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TRADE FACILITATION AND THE EXTENSIVE MARGIN OF EXPORTS

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This paper examines the link between trade facilitation and export variety for a broad cross-section of countries. We measure trade facilitation using port efficiency. We also include the bilateral import tariff and OECD membership and regional trade agreements. We find that port efficiency contributes significantly to the extensive margin of exports, and that the bilateral import tariff negatively impacts the variety of exports. The positive effect is confirmed when examining trade between countries without common land borders, or between OECD member countries and non-OECD countries. Results are not as strong when we look at within-OECD trade, or focus on bilateral trade in the intensive margin.
JEL Classification Numbers: F13, F14.

1. Introduction

Recent literature in international trade has emphasized the *extensive margin*, by which we mean the variety that a country exports and imports. When a country imports more varieties, its consumers gain, as has been shown empirically for the USA by Broda and Weinstein (2006). However, as a country exports more product varieties, its producers also gain, as shown by Feenstra and Kee (2008). This gain arises due to improved productivity in a model with heterogeneous firms (see Melitz, 2003). When a country faces improved market opportunities abroad, the high-productivity firms will begin to export. The entry of those firms will drive up factor prices in the sector and force out lower-productivity domestic firms. Hence, improved market opportunities abroad are associated with greater product variety of exports and higher overall productivity in a sector.

This linkage between export variety and productivity raises the potential for welfare-enhancing government policies via *trade facilitation*. Within this broad category of policies we include actions that allow for enhanced exports, through, for example, infrastructure development, foreign marketing opportunities and institutions.[1] The logic of the Melitz model is that such actions that facilitate trade will raise export variety and average productivity. There is a rapidly-growing body of literature discussing various actions that promote or facilitate trade flow across countries. Recent research by Limao and Venables (2000) shows that a 10% decrease in transport cost raises trade volume by more than 20%. The reduction in transport costs could be due to improvement in infrastructure: for example, improvement in ocean port facilities. Clark *et al*. (2004) analyse the effect of port efficiency on bilateral trade flows and show that improving port efficiency does reduce shipping costs considerably. Finally, a series of World Bank working papers empirically explores the trade-facilitating impact of standards (Chen *et al*., 2008), road network quality

[1] In the WTO, trade facilitation is defined as “the simplification and harmonization of international trade procedures” covering the “activities, practices and formalities involved in collecting, presenting, communicating and processing data required for the movement of goods in international trade”.

(Shepherd and Wilson, 2006), and other factors such as port efficiency, custom regimes, regulatory policy and technology (Wilson *et al*., 2005; Soloaga *et al*., 2006).

Most current works focus on the effect of trade facilitation on trade flows, instead of on the extensive margin or export variety. One exception is Kehoe and Ruhl (2004), who show that trade liberalization such as the North American Free Trade Agreement drives growth in the extensive margin, which is an important source of new trade. A closely-related study considers the impact of a currency union. For example, Baldwin and Di Nino (2006) examine the effect of the euro on the extensive margin of trade among European countries. Bergin and Lin (2009) use the NBER-UN world trade data set to study the different effects of exchange rate regimes on the extensive and intensive margins. Furthermore, research emphasizing the export diversification of developing countries naturally relates itself to studies of the export variety and its determinants. For example, Dennis and Shepherd (2007) and Amurgo-Pacheco and Pierola (2008) both focus on patterns of trade diversification in developing countries. In short, there is increasing attention being paid to the cross-border trade in varieties, instead of to trade volume.

In this paper, we examine the link between trade facilitation and export variety for a broad cross-section of countries over 13 years (1991–2003). We measure trade facilitation using the data on the *efficiency of ports*, from Blonigen and Wilson (2008). The extensive margin of exports is constructed as in Hummels and Klenow (2005), but allowing both cross-sectional and time-series variations. We also include other variables that can impact trade in our specification; notably, the trade restrictiveness index due to Kee *et al*. (2009), as well as institutional variables such as regional trade agreements (RTA).

