Institutional Quality and Trade in Intermediate Goods

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Abstract

Recently published studies stress the importance of trade in intermediate goods. The literature on determinants of trade, however, have largely focused on the sources of comparative advantage in determining aggregate trade flows rather than trade in intermediate goods. Therefore, in this paper the role of institutional quality and trade costs to explain the determinants of trade in intermediates is examined. Our simple model is based on the model of comparative advantage in the gravity framework used by Eaton and Kortum (2002) and Chor (2010) to relate trade flows of intermediate goods to institutional parameters, factor endowments and geography. Our empirical tests using a data set containing 172 countries and 17 industries spanning 10 years confirm the theoretical prediction that a country with higher institutional quality has a comparative advantage in institution-intensive goods and trade costs have a negative effect on trade. We further find that these effects are stronger in share of trade in intermediate goods vis-à-vis final goods.

Keywords: Trade in intermediate goods, Institutions, Trade costs

JEL Classification: F12, D23

1. Introduction

In the past few decades, the world has witnessed trade in intermediate goods as the most rapidly growing component of trade. Hummels et al. (2001) showed that growth in vertical specialization can account for 30% of the growth in exports of 10 Organization for Economic Co-Operation and Development (OECD) countries and 4 emerging market countries between 1970 and 1990. Between 1992 and 2006, intermediate input trade reportedly grew approximately 11.9% a year (Yi, 2003; Hummels et al., 2001, Feenstra, 1998, UNCTAD, 2008). This resulted in an increase in studies examining the importance of trade in intermediate goods. Following the earlier works (Ethier, 1982; Sanyal and Jones, 1982; Jones and Kierzkowski, 1990; Deardorff, 1998), recent studies attempted to rediscover the significant role of trade in intermediate goods to explain the nature of globalization (Hummels et al., 2001; Yi, 2003; Antras et al., 2006; Grossman and Rossi-Hansberg, 2008; Bergstrand and Egger, 2010; Johnson and Noguera, 2012a, 2012b, Baldwin and Taglioni, 2014).

There are two distinct features of trade in intermediate goods. First, intermediate goods might cross borders several times for additional value before turning into final goods. Each time these goods cross a border, trade costs are incurred. Consequently, global reductions in tariffs and transport costs lead to a significant reduction in the cost of producing these goods (Yi, 2003). Accordingly, trade in intermediate goods may be more sensitive to factor costs and geographic barriers compared with trade in final goods. Thus, location, through its effect on input costs is important when determining the pattern of specialization in intermediate goods (Eaton and Kortum, 2002). Second, trade in intermediate goods is responsive to contract environment as transaction occurs between upstream supplier and downstream buyer. Facing incomplete contracts, the upstream firm producing an intermediate input with highly relationship-specific investment has an incentive to underinvest to avoid risk of appropriation by the downstream firm. This hold-up problem and related transaction costs may be low in a country with high institutional quality, that is, the relationship-specific goods can be produced with higher productivity in countries with better contract enforcement (Nunn, 2007; Levchenko, 2007). This effect can be more pronounced with trade in intermediate goods as the hold-up problem may be more significant in the production of intermediates rather than final goods (Lanz, 2010). Thus, institutional quality may be an important factor for trade in intermediate goods with high intensity of contract.

The importance of institutions has long been discussed in the trade literature. Institutional variables such as legal and political systems provide the incentive structure for exchange determining the transaction and transformation costs in an economy (North, 1990). The quality of institutions is important not only for economic development (La Porta et al., 1997, 1998; Acemoglu et al., 2001,2002) and capital flows (McLaren, 2000; Wei, 2000; Ornelas and Turner 2005; Alfaro et al., 2005; Hyun and

Kim, 2010), but also for international trade (Anderson and Marcouiller, 2002; Costinot, 2005; Nunn, 2007; Levchenko, 2007; Chor, 2010). These recent studies showed that countries with better institutions export relatively more in sectors for which relationship-specificity is important; institutions can be a source of comparative advantage determining the pattern of trade. Given the potential direct effects of contract incompleteness on the profitability of firms, the hold-up problem of underinvestment in the production of intermediates can incur higher costs for the downstream firm than the final good consumer. Accordingly, trade in intermediate goods compared with trade in final goods is more likely to be responsive to quality of institutions. The literature, however, is largely focused on the relationship between institutions and aggregate trade, while studies investigating the role of institutions on trade in disaggregated sectors, especially on intermediate goods are limited both theoretically and empirically.

Therefore, in the present study the role of institutional quality and trade costs to explain the determinants of trade in intermediate goods is examined. Our work is based on recent models of international trade that incorporate both the Ricardian and Heckscher-Ohlin models in the structures which resembles the gravity equations. We present an extension of the Eaton and Kortum (2002) model and Chor (2010) to explore the sources of comparative advantage when determining trade flow driven by the interaction between industry and country attributes in one hand and adopt the model of trade in intermediates from Caliendo and Parro (2015) in another. In an attempt to quantify the importance of different determinants of trade flows, Chor (2010) extended the Eaton-Kortum model, in which comparative advantage is determined by the interaction between country and industry characteristics. He showed that factor endowments, financial development, legal institutions and labor market regimes are important sources of comparative advantage.

For empirical analysis, we use country-industry pair data encompassing 172 countries, 17 manufacturing industries and 10-year time series panels from 2000-2009 to test the validity of conventional trade theory of comparative advantage in the gravity framework. Using our country-industry level time series data we investigate whether the institutional quality and trade costs play a significant role in determining a pattern of trade; more specifically, whether the country with high institutional quality has comparative advantage in producing institution-intensive goods (which requires favorable environment for contract enforcement), whether country-industry specific trade costs function as barriers to trade in intermediate goods and how important these effects are.

To highlight the distinct nature of trade in intermediate goods, we separate industry trade flows as intermediate input trade and final goods (consumption goods) trade to compare the importance of different sources of comparative advantage among different type of trade flows. Unlike Eaton and Kortum (2002) and Chor (2010) who used cross-sectional data for final goods trade, our 10-year

industry level panel data is used to compare the relative importance of institutions and geography as determinants in trade in intermediate goods compared to final goods trade and capture the macroeconomic time variant factors as well as industry-country pair characteristics. A significant caveat in gravity regression is that an empirical finding may often be driven by omitted variables. Inclusion of a set of country variables such as GDP, production costs and institutional level may still allow omitted variables to bias the estimation. To avoid this problem, we include a fixed effect of exporter and importer as well as industry and year, instead of a set of country characteristics.

The results of our study are in agreement with the theoretical prediction in that both institutions and trade costs are significant factors in explaining trade patterns and are more important in trade in intermediate goods than trade in final goods.

The remainder of this paper is organized as follows: In section 2 we develop a simple theoretical framework that captures the forces of institutional quality and trade costs. In section 3 we provide empirical specifications to test theoretical hypotheses and describe the data. In section 4 the empirical results of the main regression and robustness checks are presented. Section 5 is the conclusion.

2. Model

There are three theoretical arguments on the determinants of intermediate goods trade. First, differences in factor intensity across production stages combined with factor abundances across regions are sources of comparative advantages and determinants of trade in intermediate inputs (Jones, 2000; Jones and Kierzkowski, 2003). Second, vertical specialization surges due to increased productivity through reduction in trade costs. Third, recent studies have emphasized the role of interaction between institutional quality at the country-level and relationship-specificity at the industry level (Levchenko, 2007; Nunn, 2007). Nunn (2007) showed that countries with better institutional quality provided better contract enforcement and tended to have a comparative advantage in industries with high intensity of relationship-specificity. This is due to the hold-up problem that may emerge for highly relationship-specific products rather than standardized products. The contract theory, originally pioneered by Williamson (1975, 1986), suggests that when contracts are incomplete, the contracting parties have incentive to underinvest to reduce the risk of appropriation. Subsequently, countries with a better environment for contract enforcement have a comparative advantage in producing goods intensively and use relationship-specific inputs where contract enforcement is important. Further questions may arise as to whether this effect is stronger in which component of trade.

