. Columns indicated by "lib" use "liberal" classification in Rauch (1999) to construct contract intensity. Columns indicated by "cons" use "conservative" classification in Rauch (1999) to construct contract intensity. Standard errors clustered at the exporter level (in Panel I) or at the importer level (in Panel II) are shown in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% levels.

Table 6 Consumption and Non-Consumption Goods

Panel I: Export			
	(1)	(2)	(3)
Dependent variable	$\ln uv_{ki}^{*g}$	$\ln uv_{ki}^{g}$	$\ln(\tilde{z}_{ki}^{g,FR}/\tilde{z}_{k,world}^{g})$
Non-consumption goods	-0.019	-0.020	-0.020
	(0.028)	(0.028)	(0.028)
Number of obs.	307,136	307,136	307,136
Consumption goods	-0.005	-0.002	0.006
	(0.025)	(0.025)	(0.025)
Number of obs.	131,280	131,280	131,280
Panel II: Import			
	(1)	(2)	(3)
Dependent variable	$\ln uv_{ki}^{*g}$	$\ln uv_{ki}^{g}$	$\ln(\tilde{z}_{ki}^{g,FR}/\tilde{z}_{world,i}^{g})$
Non-consumption goods	0.020**	0.024**	0.015
	(0.010)	(0.010)	(0.011)
Number of obs.	272,352	272,352	272,352
Consumption goods	0.061***	0.059***	0.058***
	(0.011)	(0.011)	(0.010)
Number of obs.	116,958	116,958	116,958

Note: This table reports the estimation results of (14) in Panel I and (15) in Panel II for consumption goods and non-consumption goods. The full set of extended controls is included in all specifications. Exporter fixed effects (FEs) and importer-SITC FEs are included for all estimates in Panel I. Importer FEs and exporter-SITC FEs are included for all estimates in Panel II. Standard errors clustered at the exporter level (in Panel I) or at the importer level (in Panel II) are shown in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% levels.

Table 7 Export Quality Inferred Using the Demand-Side Approach

	(1)	(2)	(3)	(4)
Dependent variable $\widehat{\zeta}_{ki}^{g}$	Export		Import	
Judicial quality interaction: $ci^g JQ$	0.051	-0.001	0.051***	0.044***
	(0.037)	(0.040)	(0.010)	(0.011)
Skill interaction: $h^g H$	0.030	0.019	0.014**	0.014**
	(0.034)	(0.035)	(0.007)	(0.007)
Capital interaction: $k^g K$	0.133***	0.208***	-0.052***	-0.054***
	(0.046)	(0.048)	(0.010)	(0.011)
Finance interaction: $f^g \ln CR$	-0.002	-0.002	0.0001	-0.0002
	(0.004)	(0.003)	(0.002)	(0.002)
Full set of extended controls	No	Yes	No	Yes
Number of obs.	442,088	420,170	393,668	373,419
Within R-squared	0.062	0.068	0.020	0.021

Note: This table reports the estimation results of (14) in column 1 and 2 and (15) in column 3 and 4 using quality measured by the demand-side approach as in Khandelwal, Schott and Wei (2013) and Fan, Li and Yeaple (2015). Exporter fixed effects (FEs) and importer-SITC FEs are included in columns 1 and 2. Importer FEs and exporter-SITC FEs are included in columns 3 and 4. Standard errors clustered at the exporter level (in columns 1 and 2) or importer level (in columns 3 and 4) are shown in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% levels.

Table 8A IV Estimation for Export Quality

Second-stage IV estimates	(1)	(2)	(3)
Dependent variable	$\ln uv_{ki}^{*g}$	$\ln uv_{ki}^{g}$	$\ln(\widetilde{z}_{ki}^{g,FR}/\widetilde{z}_{k,world}^{g})$
Judicial quality interaction: $ci^g JQ_i$	-0.096	-0.107	-0.097
	(0.065)	(0.069)	(0.068)
Skill interaction: $h^g H_i$	0.010	0.009	0.010
	(0.008)	(0.008)	(0.008)
Capital interaction: $k^g K_i$	-0.073***	-0.075***	-0.075***
	(0.024)	(0.025)	(0.025)
Finance interaction: $f^g \ln CR_i$	-0.002	-0.002	-0.002
	(0.002)	(0.002)	(0.002)
Number of obs.	424,483	424,483	424,483
Centered R-squared	0.017	0.019	0.026
First-stage IV estimates	(1)	(2)	(3)
Dependent variable		$ci^g JQ_i$	
British legal origin interaction: $ci^g B_i$	-0.061**	-0.061**	-0.061**
	(0.029)	(0.029)	(0.029)
French legal origin interaction: $ci^g F_i$	-0.191***	-0.191***	-0.191***
	(0.038)	(0.038)	(0.038)
German legal origin interaction: $ci^g G_i$	-0.073*	-0.073*	-0.073*
	(0.039)	(0.039)	(0.039)
Kleibergen-Paap LM stat.	13.617***	13.617***	13.617***
Kleibergen-Paap F stat.	11.834	11.834	11.834
Hansen J stat. (p-value)	0.049	0.042	0.045

Note: This table reports the IV estimation results of (14). The full set of extended controls, exporter fixed effects (FEs) and importer-SITC FEs are included in all specifications. The results of the first stage are reported in Panel II, with "Scandinavian legal origin" being the omitted category. Standard errors clustered at the exporter level are shown in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% levels.