This paper first adopts the Feenstra (1994) method to develop a panel of bilateral export variety measures, as discussed in Section 2. This method has been developed by Hummels and Klenow (2005) for a cross-section sample, where export variety is named the "extensive margin" of exports. Following Feenstra and Kee (2008), we define the export variety (or extensive margin of exports) of country h to country j as the worldwide average export over all years to country j in those categories where country h actually exports to j, relative to the worldwide average export to j over all years in all categories. Using this method, our measure of export variety is consistent both across countries and over time, as discussed in Section 3.

We then adopt a conventional empirical method, the gravity regression, to estimate how the export variety between two countries is influenced by, for example, ocean port efficiency, bilateral trade tariffs, international institutions, such as the OECD, and regional trade agreements. It is important to single out export variety for empirical investigation and to understand the role and the determinants of the extensive margins of trade. Using a conventional gravity equation with total trade flows as the dependent variable, although armed with the micro-foundation provided in Anderson and van Wincoop (2003), might be misleading because the extensive margin and the intensive margin might correspond differently to trade costs and trade facilitation factors. As revealed in Bernard *et al*. (2007), the extensive margins of trade are central to understand the effect of trade costs on trade flows. In fact, following a method proposed in Eaton *et al*. (2004), Bernard *et al*. (2007) decompose export flow into three components: the number of firms exporting to a destination, the number of products exported to that destination and average exports per product per firm. Separately regressing each component on the usual gravity variables such as distance and income, they find that it is the first two items (the extensive margin) that explain the dampening effect of distance, while the average export value (the intensive margin) is increasing in distance. This is in sharp contrast to the conventional belief that distance or trade cost reduces aggregate and average trade flow (assuming that all firms export), and this also motivates our investigation in the present paper into the different effects of port efficiency on the extensive and intensive margins. Finally, a few papers attempt to explain the theoretical reason why the extensive margin and the intensive margin adjust differently with respect to trade costs. One example is Bergin and Lin (2009). They construct a stochastic general equilibrium model, assuming sticky prices and fixed costs of entry, to explain the different effect of exchange rate uncertainty on the extensive margin (firm number) and the intensive margin (average value).

Section 4 summarizes our data and Section 5 presents the estimation. In our benchmark regression we find that bilateral port efficiency has a significant and positive impact on export variety (i.e. the extensive margin). The impact on export volume (i.e. the intensive margin) is positive, but not significant. A 10% improvement in the bilateral port efficiency increases export variety by 1.5 to 3.4%, while it only increases the intensive margin of exports by 0.2 to 1.0%. Port efficiency appears to matter much more for the extensive margin than for the intensive margin.

Similarly, for trade barriers, we look at the simple average of bilateral import tariffs. Not surprisingly, tariffs appear to discourage expansion in export variety, but they have an insignificant impact on the intensive margin. Furthermore, sharing the same language seems to promote trade at both the extensive and intensive margins. RTA and sharing common land borders both promote export volume, while the former discourages export of variety. Interestingly, being an OECD member for importing countries is shown to promote the range of export variety tremendously, while exporting countries' OECD membership does not have a significant effect on export variety.

To further explore the impact of trade facilitation on export variety, we divide the sample into five subgroups; namely, trade among OECD countries, trade between member country and non-member country, and trade among non-OECD countries, and, finally, trade between countries without common land borders. The results are not as strong when we use only the OECD countries, or focus on the intensive margin rather than variety, but continue to hold when at least one trading nation is not an OECD member, or when we exclude countries with contiguous borders with each other. Section 6 concludes.