Based on the above arguments, our model builds on the model of comparative advantage proposed by Eaton and Kortum (2002) and Chor (2010) in the gravity framework incorporating the model of trade in intermediate goods by Caliendo and Parro (2015). The first, the neoclassical model, reaffirms the difference in technology and factor abundance as determinants of comparative advantage. Eaton and Kortum (2002) developed and quantified a Ricardian model of international trade that incorporates a role of geography, in which the competing forces of comparative advantage facilitating trade and geographical barriers exist in a multi-country setting[1]. In a similar context, Chor (2010) extended Eaton and Kortum's (2002) model to explain industry level trade flows. The set of geographical variables are embodied in trade costs that are negatively related with productivity. Second, we explicitly model trade in intermediate goods employing Caliendo and Parro (2015) which develops a model with trade in intermediate goods and sectoral linkages.

2.1 Production

In our model, production technology of intermediates is constant returns to scale and markets are perfectly competitive. On the demand side, consumers are the final good producers in the importing country. We first solve for the final good sector in country *n*'s demand for intermediate goods and then each intermediate input supplier's supply and pricing decisions in country *i* for the given demand schedule. The constant elasticity of substitution (CES) objective function of producers of the final composite intermediate good in country *n* buying traded intermediate inputs is given by:

$$Q_n^k = \left[\int_{k\in K} q_n^k(\omega^k)^{(\sigma-1)/\sigma} d\omega^k\right]^{\sigma/(\sigma-1)} , \qquad (1)$$

where a continuum of varieties of intermediate goods $\omega \in [0,1]$ is produced in each sector $k \in K$, the $q_n^k(\omega^k)$ denotes the quantity demanded for intermediate input ω of sector k consumed in country n and $\sigma > 1$ is elasticity of substitution across products. Then, the production technology of intermediate good ω^k is

$$q_n^k(\omega^k) = Z_n^k(\omega^k) m_n^k(\omega^k) \prod_{f=0}^{F} \left[V_{nf}^k(\omega^k)\right]^{\gamma_f^k} \qquad (2)$$

where $Z_n^k(\omega^k)$is the Ricardian efficiency of producing intermediate good ω^k in country n, $m_n^k(\omega^k)$is a composite intermediate good used to produce intermediate good ω^k and $V_{nf}^k(\omega^k)$ is factor $f \in [0, F]$

[1] Romalis (2004) integrated Dornbusch et al.'s (1980) model with a continuum of goods and Krugman's (1980) model of monopolistic competition confirming the validity of a factor proportions model in a multi-country setting. Similar to the latter model, gravity forces are also included in our model.

to produce intermediate ω^k. The unit production cost, $c_n^k(\omega^k)$ is specified as Cobb-Douglas aggregate over factor prices and the prices of composite intermediate goods as follows.

$$c_n^k(\omega^k) = P_n^k \prod_{f=0}^{F} (w_{nf})^{\gamma_f^k} \tag{3}$$

where w_{nf} is the price of factor f, γ_f^k is the share of factor f where $\sum_{f=0}^{F} \gamma_f^k = 1$. P_n^k is an aggregate price index of the composite intermediate input as follows:

$$P_n^k = \left[\int_{k \in K} \left(p_n^k(\omega^k) \right)^{1-\sigma} d\omega^k \right]^{\frac{1}{1-\sigma}} \tag{4}$$

Solving the optimization problem of the composite intermediate goods, the demand for ω^k in country n is derived as:

$$q_n^k(\omega^k) = p_n^k(\omega^k)^{-\sigma} {P_n^k}^{\sigma-1} Q_n^k \tag{5}$$

where $p_n^k(\omega^k)$ is the lowest price of intermediate input of industry k across all locations n.

2.2 Trade Costs and Prices

We assume that intermediate goods can be produced in any country and international trade is costly. In particular, iceberg type trade cost is defined as physical units where one unit of an intermediate good from country i to n requires producing $\tau_{in}^k > 1$units in industry k that stems from distance or trade policy. Following Eaton and Kortum (2002), the cost of delivering one unit of intermediate in industry k produced in country i to country n is given by

$$p_{in}^k = \frac{c_i^k(\omega^k)\tau_{in}^k(\omega^k)}{Z_i^k(\omega^k)} \tag{6}$$

where c_i^k is the unit input cost by exporter i in industry k. Under the perfect competition, country n would pay p_{in}^k to import intermediate ω^k from country i. Since the buyers in country n would purchase the intermediate good from the lowest cost supplier, the actual price of intermediate good ω^k in country n becomes

$$p_n^k(\omega^k) = \min_i \left\{ \frac{c_i^k(\omega^k)\tau_{in}^k(\omega^k)}{z_i^k(\omega^k)} \right\} \tag{7}$$

Following Chor (2010) to decompose the index of productivity into industry and country characteristics, we specify the natural log of productivity, $\ln Z_i^k(\omega^k)$ as:

$$\ln Z_i^k(\omega^k) = \mu_i + \delta_k + \sum \beta_{cn} C_i(\omega^k) N_k(\omega^k) + \beta_{cn} \epsilon_i^k(\omega^k) \quad (8)$$

where $C_i(\omega^k)$ and $N_k(\omega^k)$ are country and industry characteristics, respectively. The interaction term between $C_i(\omega^k)$ and $N_k(\omega^k)$ captures the source of comparative advantage as a determinant of pattern of trade in intermediates. For example, if C_i is the institutional quality of country i and N_k is institutional dependence at industry k, the interaction term measures the importance of the role of institutions as a potential channel through which the exporter can produce institution-intensive intermediate good ω^k at a certain productivity level. If countries with better institutions produce more highly relationship-specific intermediate inputs compared to countries with weak contract enforcement, then the quality of institutions are assumed to play a role as a source of comparative advantage in intermediate input trade. μ_i and δ_k are the exporter and industry-specific effects, respectively. ϵ_i^k, stochastic term of productivity is independent draw from the type I extreme value distribution.

Following Eaton and Kortum (2002), we assume that the prices of intermediate goods have Fréchet distribution as follows:

$$\Pr[p_{in}^k \leq p] = 1 - F_i\left\{\frac{c_i^k \tau_{in}^k}{Z_i^k(\omega^k)}\right\} = 1 - e^{-T_{in}^k p^\theta} \quad (9)$$

where F_i is the fraction of intermediates for which country i's price is below p, $T_{in}^k = \varphi_i^k (c_i^k \tau_{in}^k)^{-\theta}$. φ_i^k is a location parameter specific to a country and an industry expressed as

$$\varphi_i^k = \exp(\theta \mu_i + \theta \delta_k + \theta \sum \beta_{cn} C_i N_k) \quad (10)$$

The lowest price for an intermediate good in country n is less than p unless each source country's price is greater than p. As in Eaton and Kortum (2002), a higher φ_i^k implies a higher average productivity of a sector k in country i governing country i's absolute advantage while the parameter θ refers to the inverse of productivity dispersion across goods reflecting the comparative advantage. The larger is θ, the smaller the dispersion of productivity and the higher the probability that country n buys intermediate good in industry k from the country with relatively low costs.

The distribution of the lowest price of an intermediate good in country n is

$$\Pr[p_n^k \leq p] = 1 - \prod_{i=1}^N \Pr[p_{in}^k \geq p]$$

Let the value of intermediate good ω^k exported from country i to country n is denoted by $X_{in}(\omega^k)$. Also, let the probability that country i produces an intermediate good ω^k in industry k at the lowest

price in country *n* is $\pi_{in}^{k}(\omega^{k})$. Then, this probability becomes the country *n*'s share of expenditure on intermediate goods from *i* at sector *k* which is presented as

$$\pi_{in}^{k}(\omega^{k}) = \frac{X_{in}^{k}(\omega^{k})}{X_{n}^{k}(\omega^{k})} = \frac{\varphi_{i}^{k}(c_{i}^{k}\tau_{in}^{k})^{-\theta}}{\sum_{s=1}^{N}\varphi_{s}^{k}(c_{s}^{k}\tau_{sn}^{k})^{-\theta}} \quad (11)$$

It is shown that the bilateral trade share is decreasing in *i*'s relative production cost and trade cost while it is increasing in relative productivity.