Table 8B IV Estimation for Import Quality

Second-stage IV estimates	(1)	(2)	(3)
Dependent variable	$\ln uv_{ki}^{*g}$	$\ln uv_{ki}^{g}$	$\ln(\widetilde{z}_{ki}^{g,FR}/\widetilde{z}_{world,i}^{g})$
Judicial quality interaction: $ci^g JQ_k$	0.066**	0.068**	0.053**
	(0.027)	(0.027)	(0.026)
Skill interaction: $h^g H_k$	-0.007	-0.005	0.001
	(0.006)	(0.006)	(0.006)
Capital interaction: $k^g K_k$	-0.028**	-0.019*	-0.027**
	(0.012)	(0.012)	(0.011)
Finance interaction: $f^g \ln CR_k$	0.005***	0.005***	0.003*
	(0.002)	(0.002)	(0.002)
Number of obs.	381,571	381,571	381,571
Centered R-squared	0.025	0.028	0.051
First-stage IV estimates	(1)	(2)	(3)
Dependent variable		$ci^g JQ_k$	
British legal origin interaction: $ci^g B_k$	-0.116***	-0.116***	-0.116***
	(0.037)	(0.037)	(0.037)
French legal origin interaction: $ci^g F_k$	-0.253***	-0.253***	-0.253***
	(0.034)	(0.034)	(0.034)
German legal origin interaction: $ci^g G_k$	-0.088*	-0.088*	-0.088*
	(0.045)	(0.045)	(0.045)
Kleibergen-Paap LM stat.	18.934***	18.934***	18.934***
Kleibergen-Paap F stat.	21.571	21.571	21.571
Hansen J stat. (p-value)	0.161	0.208	0.106

Note: This table reports the IV estimation results of (15). The full set of extended controls, importer fixed effects (FEs) and exporter-SITC FEs are included in all specifications. The results of the first stage are reported in Panel II, with "Scandinavian legal origin" being the omitted category. Standard errors clustered at the importer level are shown in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% levels.

Table 9A Export Quality: Different Elasticities of Substitution

	Low σ goods		
	(1)	(2)	(3)
Dependent variable	$\ln uv_{ki}^{*g}$	$\ln uv_{ki}^{g}$	$\ln(\tilde{z}_{ki}^{g,FR}/\tilde{z}_{k,world}^{g})$
Judicial interaction: $ci^g JQ_i$	0.005	0.005	0.004
	(0.030)	(0.030)	(0.030)
Full set of extended controls	Yes	Yes	Yes
Exporter FEs	Yes	Yes	Yes
Importer-SITC FEs	Yes	Yes	Yes
Number of obs.	209,155	209,155	209,155
	High σ goods		
	(1)	(2)	(3)
Dependent variable	$\ln uv_{ki}^{*g}$	$\ln uv_{ki}^{g}$	$\ln(\tilde{z}_{ki}^{g,FR}/\tilde{z}_{k,world}^{g})$
Judicial interaction: $ci^g JQ_i$	-0.034**	-0.033**	-0.034*
	(0.016)	(0.017)	(0.017)
Full set of extended controls	Yes	Yes	Yes
Exporter FEs	Yes	Yes	Yes
Importer-SITC FEs	Yes	Yes	Yes
Number of obs.	229,261	229,261	229,261

Note: This table reports the estimation results of (14) for goods with different elasticities of substitution. The full set of extended controls, exporter fixed effects (FEs) and importer-SITC FEs are included in all specifications. Standard errors clustered at the exporter level are shown in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% levels.