2. Measuring new varieties in international trade

Feenstra (1994) shows how to construct an exact import price index that accounts for both newly-created import varieties over time and taste or quality changes in existing varieties. This exact price index can be derived from a non-symmetric constant elasticity of substitution (CES) utility function. Consider home country h importing from many countries, each of which exports many types of commodities. For simplicity, we aggregate these goods into a single sector, but the extension to multiple sectors will be immediate.[2] For each period t, let the set of goods consumed in country h be denoted by $I_t^h \subset \{1, 2, 3, \ldots.\}$. Then the quantity vector of each type of good consumed in country h in period t is denoted by $q_t^h > 0$. The representative consumer's preferences are characterized by a non-symmetric CES utility function, which is:

[2] See, for example, Broda and Weinstein (2006), for an aggregate exact price index derived from a composite CES function incorporating many sectors and many countries.

$$U_t^h = U(q_t^h, I_t^h) = \left[\sum_{i \in I_t^h} a_{it} (q_{it}^h)^{(\sigma-1)/\sigma}\right]^{\sigma/(\sigma-1)}, \quad \sigma > 1, \tag{1}$$

where σ denotes the elasticity of substitution among all varieties, which is assumed to exceed unity; $a_{it} > 0$ denotes a parameter measuring taste (or quality) for good i, which is allowed to vary over time; and I_t^h denotes the set of goods available in period t, at prices $p_{it}^h > 0$.

By duality, the minimum unit-cost function is also a CES form:

$$c(p_t^h, I_t^h) = \left[\sum_{i \in I_t^h} b_{it} (p_{it}^h)^{1-\sigma}\right]^{1/(1-\sigma)}, \quad \sigma > 1, \quad b_{it} \equiv a_{it}^{\sigma}. \tag{2}$$

The CES unit-cost function specified above changes with evolving variety set I_t^h; therefore, it cannot be evaluated without knowledge of the taste (or quality) parameter b_{it}. However, a result from index number theory is that the ratio of cost functions can be evaluated using data on prices and qualities in the two periods or two countries. Our interest is in the ratio $\frac{c(p_t^h, I_t^h)}{c(p_{t-1}^h, I_{t-1}^h)}$, which can be measured as follows:

2.1 Proposition (Feenstra, 1994)

Assume that $b_{it-1} = b_{it}$ for $i \in I^h \subseteq I_{t-1}^h \cap I_t^h \neq \varnothing$, and that the quantities are cost-minimizing. Then, for $\sigma > 1$:

$$\frac{c(p_t^h, I^h)}{c(p_{t-1}^h, I^h)} = P_{SV}(p_t^h, p_{t-1}^h, q_t^h, q_{t-1}^h, I^h) \left(\frac{\lambda_t(I^h)}{\lambda_{t-1}(I^h)}\right)^{1/(\sigma-1)}, \tag{3}$$

where $P_{SV}(p_t^h, p_{t-1}^h, q_t^h, q_{t-1}^h, I^h) = \prod_{i \in I^h} \left(\frac{p_{it}^h}{p_{it-1}^h}\right)^{\omega_i(I^h)}$ is the price index due to Sato (1976) and Vartia (1976), constructed as a geometric mean of the price ratios with the weights $\omega_i(I^h)$, which are constructed from the expenditure shares as in Equations (4) and (5),

$$s_{it}(I^h) = \frac{p_{it}^h q_{it}^h}{\sum_{i \in I^h} p_{it}^h q_{it}^h} \tag{4}$$

$$\omega_i(I^h) \equiv \left(\frac{s_{it}(I^h) - s_{it-1}(I^h)}{\ln s_{it}(I^h) - \ln s_{it-1}(I^h)}\right) \Big/ \sum_{i \in I^h} \left(\frac{s_{it}(I^h) - s_{it-1}(I^h)}{\ln s_{it}(I^h) - \ln s_{it-1}(I^h)}\right). \tag{5}$$