We close the model by assuming that factor market clears. Total factor payments across goods is equal to factor income.

$$\sum_{k=1}^{K}\sum_{n=1}^{N}\gamma_{f}^{k}X_{in}^{k} = w_{if}V_{if} \quad (12)$$

3. Empirical Specification

3.1. Empirical Model

3.1.1. The Determinants of Trade in Intermediate Goods

Using the truncated OLS estimation method, our empirical analysis tests the prediction of the roles of trade cost and institutional quality as sources of comparative advantage in intermediate input trade. To analyze the impact of trade costs on industry trade flows in the gravity model framework, we specify the natural log of trade cost as follows:

$$\ln \tau_{in}{}^{k} = \beta_{g}G_{in}{}^{k} + \partial_{k} + \varepsilon_{in} + v_{in}^{k} \quad (13)$$

where $G_{in}{}^{k}$ is a set of geographical variables that can affect trade cost such as physical distance (or FOB shipping costs at the country-industry level) and trade policy as tariff barriers, colonial ties, common language, sharing a border, and Regional Trade Agreements (RTA). The natural log of trade cost may be industry specific by ∂_{k}, country-pair specific by ε_{in}, or country-pair-industry specific by v_{in}^{k}. Substituting equation (10) and (13) using $\sum_{f=0}^{F}\gamma_{f}^{k} = 1$ into (11) at time *t* and taking natural log can yield the estimating equation for export of intermediate good ω^{k} from country *i* to *n*:

$$\ln X_{int}^{k}(\omega^{k}) = -\theta(lnP_{it}^{k} + ln\omega_{i0t} - \sum_{f=1}^{F}\gamma_{f}^{k}ln(\frac{w_{ift}}{w_{i0t}})) + \theta\sum\gamma_{cn}C_{ict}N_{knt} - \theta\beta_{g}G_{int}^{k} + \theta\mu_{i} + \theta(\delta_{kt} - \partial_{kt}) - \theta\varepsilon_{in} - \theta v_{int}^{k} \quad (14)$$

Due to the limited availability of data on factor prices, we follow Chor (2010) and Romalis (2004) to employ the inverse function of relative factor endowment $\frac{V_{ift}}{V_{iot}}$ as proxy for relative factor prices $\frac{w_{ift}}{w_{iot}}$. According to this assumption, if $\frac{V_{ift}}{V_{iot}}$ represents the relative abundance of capital-labor ratio in country *i*, γ_f^k is capital labor ratio (capital intensity) of an industry *k*, positive and significant coefficient supports the Heckscher-Ohlin theorem stating the capital-abundant country has a comparative advantage in producing a capital-intensive intermediate good and exports the good to the capital-scarce country. $\frac{V_{ift}}{V_{iot}}$ can also be the relative abundance of human capital out of the population in country *i*, instead of physical capital abundance. Then γ_f^k can be human capital intensity of an industry *k* testing the alternative effect of Heckscher-Ohlin force. The terms specific to the exporter *i* and importer *j* are reduced to exporter fixed effect and importer fixed effect respectively. The time fixed effect that captures macroeconomic shocks and industry fixed effects are considered. The positive estimate of $\theta\gamma_{cn}$ of an institution's interaction term would provide evidence consistent with the prediction of the model in that countries with higher institutional quality have comparative advantage in institutionally intensive industries.

Measurement of Institutional Variables

We follow Nunn (2007), Rauch (1999) and Chor (2010) to construct the proxy for institutional intensity. Nunn (2007) tested the hypothesis whether countries with better contract enforcement export relatively more in industries with relationship-specific investments. The relationship specificity RS_k at industry *k* is constructed as below:

$$RS_k = \sum_l^k \varphi_l z_l^{rs2}$$

$$z_l^{rs2} = \sum_m s_{lm}\left(R_m^{no} + R_m^{ref\ price}\right) \qquad (11)$$

where R_m^{no} is the share of input *m* for which it is neither reference priced nor sold at organized exchange, $R_m^{ref\ price}$ is the share of input *m* which is not sold on an organized exchange but is reference priced and s_{lm} is the proportion of value of input *m* out of the total value of all inputs used in industry *l*. To aggregate the 4-digit U.S. input-output (IO-87) classification used in Nunn (2007) to the UN BEC 2-digit industry classification used in this paper, we construct RS_k, the weighted average of z_l^{rs2} using φ_l, the share (value) of industry *l* out of the total input value of industries based on Rauch (1999) and Chor (2010). The country level institutional quality in country *i* at time *t* is measured as law and order (Law_{it}), property rights (Pro_{it}), or contract enforcement ($Contract_{it}$). Thus, the interaction term between the

log taken institutional quality in country i and the relationship specificity of an industry k at year t is indicated as $Law_{it} \times RS_{kt}$, $Pro_{it} \times RS_{kt}$, and $Contract_{it} \times RS_{kt}$.

3.1.2. Determinants of Trade in Intermediate Goods vs. Final Goods

To examine the role of determinants on trade in intermediates compared to final goods, we need to test whether the difference in coefficients are statistically significant. We decompose the trade into intermediates and final goods and take the natural logarithm of the ratio between trade value of intermediate goods and that of final goods as dependent variable instead of the level of trade value. Since the ratio of trade in intermediate goods is the inverse of the ratio of trade in final goods, our estimations on the ratio of intermediates trade can account for the relative responsiveness of trade in intermediates and final goods to set of determinants.

3.1.3. The Extensive and Intensive Margins of Trade in Intermediate Goods

Since the share of trade in intermediate goods has many zeros, we further employ the 2- stage Heckman selection estimation method to control for zero trade flows and sample selection bias. Table 1 shows that approximately 41% of exports in intermediate goods and 50% of exports in final goods are zero flows in our industry level data set[2]. Linders and Groot (2006) show that the conventional log-linear gravity model cannot directly account for the occurrence of zero flows between countries. Since we use the log-linearized trade value in table 3 and the ratio of trade value of intermediates in table 4 as the dependent variable, zero values are automatically dropped. These dropped zero flows may be the outcome of the binary decision to export or not and the procedures without considering zero flows may lead to sample selection bias when the zeros in the sample are not random and the probability of trading depends on trade costs. This is a violation of the first OLS assumption, which can lead to biased and inconsistent parameter estimates because the sample selection problem creates bias if the error terms in the selection and outcome equations are correlated. An alternative solution proposed in the literature is to use a Heckman sample selection model. While other methods treat zero flows as nonexistent, Heckman considers them unobserved. The problem associated with the zeros in trade data can be cured

[2] Using aggregate trade data, Helpman et al. (2008) also reported that approximately half of the bilateral trade matrix is filled with zeros.

with a two stage Heckman sample selection model[3]. Since our interest lies in the relative importance of the determinants of trade in intermediates vis-à-vis trade in final goods, we examine the effects on the ratio of intermediates trade value over the final goods trade value. The first step probit model of Heckman selection procedure to explore the extensive margins of the ratio of the intermediates trade on the binomial decision variable takes 1 if the ratio of trade in intermediate goods over the trade value of final goods is positive and zero otherwise. The second stage model for intensive margins take the ratio of trade in intermediate goods as dependent variable of the outcome equation.

3.2. Data

The data source of bilateral trade is the United Nations Broad Economic Categories (UN BEC) database. Our data consist of 172 countries and 17 industries spanning a 10-year period (2000-2009). The same dataset is used to construct the intermediate input trade ((Lanz (2010), Türkcan (2005), Choi (2005), Choi and Han (2008), Gamberoni et. al. (2010), European Commission (2010)). For industry-country pair analyses, these works utilize the International Standard Industrial Classification (ISIC), Standard International Trade Classification (SITC), Harmonized Commodity Description and Coding System (HS) and BEC code. In this paper we employ the 4-digit ISIC Rev. 3 (except services sectors), 6-digit HS 1992 and BEC code. The harmonizing code is obtained from the World Integrated Trade Solution (WITS). See Appendix 1 and 2 for details regarding how we construct the data.

To capture the institutional quality of host countries, we use annual data from the International Country Risk Guide and Freedom House, which reports the quality of various institutions. We first select law and order because it is one of the most relevant variables for economic performances reported in the literature (Rigobon and Rodrik, 2005). The score on the law and order variable provides an assessment of the strength of the legal system and observance of the law. The score is measured on a scale ranging from 0 to a bounded random number 6. We use the normalized components as a proxy for the institutional quality[4]. A score of zero indicates the presence of institutions of very low quality and a maximum score denotes the presence of institutions of very high quality for any given country. The data on property rights is from Freedom House. Other institutional data such as the number of contract procedures (indicated as *Contract*) are collected from the World Development Indicator (WDI). For

[3] In the survey paper, Gomez-Herrera showed the Heckman, truncated OLS and panel random effect model are closest to the real distribution and perform better than Tobit and OLS estimation with modified dependent variable (OLS(1+x)).