Table 9B Import Quality: Different Elasticities of Substitution

	Low σ goods		
	(1)	(2)	(3)
Dependent variable	$\ln uv_{ki}^{*g}$	$\ln uv_{ki}^{g}$	$\ln(\widetilde{z}_{ki}^{g,FR}/\widetilde{z}_{world,i}^{g})$
Judicial interaction: $ci^g JQ_k$	0.048***	0.054***	0.027**
	(0.011)	(0.012)	(0.012)
Full set of controls	Yes	Yes	Yes
Importer FEs	Yes	Yes	Yes
Exporter-SITC FEs	Yes	Yes	Yes
Number of obs.	186,274	186,274	186,274
	High σ goods		
	(1)	(2)	(3)
Dependent variable	$\ln uv_{ki}^{*g}$	$\ln uv_{ki}^{g}$	$\ln(\widetilde{z}_{ki}^{g,FR}/\widetilde{z}_{world,i}^{g})$
Judicial interaction: $ci^g JQ_k$	0.026***	0.027***	0.023**
	(0.010)	(0.010)	(0.010)
Full set of controls	Yes	Yes	Yes
Importer FEs	Yes	Yes	Yes
Exporter-SITC FEs	Yes	Yes	Yes
Number of obs.	203,036	203,036	203,036

Note: This table reports the estimation results of (15) for goods with different elasticities of substitution. The full set of extended controls, importer fixed effects (FEs) and exporter-SITC FEs are included in all specifications. Standard errors clustered at the importer level are shown in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% levels.

Table 10A IV Estimation for Export Quality: Different Elasticities of Substitution

	Low σ goods		
	(1)	(2)	(3)
Dependent variable	$\ln uv_{ki}^{*g}$	$\ln uv_{ki}^{g}$	$\ln(\widetilde{z}_{ki}^{g,FR}/\widetilde{z}_{k,world}^{g})$
Judicial interaction: $ci^g JQ_i$	-0.102	-0.115	-0.103
	(0.080)	(0.084)	(0.081)
Full set of controls	Yes	Yes	Yes
Exporter FEs	Yes	Yes	Yes
Importer-SITC FEs	Yes	Yes	Yes
Number of obs.	201,614	201,614	201,614
Kleibergen-Paap LM stat.	13.393***	13.393***	13.393***
Kleibergen-Paap F stat.	11.472	11.472	11.472
Hansen J stat. (p-value)	0.057	0.051	0.053
	High σ goods		
	(1)	(2)	(3)
Dependent variable	$\ln uv_{ki}^{*g}$	$\ln uv_{ki}^{g}$	$\ln(\widetilde{z}_{ki}^{g,FR}/\widetilde{z}_{k,world}^{g})$
Judicial interaction: $ci^g JQ_i$	-0.062	-0.069	-0.065
	(0.055)	(0.058)	(0.060)
Full set of controls	Yes	Yes	Yes
Exporter FEs	Yes	Yes	Yes
Importer-SITC FEs	Yes	Yes	Yes
Number of obs.	222,869	222,869	222,869
Kleibergen-Paap LM stat.	13.509***	13.509***	13.509***
Kleibergen-Paap F stat.	12.409	12.409	12.409
Hansen J stat. (p-value)	0.125	0.099	0.110

Note: This table reports the IV estimation results of (14) for goods with different elasticities of substitution. The full set of extended controls, exporter fixed effects (FEs) and importer-SITC FEs are included in all specifications. Standard errors clustered at the exporter level are shown in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% levels.

Table 10B IV Estimation for Import Quality: Different Elasticities of Substitution

	Low σ goods		
	(1)	(2)	(3)
Dependent variable	$\ln uv_{ki}^{*g}$	$\ln uv_{ki}^{g}$	$\ln(\widetilde{z}_{ki}^{g,FR}/\widetilde{z}_{world,i}^{g})$
Judicial interaction: $ci^g JQ_k$	0.070**	0.073**	0.053*
	(0.030)	(0.031)	(0.031)
Full set of controls	Yes	Yes	Yes
Importer FEs	Yes	Yes	Yes
Exporter-SITC FEs	Yes	Yes	Yes
Number of obs.	182,505	182,505	182,505
Kleibergen-Paap LM stat.	19.084***	19.084***	19.084***
Kleibergen-Paap F stat.	21.223	21.223	21.223
Hansen J stat. (p-value)	0.263	0.298	0.221
	High σ goods		
	(1)	(2)	(3)
Dependent variable	$\ln uv_{ki}^{*g}$	$\ln uv_{ki}^{g}$	$\ln(\widetilde{z}_{ki}^{g,FR}/\widetilde{z}_{world,i}^{g})$
Judicial interaction: $ci^g JQ_k$	0.062**	0.062***	0.053**
	(0.024)	(0.024)	(0.022)
Full set of controls	Yes	Yes	Yes
Importer FEs	Yes	Yes	Yes
Exporter-SITC FEs	Yes	Yes	Yes
Number of obs.	199,066	199,066	199,066
Kleibergen-Paap LM stat.	18.708***	18.708***	18.708***
Kleibergen-Paap F stat.	21.689	21.689	21.689
Hansen J stat. (p-value)	0.120	0.153	0.107

Note: This table reports the IV estimation results of (15) for goods with different elasticities of substitution. The full set of extended controls, importer FEs and exporter-SITC FEs are included in all specifications. Standard errors clustered at the importer level are shown in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% levels.