The values $\lambda_t(I^h)$ and $\lambda_{t-1}(I^h)$ are constructed as:

$$\lambda_\tau(I^h) = \left(\frac{\sum_{i \in I^h} p_{i\tau}^h q_{i\tau}^h}{\sum_{i \in I_\tau^h} p_{i\tau}^h q_{i\tau}^h}\right) = 1 - \left(\frac{\sum_{i \in I_\tau^h, i \notin I^h} p_{i\tau} q_{i\tau}}{\sum_{i \in I_\tau^h} p_{i\tau} q_{i\tau}}\right), \quad \tau = t-1, t. \tag{6}$$

This theorem states that the exact price index with variety change is equal to the Sato–Vartia P_{SV}, multiplied by a term of $[\lambda_t(I^h)/\lambda_{t-1}(I^h)]^{1/(\sigma-1)}$, which captures the creation and destruction of varieties over time.

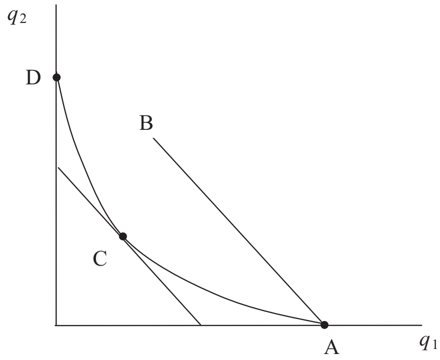

FIGURE 1. Gains from consumer variety

Notice that each of the terms $\lambda_\tau(I^h) \leq 1$ can be interpreted as the period τ expenditure on the varieties in the overlapping set I^h, relative to the period τ total expenditure. Alternatively, this can be interpreted as one minus the period τ expenditure on "new" varieties (not in the set I^h), relative to the period τ total expenditure. When there is a greater number of new varieties in period t, or, more precisely, when the new varieties take greater share of expenditure than disappearing varieties, the value of $\lambda_t(I^h)$ will be lower than $\gamma_{t-1}(I^h)$. Then the exact price index will be lower relative to the "conventional" price index, which does not take into account the change in varieties. Thus, $\lambda_t(I^h)$ provides an inverse measure of new varieties in period t.

The term $[\lambda_t(I^h)/\lambda_{t-1}(I^h)]^{1/(\sigma-1)}$ measures the decrease in unit cost (or price index) due to expansion of the range of varieties. Figure 1 illustrates the gains from adding a new variety. We consider a two-good case: when only one product (q_1) is available (at A), the minimum cost of achieving the utility level U (represented by the indifference curve ACD) is the budget line AB. With the introduction of a second product (q_2), the minimum expenditure of getting the same utility is the budget line tangent to the indifferent curve through C. This downward shift of the budget line shows consumers' gain from product variety. While Figure 1 focuses on the consumer impact from new varieties, there is an analogous argument on the benefits from output variety for producers, which we turn to next.

3. Measurement of output or export variety

Now we turn to the case of measuring output variety. Consider a world economy with many $h = 1, \ldots, H$ countries, each of which produce many types of goods. For simplicity in this section we aggregate these goods into a single sector, but the extension to multiple sectors will be immediate. For each period t, let the set of goods produced in country h be denoted by $I_t^h \subset \{1, 2, 3, \ldots.\}$. Then the quantity vector of each type of good produced in country c in period t is denoted by $q_t^h > 0$. The aggregate output of each country h, $Q_t^h = f(q_t^h, I_t^h)$, is in the same form as in Equation (1). However, the elasticity of substitution between *outputs* is $\sigma < 0$. Note that Q_t^h could be interpreted as a scalar measure of resources needed to produce those outputs, $q_t^h > 0$. We assume that total output obtained from the economy is constrained by the transformation curve:

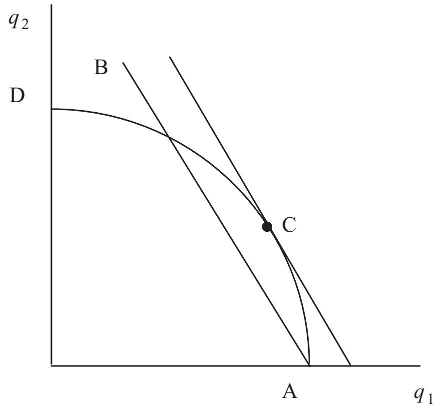

FIGURE 2. Gains from output variety

$$F[f(q_t^h, I_t^h), V_t^h] = 0, \tag{7}$$

where $V_t^h = (v_{1t}^h, v_{2t}^h, \dots, v_{Mt}^h) > 0$ is the endowment vector for country h in year t.