[4] We normalized each component by dividing the difference between the value and the minimum value by the difference between the maximum value and minimum value.

simplicity and consistency in interpretation of the role of institutions with property rights and law and order, where the large size of the variables imply higher institutional quality, we take the negative sign of the natural log of the number of contract procedures because the greater the number of contract procedures, the lower the institutional quality. The fixed entry costs is measured as the number of procedures and the number of days to start a business in exporting and importing countries and are collected from the WDI.

The tariff data is from the United Nations Conference on Trade and Development Trade Analysis and Information Systems (UNCTAD TRAINS). We use the weighted average of applied Most Favored Nation Treatment (MFN) tariff for each industry within a country over time. Transport costs are computed as cost, insurance and freight (CIF) transport costs divided by FOB transport costs. CIF and FOB transportation costs are collected from the UN Commodity Trade Statistics (COMTRADE) database. The sets of geographical variables such as physical distance, colonial ties, common language and common borders are from Centre d'Etudes Prospectives et d'Informations Internationales (CEPII). We use the greatest circle distance between capital cities of countries for distance. The country level capital stock measured as gross fixed capital formation is from the World Bank World Development Indicator (WDI). The RTA dummies are from the World Trade Organization (WTO) RTA database. Industry level capital stock (tangible fixed capital) and the number of employees of the exporting country[5] at the industry level is based on the United Nations Industrial Development Organization Industrial Commodity Statistical Database (UNIDO INDSTAT). Data on non-production worker and secondary enrollment ratio are from NBER-CES database and World Development Indicator respectively. The summary statistics for each variable is reported in Table 1.

Insert [Table 1] Here

Our analysis focuses on the interaction between country level institutional quality and industry level relationship specificity in determining the trade patterns because whether the institutions as a source of comparative advantage in trade in intermediate goods as well as final goods are important is unknown. Figure1 shows the relationship between the country level institutional quality and the weighted average of relationship specificity of industries in each country. The institutional quality is measured as the law and order. The relationship specificity is weighed by the share of intermediate goods exported from

[5] The industry level capital and number of employees were country-industry specific in our data, meaning the capital intensity differs across countries and industries considering the heterogeneous industry characteristics across countries. This is in contrast to Chor (2010) in which U.S. capital intensity was used to measure industry characteristics of all countries in the data set. However, we used the U.S. contract intensity to measure contract intensity due to limited data availability on sales of intermediate inputs in organized exchange.

each industry out of the total exported from the reporter country within each year. This index is averaged over the time span. The fitted line of the scatter plot shows the positive correlations between the institutional quality and the relationship specificity for a given country.

Insert [Figure 1] Here

The additional control variables are the conventional Heckscher-Ohlin source of comparative advantage, the physical capital endowment and human capital endowment. The physical capital endowment is measured as the gross fixed capital formation per employee while the human capital endowment is measured as the secondary enrolment ratio. To detect the Heckscher-Ohlin forces, both physical and human capital endowment ratios at country level are multiplied by physical capital intensity and human capital intensity at industry level respectively. Physical capital intensity is measured as the log of fixed capital formation per employee at industry level. Human capital intensity is measured as the log of the ratio of non-production labor to total employment. For empirical analysis, raw variables for property rights, law and order, number of contract procedures, physical capital per employment and human capital per employment are mean-centered to avoid potential multicollinearity. Table 2 shows the average industry attributes including relationship specificity and physical capital intensity. The petroleum products industry is the least relationship-specific industry while the auto industry is the most relationship-specific. In contrast, the petroleum product is the most capital intensive while the miscellaneous products use capital the least.

Insert [Table 2] Here

4. Empirical Results

4.1. The Determinants of Trade in Intermediate Goods: Truncated OLS

The baseline model is estimated using the truncated OLS regression method. Since zero trade flows are dropped by taking the natural log of trade, truncated OLS estimates show the effects of the determinants on the positive values of trade volume upon trade occurring between trading partners.

Table 3 shows the results of the estimating equation (10) under various specifications from truncated OLS models. Columns (1), (3), and (5) show estimates of the determinants of trade in intermediate goods while columns (2), (4), and (6) present values for trade in final goods. All regressions include fixed effects of industries, years, exporting and importing countries. All six columns show robust standard errors clustered by exporter-importer pair.

Insert [Table 3] Here

Institutional Quality

The columns (1) through (6) support the hypotheses on the role of institutional quality as a source of comparative advantage. The interaction term between the measure of law and order of the exporting country collected from ICRG and relationship specificity at the industry level derived from Nunn (2007) shows the positive effects on trade volume. This indicates that a country in which a law is well observed tends to specialize in producing goods which intensively use relationship-specific inputs which are dependent upon contract enforcement. This confirms the results from Nunn (2007), Levchenko (2007) and Chor (2010). As an alternative country measure of law and order, property rights, collected from Freedom House is interacted with industry measures of relationship specificity. We also obtain a positive and highly significant coefficient on this interaction term. Lastly, the efficiency of making a contract measured as the natural log of the inverse of number of contract procedures has more positive effects on trade in relationship specific industries. This confirms that a country with high quality of rule of law, property rights and good quality of contract environment tends to export more intermediate goods with high intensity of relationship-specificity. The effect of institutional quality as a source of comparative advantage in exporting institutional intensive goods are greater for trade in intermediate goods than final goods. The coefficients of the interaction terms in intermediate goods trade in columns (1), (3) and (5) are larger than those in final goods trade presented in columns (2), (4) and (6) and these differences were statistically significant.

Industry Level Trade Costs

Table 3 also shows the estimation results when the natural log of the weighted tariff and transportation costs between trading partners, are used as proxies for trade costs. The columns (1), (3), and (5) show that the weighted average of tariffs by the share of each industry have negative impact on trade in intermediate goods. However, from the results reported in columns (2), (4), and (6), the effects of tariff on trade in final goods are statistically insignificant. Thus, the negative impact of tariff is stronger and more significant on intermediate goods trade than on final goods trade. The transport cost is measured as CIF divided by FOB. The natural log of transportation cost is negatively associated with trade in both intermediate and final goods and the effects are larger for trade in intermediates.

Geography

The estimates of log of distance across columns (1) through (6) show that the distance between trading partners has a negative and highly significant effect on trade in intermediate inputs, confirming the

importance of proximity as a determinant of trade patterns. The magnitudes of the coefficients on the effect of distance on trade in intermediate goods are approximately 1.6, which is slightly larger than trade in final goods (1.4). The gravity variables have positive effects on trade in both intermediate and final goods. The colonial tie between exporter and importer in the past has a positive impact on trade and all coefficients are statistically significant. Additionally, when trading partners used the same language, the volume of trade increased more. The sharing of common borders also has a positive effect on trade in intermediate and final goods. Trade integration through regional trade agreement contributed to both types of trade.

Factor Endowments

When examining the effects of interaction between the country-level abundance of the capital-labor ratio and industry-level capital intensity, a positive effect on trade in both intermediate and final goods is observed. The coefficient of the interaction between the human capital endowment and human capital intensity is also significantly positive. This result demonstrates the validity of Heckscher-Ohlin theorem; a country with more capital per worker tends to export more in capital intensive industries. The magnitude of the effect of physical capital is slightly larger for trade in final goods than intermediate goods while the effect of human capital is stronger in intermediate goods trade.

Insert [Table 4] Here

4.2. The Determinants of Trade in Intermediate Goods vs. Final Goods

To examine the relative importance of the trade in intermediates to final good trade, we use the ratio of trade in intermediate goods to final goods in natural logarithm as dependent variable. Table 4 reports OLS estimation results with this ratio of trade in intermediates. It shows that the coefficients of interaction term between institutional quality and relationship specificity are consistently positive and statistically significant across model specifications. This implies that a country with high quality of rule of law, property rights and good quality of contract environment tends to export higher share of intermediate goods with high intensity of relationship-specificity than final goods. The magnitudes of coefficients are much larger than that of other determinants of share of trade in intermediates. This result shows that the size of the positive effect of institutional quality on trade in intermediate goods is significantly larger than that on final goods trade as reported in Table 3. Column (1) through (3) in Table 4 also show that the trade share of intermediates is significant and negatively related with both tariff

and transport cost. This result confirms the result in Table 3 in that the effect of tariff is insignificant and the impact of transport cost is smaller in final goods trade compared to intermediates trade. The size of the effect of distance on trade in intermediate goods is statistically larger than that on trade in final goods. All other geographical factors, except colonial tie, show the significant and negative linkage with the ratio of trade in intermediate goods. This is also in line with the result in Table 3, where the positive coefficients of RTA, common language and sharing border on trade in intermediates are less than those on final goods. We find a positive coefficient of the interaction term between country-level physical capital abundance and industry-level capital intensity but the statistical significance disappear according to model specification. The human capital abundance seems play more important role than physical capital abundance as a source of comparative advantage in determining share of trade in intermediate goods.