Because for *outputs*, we suppose that $\sigma < 0$ in Equation (1), which means that the set of feasible output varieties, q_{it}^h, in any country will lie along a strictly concave transformation curve defined by Equation (7). This is shown in Figure 2, where we draw the transformation frontier between two product varieties, q_{1t} and q_{2t}, within a country. For a given transformation curve, and given prices, an increase in the number of output varieties will raise revenue. For example, if only output variety 1 is available, then the economy would be producing at the corner A, with output revenue shown by the line AB. Then if variety 2 becomes available, the new equilibrium will be at point C, with an *increase* in revenue: it is clear to see that the revenue line shifts out. This illustrates the benefits of output variety.

Figure 2 considers maximizing the value of output obtained in each industry. Under the assumption of perfect competition, the value of output obtained in each country will be $P_t^h Q_t^h$, where P_t^h is a CES index of the prices of all output varieties produced in the country:

$$P_t^h \equiv c(p_t^h, I_t^h) = \left(\sum\nolimits_{i \in I_t^h} b_i (p_{it}^h)^{1-\sigma}\right)^{1/(1-\sigma)}, \quad b_i = a_i^\sigma > 0, \quad h = 1, \dots, H, \tag{8}$$

where $p_t^h > 0$ is the domestic price vector for each country.

The right-hand side of Equation (8) is a CES cost function, so, again, the exact price index theorem developed in Feenstra (1994) applies here. In particular, the ratio of the output price indices over two countries, a and b, equals the product of the Sato–Vartia price index of goods that are common, $I_t \equiv (I_t^a \cap I_t^b) \neq \varnothing$, multiplied by terms reflecting the revenue share of "unique" goods:

$$\frac{P_t^a}{P_t^b} = \prod_{i \in I} \left(\frac{p_{it}^a}{p_{it}^b}\right)^{\omega_i(I_t)} \left(\frac{\lambda_t^a(I_t)}{\lambda_t^b(I_t)}\right)^{1/(\sigma-1)}, \quad a, b = 1, \dots, H, \tag{9}$$

where the weights $\omega_i(I_t)$ are constructed from the revenue shares in the two countries:

$$\omega_i(I_t) \equiv \left(\frac{s_{it}^a(I_t) - s_{it}^b(I_t)}{\ln s_{it}^a(I_t) - \ln s_{it}^b(I_t)} \right) \Big/ \sum_{i \in I_t} \left(\frac{s_{it}^a(I_t) - s_{it}^b(I_t)}{\ln s_{it}^a(I_t) - \ln s_{it}^b(I_t)} \right) \tag{10}$$

$$s_{it}^h(I_t) \equiv p_{it}^h q_{it}^h \Big/ \sum\nolimits_{\in I} p_{it}^h q_{it}^h, \quad \text{for } h = a, b \tag{11}$$

$$\lambda_t^h(I_t) = \frac{\sum_{i \in I} p_{it}^h q_{it}^h}{\sum_{i \in I_t^h} p_{it}^h q_{it}^h} = 1 - \frac{\sum_{i \in I_t^h, i \notin I} p_{it}^h q_{it}^h}{\sum_{i \in I_t^h} p_{it}^h q_{it}^h}, \quad \text{for } h = a, b. \tag{12}$$