4.3. Extensive and Intensive Margins of Share of Trade in Intermediate Goods

To correct for the selection bias due to possible unobserved firm-level heterogeneity from many zero values of share of trade in intermediate goods, a two-stage sample selection model is estimated as a robustness check. In the first stage, the probit selection equation yields a predicted extensive margin, the probability of export ratio. In the second stage, the log linear equation produces the estimation of the intensive margin, the volume of export ratio between two countries at the industry level. The selection equation includes additional proxy for fixed entry costs as the valid excluded variable in the second stage to control for unobserved heterogeneity. To satisfy this exclusion restriction, this proxy should affect fixed trade costs or export decisions but not variable costs or export volume. Following Helpman et al. (2008) and Yadav (2014), the fixed entry cost, (*Entry cost*) is measured as a binary indicator of 1 if the sum of the number of days and number of procedures to start up a business in both exporting and importing countries is above the median of country pairs during the same time span, and 0 otherwise.

Table 5 shows the maximum likelihood estimation of Heckman's selection for the share of intermediate trade over the total trade. Columns (1a), (2a) and (3a) show the selection equations according to the model specification for the share of intermediate goods trade and column (1b), (2b) and (3b) report the estimated coefficients and robust standard errors clustered by exporter-importer pairs for the outcome equation. The results of both selection and outcome equations confirm the relatively more significant role of institutional quality as a source of comparative advantage in trade in intermediate goods compared to final goods trade. The country with high quality of rule of law, property

rights and contract environment is more likely to enter host country by exporting and sell more share of intermediate goods with higher intensity in relationship specificity. Both extensive margin from entry decision and intensive margin from outcome are positive and significant. Thus institutional quality may play relatively more important role as reducing fixed cost of starting exporting and raising volume of trade in intermediate goods than final goods. Heckscher-Ohlin forces measured as physical and human capital abundance also have positive effects on the share of trade in intermediate goods. Trade costs and distance between exporter and importer have negative extensive and intensive margins and the magnitude of these effects. For RTA, common language and sharing the same border has positive impact on selection, but switch to negative effects once the intermediate good is exported. The inverse Mills ratios computed to produce the consistent estimation of the first step equation of all six specifications are statistically significant and positive. The fixed entry cost of bilateral trade, which is included only in the selection equation, is negatively associated with the extensive margin of trade flows although the effect is not significant. Potentially, part of the effects of entry costs already captured in the import country fixed effects may have caused this result.

Insert [Table 5] Here

4.4 The Determinants of Trade in Intermediates and Final Goods by Region

The determinants of trade in intermediate goods may differ by importing region. [Table 6] to [Table 8] report the results of the gravity model by seven different importing regions. [Table 6] shows that law and order is the source of comparative advantage in producing relationship specific intermediate goods in all seven regions. In contrast, according to [Table 7], the role of institutional quality is positive and significant only when firms export final goods to Middle East and North Africa, Sub-Saharan Africa and North America. These regions, except North America are those with lower quality of institutions compared with the rest of the world. This implies that better quality of law and order of exporting countries is particularly important in producing institution-intensive final goods when they are destined to countries with weak law enforcement while it is consistently important in producing relationship specific intermediates in all regions. In [Table 8], we estimate the relative importance of institutional quality as a source of comparative advantage in producing intermediate goods vis-vis final goods by host region. It is shown that institutions matter more in determining trade in intermediates than final goods and this gap is significant when goods are exported to Europe, Central Asia, Middle East, Africa, East Asia and Pacific. This effect is reversed (institutions matter more in determining exports of final goods rather than intermediate goods) when goods are exported to North America and there is no

statistically different role of institutions as source of comparative advantage producing between intermediates and final goods destined to Latin America, Caribbean and South Asia. In sum, institutional quality can be an important source of comparative advantage in producing intermediate goods regardless of importing region, while it can play different role in producing final goods depending on destination region. Thus, we again confirm the empirical result showing that the effects of high quality of institutions on trade is stronger for intermediate goods than final goods and this effect is pronounced in most regions except South Asia and Americas

5. Conclusion

In this study we assess the importance of institutional quality and trade costs as determinants of trade in intermediate goods. Based on the model of comparative advantage in a gravity framework, our simple model of intermediate goods hypothesizes the impacts of institutions and a set of geographical characteristics on trade. The main empirical test using bilateral trade flows confirms the presence of positive impact of institutions and inhibiting role of trade costs in determining patterns of trade. From the estimation results on the ratio of intermediate goods trade to final goods trade to compare the relative importance of the determinants between trade components, we further find that these effects are greater in intermediate goods trade in most regions. This implies that a country with higher institutional quality has a comparative advantage in producing institutionally intensive goods and trade costs measured as both trade policy and transport cost are negatively associated with trade. Forethemore, intermediate goods trade vis-à-vis final goods trade is relatively more sensitive to institutions and trade costs. Thus, previous findings on the role of comparative advantage and geography on aggregate trade volume may be more driven by trade in intermediate goods.

Existing theories do not explain why the trade in intermediate goods compared to final goods are more responsive to institutional quality. However, we can conjecture that given the thicker input market of downstream firm than upstream firm, the hold-up problem of underinvestment in the production of intermediates can incur higher costs for the upstream firm than the downstream firm. This may lead to larger sensitivity of trade in intermediate goods producers rather than final goods producers to the sources of comparative advantage and geography. Further studies may be necessary to understand the mechanisms through which these effects are stronger in intermediate goods trade.

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[Table 1] Summary statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
lnExport_intermediates	1235764	12.363	3.671	0	25.229
lnExport_final	1039672	11.648	3.601	0	24.530
Export_intermediates dummy	2093056	0.590	0.492	0	1
Export_final dummy	2093056	0.497	0.500	0	1
lnDistance	2081482	8.527	0.908	0.632	9.899
lnwtariff	1076424	1.894	1.136	-4.605	5.762
lntcost	1730110	0.184	1.537	-16.200	16.207
Colony	2081482	0.081	0.272	0	1
Language	2081482	0.160	0.366	0	1
Border	2062875	0.034	0.180	0	1
RTA	2093056	0.225	0.418	0	1
lnCapital_endowment	1900937	7.859	1.569	2.431	10.886
lnHuman capital_endowment	1728959	4.373	0.459	1.8	5.079
Property rights	1951933	0.574	0.270	0	1
Law and order	1679076	0.690	0.219	0.083	1
Contract procedure	1408965	35.968	6.264	21	55
lnCapital_intensity	2093056	9.599	0.762	8.300	11.772
lnHuman capital_intensity	2093056	4.661	0.673	3.476	6.921
Relationship specificity	2093056	0.532	0.217	0.036	0.874

Note: Units of values are millions of US dollars.

[Table 2] Industry characteristics

Industry	Percentage share	Relationship specificity	Capital intensity
Fabricated metals	6.45	0.423	8933.8
Machinery equipment	6.99	0.717	10458.8
Textiles and apparel	7.26	0.505	4942.3
Electronic products	7.15	0.810	27853.2
Rubber and plastics	6.61	0.407	12554.6
Timber and wooden products	5.98	0.484	9581.0
Food, beverages and tobacco	7.17	0.373	12656.7
Autos and trailers	5.79	0.874	21915.2
Paper products and publishing	6.42	0.457	11420.3
Chemical products	7.16	0.332	37084.5
Petroleum products	3.73	0.036	129514.3
Basic non-ferrous metals	5.23	0.203	41465.8
Non-metallic products	5.85	0.476	19729.4
Medical appliances, precision and optical instruments	5.96	0.799	9344.4
Ships	2.19	0.794	18988.0
Miscellaneous transportation equipment	4.21	0.867	19016.5
Miscellaneous products	5.85	0.548	4023.9

Note: Relationship specificity is measured as the weighted average of the share of input for which it is neither reference priced nor sold at organized exchange and the share of input for which it is not sold at organized exchange but reference priced. Capital intensity is the natural log of fixed capital formation per employee.

[Table 3] The determinants of trade in intermediate goods and final goods: Truncated OLS

Dependent variable	(1) *Intermediate*	(2) *Final*	(3) *Intermediate*	(4) *Final*	(5) *Intermediate*	(6) *Final*
Trade cost						
Tariff	-0.0734***	-0.001	-0.0757***	-0.002	-0.064***	0.006
	(0.0104)	(0.009)	(0.009)	(0.009)	(0.0107)	(0.010)
Transport cost	-0.225***	-0.183***	-0.215***	-0.181***	-0.217***	-0.175***
	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)
Geography						
Distance	-1.607***	-1.412***	-1.630***	-1.418***	-1.631***	-1.420***
	(0.0299)	(0.0283)	(0.0294)	(0.0278)	(0.0318)	(0.0301)
RTA	0.436***	0.516***	0.442***	0.528***	0.515***	0.561***
	(0.0440)	(0.0434)	(0.0424)	(0.0423)	(0.0454)	(0.0452)
Colony	0.910***	0.833***	0.988***	0.903***	0.999***	0.870***
	(0.0968)	(0.0898)	(0.0966)	(0.0906)	(0.0998)	(0.0946)
Language	0.598***	0.857***	0.613***	0.879***	0.672***	0.918***
	(0.0546)	(0.0539)	(0.0544)	(0.0534)	(0.0569)	(0.0562)
Border	0.487***	0.628***	0.442***	0.583***	0.449***	0.605***
	(0.118)	(0.115)	(0.115)	(0.112)	(0.128)	(0.124)
Heckscher-Ohlin						
$(K/L)_i \times (K/L)_k$	0.013***	0.037***	0.024***	0.038***	0.014***	0.054***
	(0.0033)	(0.0035)	(0.003)	(0.0033)	(0.0042)	(0.0045)
$(H/L)_i \times (H/L)_k$	1.868***	1.800***	1.691***	1.678***	2.226***	1.856***
	(0.082)	(0.087)	(0.079)	(0.082)	(0.099)	(0.096)
Institutions						
$Law \times RS$	4.091***	0.08				
	(0.153)	(0.155)				
$Pro \times RS$			4.336***	0.396***		
			(0.128)	(0.146)		
$Contract \times RS$					5.077***	1.589***
					(0.250)	(0.330)
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Exporter FE	Yes	Yes	Yes	Yes	Yes	Yes
Importer FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	405,573	336,773	467,669	390,176	341,814	287,380
R-squared	0.546	0.561	0.556	0.566	0.556	0.571

Note: The dependent variable *Intermediate* (*Final*) represents export value of intermediate goods (final goods) in industry *k* from country *i* to country *n* in year *t*. OLS estimation method was employed conditional on observing a positive trade flow. Robust standard errors clustered by exporter-importer pair are in parentheses. . ***, ** and * indicate statistical significance at 1%, 5% and 10%, respectively. Institutional quality indices are normalized and mean-centered to avoid multicollinearity in interaction term.

[Table 4] The determinants of the ratio of trade in intermediate goods: Truncated OLS

VARIABLES	(1) *Ratio*	(2) *Ratio*	(3) *Ratio*
Trade cost			
Tariff	-0.0847***	-0.0855***	-0.0814***
	(0.0120)	(0.0114)	(0.0126)
Transport cost	-0.0271**	-0.0205**	-0.0347***
	(0.0107)	(0.0102)	(0.0112)
Geography			
Distance	-0.157***	-0.165***	-0.154***
	(0.0169)	(0.0165)	(0.0178)
RTA	-0.0766***	-0.0749***	-0.0412
	(0.0264)	(0.0249)	(0.0272)
Colony	0.135**	0.157***	0.145***
	(0.0555)	(0.0551)	(0.0554)
Language	-0.228***	-0.248***	-0.243***
	(0.0290)	(0.0288)	(0.0299)
Border	-0.153***	-0.129***	-0.137**
	(0.0502)	(0.0497)	(0.0535)
Heckscher-Ohlin			
$(K/L)_i \times (K/L)_k$	0.00715**	0.00872***	0.00604
	(0.00354)	(0.00313)	(0.00436)
$(H/L)_i \times (H/L)_k$	0.196*	0.269**	0.459***
	(0.116)	(0.112)	(0.140)
Insitutions			
$Law \times RS$	2.713***		
	(0.180)		
$Pro \times RS$		2.272***	
		(0.165)	
$Contract \times RS$			1.847***
			(0.388)
Industry FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Exporter FE	Yes	Yes	Yes
Importer FE	Yes	Yes	Yes
Observations	275,789	319,694	236,328
R-squared	0.302	0.305	0.310

Note: The dependent variable *Ratio* is the natural logarithm of the ratio of export value of intermediate goods to final goods export value in industry *k* from country *i* to country *n* in year *t*. Truncated OLS estimation method was employed conditional on observing a positive trade flow. Robust standard errors clustered by exporter-importer pair are in parentheses. . ***, ** and * indicate statistical significance at 1%, 5% and 10%, respectively.

[Table 5] The determinants of share of trade in intermediate goods: Heckman Selection Model

VARIABLES	(1a) Selection $\widetilde{Ratio}$	(1b) Outcome *Ratio*	(2a) Selection $\widetilde{Ratio}$	(2b) Outcome *Ratio*	(3a) Selection $\widetilde{Ratio}$	(3b) Outcome *Ratio*
Trade Cost						
Tariff	-0.0225***	-0.066***	-0.019***	-0.067***	-0.019***	-0.067***
	(0.00389)	(0.006)	(0.0035)	(0.0054)	(0.003)	(0.005)
Transport cost	-0.0626***	-0.040***	-0.0619***	-0.038***	-0.061***	-0.037***
	(0.002)	(0.0049)	(0.0018)	(0.0045)	(0.0017)	(0.0044)
Geography						
Distance	-0.782***	-0.305***	-0.783***	-0.296***	-0.772***	-0.291***
	(0.0059)	(0.0098)	(0.0054)	(0.0089)	(0.0053)	(0.0089)
RTA	0.169***	-0.0148	0.200***	-0.0164	0.200***	-0.0079
	(0.009)	(0.013)	(0.0082)	(0.0124)	(0.008)	(0.012)
Colony	0.492***	0.275***	0.488***	0.277***	0.481***	0.273***
	(0.0145)	(0.0267)	(0.013)	(0.0247)	(0.0129)	(0.0241)
Language	0.377***	-0.048***	0.377***	-0.055***	0.377***	-0.057***
	(0.0101)	(0.0156)	(0.00921)	(0.0143)	(0.00906)	(0.0142)
Border	0.348***	-0.106***	0.327***	-0.075***	0.317***	-0.073***
	(0.0242)	(0.0273)	(0.0212)	(0.0247)	(0.0206)	(0.0246)
Heckscher-Ohlin						
$(K/L)_i \times (K/L)_k$	0.038***	0.0213***	0.0337***	0.0174***	0.0311***	0.0086***
	(0.00168)	(0.00289)	(0.0014)	(0.00244)	(0.00138)	(0.0023)
$(H/L)_i \times (H/L)_k$	0.817***	0.345***	0.771***	0.372***	0.806***	0.556***
	(0.0249)	(0.0536)	(0.023)	(0.0503)	(0.0223)	(0.049)
Institutions						
$Law \times RS$	0.942***	2.276***				
	(0.0569)	(0.0948)				
$Pro \times RS$			1.097***	2.165***		
			(0.0452)	(0.0683)		
$Contract \times RS$					1.400***	1.566***
					(0.0714)	(0.114)
Entry cost	-0.0049		-0.0048		-0.0055	
	(0.00838)		(0.00758)		(0.00746)	
Selection						
Inverse Mill's Ratio	0.634***		0.608***		0.594***	
	(0.0260)		(0.0234)		(0.0233)	
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Exporter FE	Yes	Yes	Yes	Yes	Yes	Yes
Importer FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	382,054	266,664	459,277	319,927	469,975	323,442

Note: Dependent variable $\widetilde{Ratio}$ in the first stage of the Heckman procedure is 1 if the ratio of intermediates trade to final goods trade is positive and 0 otherwise. The dependent variable *Ratio* in the second stage is the positive values of the ratio of trade in intermediate goods including the inverse Mills ratio from the first stage. The entry cost was excluded at the second stage estimation. ***, ** and * indicate statistical significance at 1%, 5% and 10%, respectively. Robust standard errors clustered by exporter-importer pair are in parentheses.