Notice that the output shares in Equation (11), for each country, are measured relative to the *common* set of goods I_t. Then, the weights in Equation (10) are the *logarithmic mean* of the shares $s_{it}^a(I_t)$ and $s_{it}^b(I_t)$, and sum to unity over the set of goods $i \in I_t$.[3]

To interpret Equation (12), notice that $\lambda_t^h(I_t) \leq 1$ due to the differing summations in the numerator and denominator. This term will be strictly less than one if there are goods in the set I_t^h that are *not found* in the common set I_t. In other words, if country *a* is selling some goods in period *t* that are *not sold* by country b, this will make $\lambda_t^a(I_t) < 1$. Then we could use $\lambda_t^a(I_t)/\lambda_t^b(I_t)$ as an inverse measure of country *a*'s export variety, relative to country *b*. Having more export variety in *a* (i.e. having lower $\lambda_t^a(I_t)/\lambda_t^b(I_t)$) leads to a higher price index for *a* (because $\sigma < 0$), reflecting an increase in *a*'s revenue.

For cross-section comparison of $\lambda_t^a(I_t)/\lambda_t^b(I_t)$, we could choose the *worldwide exports* to all destinations as a consistent "comparison country". Let $I_t^w = \bigcup_h I_t^h$ be the complete set of varieties exported by the world in year *t*, and let $p_{it}^w q_{it}^w$ be the total value of imports for good *i*. Then, comparing country *h* to the world in year *t*, it is obvious that the common set is the goods exported by *h*; i.e. $I_t \equiv I_t^h \cap I_t^w = I_t^h;\ h = a, b$. Therefore, $\lambda_t^h(I_t^h) = 1;\ h = a, b$, and a direct measure of country *h*'s export variety (recall $\sigma < 0$) is:

$$\lambda_t^w(I_t^h) = \frac{\sum_{i \in I_t^h} p_{it}^w q_{it}^w}{\sum_{i \in I_t^w} p_{it}^w q_{it}^w}, \quad h = a, b. \tag{13}$$

The system of Equations (9)–(13) above is exactly a cross-country analogue to the time-series import price index in Feenstra (1994). New varieties lead to a fall in prices (from reservation level on demand) for consumers or importers, but a rise in prices (from reservation level on supply) for producers or exporters. The time-series version of import variety is used by Broda and Weinstein (2006), whereas the cross-section version provides us the theoretical base to the derivation of the "export extensive margin", as defined in Hummels and Klenow (2005). From Equation (13), a country's export variety is measured as the worldwide export in goods exported by the country, relative to the worldwide export in all goods. This is exactly what is used in Hummels and Klenow using their worldwide data!

[3] More precisely, the numerator of Equation (10) is the logarithmic mean of the output shares of the two countries, and lies in-between these shares. The denominator of (10) is introduced so that the weights $\omega_i(I_t)$ sum to unity.

Our main interest is nations' export varieties (or the *extensive margin of exports*). Given the panel property of our data which cover 1988 to 2005 and a large sample of countries, we will adopt the union method developed in Feenstra and Kee (2008). This union method combines cross-section and time-series and provides consistent measures of export variety, and is briefly summarized as follows.

Suppose that the set of exports from country h and w differ, but have some varieties in common. Denote this common set by $I_t \equiv (I_t^h \cap I_t^w) \neq \varnothing$. An *inverse* measure of export variety from h is $\lambda_t^h(I_t)/\lambda_t^w(I_t)$, where

$$\lambda_t^a(I_t) = \frac{\sum_{i \in I} p_{it}^a q_{it}^a}{\sum_{i \in I_t^h} p_{it}^a q_{it}^a} = 1 - \frac{\sum_{i \in I_t^h, i \notin I} p_{it}^a q_{it}^a}{\sum_{i \in I_t^h} p_{it}^a q_{it}^a}, \quad \text{for } a = h, w. \tag{14}$$