[Table 6] The determinants of trade in intermediate goods by importing region

Variables	(1) Latin America & Caribbean	(2) Europe & Central Asia	(3) Middle East & North Africa	(4) East Asia & Pacific	(5) Sub-Saharan Africa	(6) South Asia	(7) North America
Trade Cost							
Tariff	-0.0772***	-0.0211	-0.0363	-0.17***	0.0238	-0.22***	-0.11***
	(0.0234)	(0.0183)	(0.0348)	(0.0420)	(0.0665)	(0.065)	(0.021)
Transport Cost	-0.215***	-0.328***	-0.229***	-0.173***	-0.227***	-0.108***	-0.145***
	(0.0389)	(0.0296)	(0.0173)	(0.0387)	(0.0605)	(0.0401)	(0.0184)
Geography							
Distance	-0.970***	-1.732***	-1.773***	-1.046***	-4.74***	-0.646	-1.443***
	(0.102)	(0.0843)	(0.135)	(0.0800)	(0.732)	(0.397)	(0.107)
RTA	0.633***	0.503***	0.367***	0.0537	0.316**	0.632**	0.747***
	(0.0849)	(0.0859)	(0.0720)	(0.0789)	(0.122)	(0.255)	(0.105)
Colony	0.503**	1.590***	0.0627	0.666***		-1.189*	0.304*
	(0.214)	(0.201)	(0.180)	(0.149)		(0.681)	(0.155)
Language	0.434***	-0.0617	0.600***	0.438**	0.351**	-0.340	0.790***
	(0.111)	(0.296)	(0.0934)	(0.192)	(0.136)	(0.295)	(0.114)
Border	0.595*	0.916***	0.236	0.207	0.265	-0.515	0.575**
	(0.332)	(0.153)	(0.207)	(0.284)	(0.161)	(0.486)	(0.287)
Heckscher-Ohlin							
$(K/L)_i \times (K/L)_k$	0.0180**	0.0525***	0.00903	0.0107	0.0348**	0.00477	0.0206**
	(0.00870)	(0.00729)	(0.00655)	(0.00927)	(0.0138)	(0.0155)	(0.00809)
$(H/L)_i \times (H/L)_k$	0.272***	-0.0819	0.210***	0.384***	0.179	0.417***	0.517***
	(0.0678)	(0.0641)	(0.0568)	(0.0736)	(0.110)	(0.126)	(0.0560)
Institutions							
$Law \times RS$	4.745***	3.382***	4.534***	4.427***	3.319***	5.221***	5.115***
	(0.398)	(0.430)	(0.285)	(0.402)	(0.744)	(0.658)	(0.320)
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Exporter FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	65,510	69,225	103,003	55,637	19,758	17,150	75,290
R-squared	0.629	0.597	0.524	0.521	0.708	0.560	0.444

Notes: OLS estimation method was employed conditional on observing a positive trade flow. Robust standard errors clustered by exporter-importer pair are in parentheses. . ***, ** and * indicate statistical significance at 1%, 5% and 10%, respectively. Institutional quality index is normalized and mean-centered to avoid multicollinearity in interaction term. The estimate of the impact of colonial tie is dropped for Sub-saharan Africa. It may be due to the fact many of this region has colonial histories that colonial tie has no role in shaping the trade pattern in intermediate goods.

[Table 7] The determinants of trade in final goods by importing region

	(1) Latin America & Caribbean	(2) Europe & Central Asia	(3) Middle East & North Africa	(4) East Asia & Pacific	(5) Sub-Saharan Africa	(6) South Asia	(7) North America
Trade Cost							
Tariff	0.0584***	-0.061***	0.08**	-0.0793**	0.0376	-0.222***	-0.089***
	(0.0220)	(0.0169)	(0.0374)	(0.0377)	(0.0654)	(0.0547)	(0.0234)
Transport cost	-0.163***	-0.209***	-0.212***	-0.126***	-0.0989*	-0.176***	-0.136***
	(0.0355)	(0.0275)	(0.0187)	(0.0284)	(0.0502)	(0.0479)	(0.0203)
Geography							
Distance	-1.140***	-1.508***	-1.397***	-0.807***	-6.274***	-0.440	-1.142***
	(0.105)	(0.0761)	(0.106)	(0.0667)	(0.659)	(0.434)	(0.102)
RTA	0.464***	0.567***	0.451***	0.0224	0.142	0.107	0.799***
	(0.0902)	(0.0834)	(0.0685)	(0.0745)	(0.126)	(0.288)	(0.105)
Colony	0.709***	1.686***	0.0989	0.417***		-0.616	0.127
	(0.167)	(0.207)	(0.156)	(0.141)		(0.667)	(0.130)
Language	0.471***	0.278	0.901***	0.321*	0.596***	-0.285	0.930***
	(0.116)	(0.301)	(0.0964)	(0.168)	(0.139)	(0.306)	(0.121)
Border	0.458	0.913***	0.339	0.183	0.502***	-0.0543	0.867***
	(0.327)	(0.153)	(0.208)	(0.263)	(0.148)	(0.567)	(0.239)
Heckscher-Ohlin							
$(K/L)_i \times (K/L)_k$	0.0487***	0.0797***	0.0389***	0.0177*	0.0567***	0.00871	0.0290***
	(0.00922)	(0.00733)	(0.00733)	(0.00965)	(0.0136)	(0.0172)	(0.00775)
$(H/L)_i \times (H/L)_k$	0.510***	0.242***	0.357***	0.623***	0.430***	0.449***	0.233***
	(0.0676)	(0.0649)	(0.0490)	(0.0679)	(0.146)	(0.134)	(0.0486)
Institutions							
$Law \times RS$	0.0506	-0.559*	0.902***	-1.146***	1.356*	0.921	1.321***
	(0.352)	(0.299)	(0.310)	(0.370)	(0.748)	(0.601)	(0.297)
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Exporter FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	53,658	60,816	83,837	46,059	17,685	12,617	62,101
R-squared	0.647	0.614	0.522	0.580	0.725	0.538	0.486

Notes: OLS estimation method was employed conditional on observing a positive trade flow. Robust standard errors clustered by exporter-importer pair are in parentheses. . ***, ** and * indicate statistical significance at 1%, 5% and 10%, respectively. Institutional quality index is normalized and mean-centered to avoid multicollinearity in interaction term.

[Table 8] The determinants of the ratio of trade in intermediate goods by importing region

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Variables	Latin America & Caribbean	Europe & Central Asia	Middle East & North Africa	East Asia & Pacific	Sub-Saharan Africa	South Asia	North America
Trade Cost							
Tariff	-0.15***	-0.043***	-0.147***	-0.088*	-0.091**	-0.135**	-0.120**
	(0.0251)	(0.0161)	(0.0521)	(0.0479)	(0.0428)	(0.0525)	(0.0530)
Transport cost	-0.075***	-0.0275	-0.0003	-0.09***	-0.021	-0.15***	0.0157
	(0.0275)	(0.0180)	(0.0355)	(0.0307)	(0.0750)	(0.0550)	(0.0299)
Geography							
Distance	-0.0668	-0.160***	0.0409	-0.0713	1.01***	-0.418	-0.217
	(0.0728)	(0.0592)	(0.0637)	(0.0715)	(0.347)	(0.301)	(0.135)
RTA	-0.0447	-0.154***	0.496***	0.110	-0.0655	0.255	0.206
	(0.0573)	(0.0477)	(0.0963)	(0.129)	(0.0803)	(0.185)	(0.161)
Colony	0.288***	0.172	-0.108	0.516***		-3.591**	0.0678
	(0.102)	(0.112)	(0.386)	(0.117)		(1.694)	(0.174)
Language	0.159*	-0.176***	-0.240	0.275*	-0.509***	-0.00137	-0.51***
	(0.0862)	(0.0428)	(0.249)	(0.143)	(0.173)	(0.369)	(0.171)
Border	-0.244*	0.109	0.164	0.247	0.191**	-0.392*	-0.0375
	(0.128)	(0.0842)	(0.138)	(0.172)	(0.0912)	(0.209)	(0.192)
Heckscher-Ohlin							
$(K/L)_i \times (K/L)_k$	0.014***	-0.030***	-0.038***	0.02***	-0.11***	0.13***	0.06***
	(0.00280)	(0.00274)	(0.00643)	(0.0054)	(0.0187)	(0.0189)	(0.0073)
$(H/L)_i \times (H/L)_k$	-0.195**	-0.539***	-0.912***	-0.195	-0.458***	-0.69***	0.34***
	(0.0769)	(0.0468)	(0.112)	(0.120)	(0.112)	(0.101)	(0.0986)
Institutions							
$Law \times RS$	-0.373	3.458***	2.136***	2.300***	5.865***	1.154	-2.71***
	(0.276)	(0.196)	(0.374)	(0.817)	(0.407)	(0.995)	(0.654)
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Exporter FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	49,517	144,357	29,354	16,650	12,900	11,076	11,935
R-squared	0.286	0.342	0.211	0.302	0.536	0.387	0.281

Notes: The dependent variable is the natural logarithm of the ratio of export value of intermediate goods to final goods export value in industry *k* from country *i* to country *n* in year *t*. Truncated OLS estimation method was employed conditional on observing a positive trade flow. Robust standard errors clustered by exporter-importer pair are in parentheses. . ***, ** and * indicate statistical significance at 1%, 5% and 10%, respectively.

Appendix 1. Industry classification

	ISIC Rev.3	Code	This paper
151	Production, processing and preservation of meat, fish, fruit, vegetables, oils and fats	03	Food, beverages and tobacco
152	Manufacture of dairy products		
153	Manufacture of grain mill products, starches and starch products and prepared animal feeds		
154	Manufacture of other food products		
155	Manufacture of beverages		
16	Manufacture of tobacco products		
17	Manufacture of textiles	04	Textiles and apparel
18	Manufacture of wearing apparel; dressing and dyeing of fur		
1911	Tanning and dressing of leather		
1912	Manufacture of luggage, handbags and similar items, saddlery and harness		
192	Manufacture of footwear		
201	Sawmilling and planning of wood	05	Timber and wooden products
202	Manufacture of products of wood, cork, straw and plaiting materials		
361	Manufacture of furniture		
21	Manufacture of paper and paper products	06	Paper products and publishing
22	Publishing, printing and reproduction of recorded media		
231	Manufacture of coke oven products	07	Chemical products
233	Processing of nuclear fuel		
241	Manufacture of basic chemicals		
242	Manufacture of other chemical products		
243	Manufacture of man-made fibers		
232	Manufacture of refined petroleum products	08	Petroleum products
2511	Manufacture of rubber tires and tubes; retreading and rebuilding of rubber tires	09	Rubber and plastics
2519	Manufacture of other rubber products		
252	Manufacture of plastics products		
261	Manufacture of glass and glass products	10	Non-metallic products
2691	Manufacture of non-structural non-refractory ceramic ware		
2692	Manufacture of refractory ceramic products		
2693	Manufacture of structural non-refractory clay and ceramic products		
2694	Manufacture of cement, lime and plaster		
2695	Manufacture of articles of concrete, cement and plaster		
2696	Cutting, shaping and finishing of stone		
2699	Manufacture of other non-metallic mineral products n.e.c.		
271	Manufacture of basic iron and steel	11	Basic non-ferrous metals
272	Manufacture of basic precious and non-ferrous metals		
273	Casting of metals		

28	Manufacture of fabricated metal products, except machinery and equipment	12	Fabricated metals
2911	Manufacture of engines and turbines, except aircraft, vehicle and cycle engines	13	Machinery equipment
2912	Manufacture of pumps, compressors, taps and valves		
2913	Manufacture of bearings, gears, gearing and driving elements		
2914	Manufacture of ovens, furnaces and furnace burners		
2915	Manufacture of lifting and handling equipment		
2919	Manufacture of other general purpose machinery		
292	Manufacture of special purpose machinery		
293	Manufacture of domestic appliances n.e.c.		
30	Manufacture of office, accounting and computing machinery	14	Electronic products
31	Manufacture of electrical machinery and apparatus n.e.c.		
32	Manufacture of radio, television and communication equipment and apparatus		
34	Manufacture of motor vehicles, trailers and semi-trailers	15	Autos and trailers
351	Manufacture of ships and boats	16	Ships and boats
352	Manufacture of railway and tramway locomotives and rolling stock	17	Miscellaneous transportation equipment
353	Manufacture of aircraft and spacecraft		
359	Manufacture of transport equipment n.e.c.		
33	Manufacture of medical, precision and optical instruments, watches and clocks	18	Medical appliances, precision and optical instruments
369	Manufacturing n.e.c.	19	Miscellaneous products

The majority of world trade data are classified by SITC or HS code. However, since these classifications are at the product level rather than industry level, we harmonized the 4-digit ISIC Rev.3 and 6- digit HS 1992 classification to convert them to 17 industries, which is similar to 2-digit ISIC Rev.3. To construct intermediate input trade data from the BEC code, we used the methodology suggested by Miroudot et al. (2009) and reclassified the data into parts and components, processed goods, capital and consumption goods. Intermediate inputs are the sum of parts and components and processed goods (See Appendix 2).

Appendix 2. Industry reclassification

BEC	Industry	Miroudot	This paper
111	Food and beverages mainly for industries	Intermediate	Processed
112	Food and beverages mainly for households	Consumption	Consumption
121	Processed food and beverages mainly for industries	Intermediate	Processed
122	Processed food and beverages mainly for households	Consumption	Consumption
21	Primary industrial supplies	Intermediate	Processed
22	Processed industrial supplies	Intermediate	Processed
31	Primary fuels and lubricants	Intermediate	Processed
321	Motor spirit	Not classified	Processed
322	Other fuels and lubricants	Intermediate	Processed
41	Capital goods except transport equipment	Capital	Capital
42	Capital goods: parts and accessories	Intermediate	Parts and components
51	Passenger motor cars	Not classified	Consumption
521	Industrial transport equipment	Capital	Capital
522	Non-industrial transport equipment	Consumption	Consumption
53	Transport equipment: parts and accessories	Intermediate	Parts and components
61	Consumer goods not elsewhere specified: durables	Consumption	Consumption
62	Consumer goods not elsewhere specified: semi-durables	Consumption	Consumption
63	Consumer goods not elsewhere specified: non-durables	Consumption	Consumption
7	Goods not elsewhere specified	Not classified	Not specified

Appendix 3. List of countries

Anguilla	Dominica	Kiribati	Paraguay
Albania	Denmark	Rep. of Korea	Occ. Palestinian Terr.
Andorra	Dominican Rep.	Kuwait	French Polynesia
United Arab Emirates	Algeria	Lebanon	Qatar
Argentina	Ecuador	Sri Lanka	Romania
Armenia	Egypt	Lesotho	Russian Federation
Antigua and Barbuda	Eritrea	Lithuania	Rwanda
Australia	Spain	Luxembourg	Saudi Arabia
Austria	Estonia	Latvia	Sudan
Azerbaijan	Ethiopia	China, Macao SAR	Senegal
Burundi	Finland	Morocco	Singapore
Belgium	Fiji	Rep. of Moldova	Sierra Leone
Benin	France	Madagascar	El Salvador
Burkina Faso	Gabon	Maldives	Suriname
Bangladesh	United Kingdom	Mexico	Slovakia
Bulgaria	Georgia	TFYR of Macedonia	Slovenia
Bahrain	Ghana	Mali	Sweden
Bahamas	Guinea	Myanmar	Swaziland
Bosnia Herzegovina	Gambia	Montenegro	Seychelles
Belarus	Guinea-Bissau	Mongolia	Syria
Belize	Greece	Mozambique	Turks and Caicos Isds
Bolivia	Grenada	Mauritania	Togo
Brazil	Greenland	Montserrat	Thailand
Barbados	Guatemala	Mauritius	Turkmenistan
Brunei Darussalam	Guyana	Malawi	Timor-Leste
Bhutan	Hong Kong	Malaysia	Tonga
Botswana	Honduras	Namibia	Trinidad and Tobago
Central African Rep.	Croatia	New Caledonia	Tunisia
Canada	Hungary	Niger	Turkey
Switzerland	Indonesia	Nigeria	Tuvalu
Chile	India	Nicaragua	Tanzania
China	Ireland	Netherlands	Uganda
Cote d'Ivoire	Iran	Norway	Ukraine
Cameroon	Iceland	Nepal	Uruguay
Colombia	Israel	New Zealand	USA
Comoros	Italy	Oman	Venezuela
Cape Verde	Jamaica	Pakistan	Viet Nam
Costa Rica	Jordan	Panama	Vanuatu
Cuba	Japan	Peru	Samoa
Cyprus	Kazakhstan	Philippines	Yemen
Czech Rep.	Kenya	Papua New Guinea	South Africa
Germany	Kyrgyzstan	Poland	Zambia
Djibouti	Cambodia	Portugal	Zimbabwe