We will use the worldwide exports in all year as a comparison: denoting this comparison country by w, so that the set $I^w = \bigcup_{h,t} I_t^h$ is the *total set of traded varieties* over all years, and $\bar{p}_i^w \bar{q}_i^w$ is the *average value of exports* for variety i. That is, we take the union of all products sold in any year, and also average the export sales of each product over years. Then, comparing country h to country w, it is immediate that the common set of goods exported or imported is $I \equiv I_t^h \cap I^w = I_t^h$; therefore, we have that $\lambda_t^h(I_t^h) = 1$, so a direct measure for bilateral export variety is given by:

$$\lambda_t^w(I_t^h) = \frac{\sum_{i \in I_t^h} \bar{p}_i^w \bar{q}_i^w}{\sum_{i \in I^w} \bar{p}_i^w \bar{q}_i^w}. \tag{15}$$

In words, according to Equation (15), the bilateral export variety (or the extensive margin of exports) from h to j is defined as the world's average exports to j in categories that are exported by h to j, relative to the world's average exports to j in all categories. By choosing the world's average exports over all sample years as comparison, our measure of the extensive margin is consistent across nations and over time periods. Then to summarize the bilateral export variety into a multilateral export variety index for each country, we adopt the Sato–Vartia index number method: a geometric mean of bilateral export varieties from the same country to different destinations, with weights defined as the logarithmic mean of the shares of j in the overall exports of h and the world w, which is also normalized so that the weights sum up to unity.

4. Trade facilitation

In this section we turn to our empirical estimation on factors that facilitate trade.

Our main interest is to look at the influence of different factors on trade, and, in particular, on export variety. We first describe our data sources.

4.1 Export data

We draw our trade flow data from *the Commodity and Trade Database* (COMTRADE) database of the United Nations Statistics Division. The data are reported in the Harmonized System (HS) classification code at 6-digit level, which means altogether 5017 HS-6 products, and include shipment values and quantities. The database combines bilateral import data collected by the national statistical agencies of importing countries over all their exporting partners. This is the same data set used in Hummels and Klenow (2005), but our data cover a much longer time period (1988–2005) instead of their single year sample (only 1995).

Note that the HS classification was not widely adopted until the mid-1990s.[4] For example, in our data set there are only 11 countries that reported their imports using the HS classification in 1988. In addition, countries taking an important role in international trade participate in the system only in later years: the USA since 1991, China since 1992, UK and Russia since 1993, and France and Italy since 1994. Although this lack of reporting countries in the early years would not hurt our calculation of *bilateral* extensive margins and related regressions, it would bias our estimation on a comprehensive *multilateral* extensive margin for each country. This is because to calculate a comprehensive multilateral extensive margin, we need to know the importance of each of the country's exporting destinations in world trade and use the relative importance as weights. Hence, we start from 1994 to construct the multilateral export varieties, while using the full set of data to construct a separate measure of bilateral export varieties for our regressions.

4.2 GDP and population

The standard formulation of the gravity model includes variables on country endowments and economic capacity, which play important roles in determining countries' bilateral trade flow. Our empirical specification will be built on such a gravity equation, where we include the total population of the country and the real GDP per capita (in 2000 US$). Those data are taken from the World Development Indicators (World Bank, various years). The data set covers a broad number of countries[5] (228 countries) over a long time period (1960–2006).

4.3 Gravity factors

Besides income level and population, we also need institutional and geographical elements as additional controls. To control cultural and geopolitical factors, we introduce dummies for, for example, common land border, RTA and usage of common language, into our gravity model. Those data are taken from Rose (2004), who constructs a rich data set covering all those variables. Transportation costs are an important factor determining trade volume and trade components; one key factor affecting transportation costs is the distance between trade partners. Rose (2004) also provides data on distance, which measures the Great Circle distance between capital cities of each country. Because this data set ends in 1999, we will update information whenever possible. It is argued in the literature that OECD membership could possibly promote bilateral trade, so we will also use information on countries' OECD membership.

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[4] The year (1995) used in Hummels and Klenow (2005) is good enough because the 59 importers in data represent the vast majority of world imports.

[5] However, Taiwan is not included in the World Development Indicators. In this case, we use data from the Penn World Table instead, which is up to 2004.

4.4 Bilateral import tariff

We draw the tariff data from UNCTAD's Trade Analysis and Information System (TRAINS). The tariff lines between countries are available by 6-digit HS categories. We take simple averages to generate a measure of bilateral import tariffs.[6]

4.5 Port efficiency

Ocean ports are a central and necessary component in facilitating international trade. Blonigen and Wilson (2008) develop a straightforward measure of port efficiency. In their methodology, "port inefficiency" adds additional cost to the total import costs, including port administration and financing costs. They run an ordinary least squares regression, regressing import charges on those observable cost terms, such as distance and freight costs, and then *port inefficiency* is uncovered from a ports fixed-effect indicator. Because this fixed-effect dummy measures the ports' contribution to the import costs, it is inversely correlated with a measure of port efficiency: the lower is this estimate of fixed effects, the more efficient is the port.

Due to limitation of data, Blonigen and Wilson could, at best, provide the estimate on the top 100 foreign ports, over 1991 to 2003. Following Blonigen and Wilson, we use a weighted-average port efficiency index where the weights are each port's share in the imports of the USA. Using one minus the original fixed effect estimate, we obtain a positive measure of port efficiency. By taking the natural log, we are able to measure the elasticity of export variety in response to improvement in port efficiency. One caveat is that their estimation only uses US import data, so it actually only provides the foreign ports' efficiency in their trade with one or more US local ports. In our estimation using countries' exports to the whole world, ideally we want to collect a comprehensive efficiency index uncovering each port's performance to all its destinations. In adopting Blonigen and Wilson's measure, we have to sacrifice some accuracy in several respects: first, that a port's efficiency does not vary with its destination; and, second, that a weighted average of efficiency indices of those ports that are utilized in transporting products to or from the USA is a close approximation of the efficiency summary of all ports in the same country.

5. Estimation results

Our benchmark estimation is based on the following gravity model of bilateral international trade:

$$\begin{aligned}\ln(EV_{ijt}) = {} & \alpha_1 \ln(gdppc_{it}) + \alpha_2 \ln(gdppc_{jt}) + \beta_1 \ln(pop_{it}) + \beta_2 \ln(pop_{jt}) + \gamma\, port_{ijt} \\ & + \kappa Tariff_{ijt} + \phi_1 \ln(dist_{ij}) + \phi_2 comlang_{ij} + \phi_3 border_{ij} + \phi_4 regional_{ijt} \\ & + \phi_5 oecd_{it} + \phi_6 oecd_{jt} + \tau_t + \theta_i + \lambda_j + \varepsilon_{ijt},\end{aligned} \tag{16}$$

where *i* refers to the exporter, *j* denotes the importer and *t* denotes year. The left-hand side dependent variable EV_{ijt} indicates the bilateral extensive margin of exports between the

[6] Conceptually, it is the applied tariffs including preferential tariffs, which is importer-exporter-pair specific. Besides the simple average tariff, we could also use a weighted average of bilateral import tariffs, which leads to very similar results.

TABLE 1
Summary statistics for key variables

Variable	Observations	Mean	Standard deviation	Minimum	Maximum
Port efficiency	17,442	0.514	0.121	−0.266	0.987
L.1 period port efficiency	15,556	0.514	0.119	−0.266	0.805
L.3 period port efficiency	12,294	0.515	0.114	−0.045	0.805
L.5 period port efficiency	9,632	0.518	0.121	−0.148	0.805
Bilateral import tariff	16,954	0.079	0.092	0.000	1.455
Log imp gdp p/c (2000 US$)	17,442	8.614	1.353	5.656	10.525
Log exp gdp p/c (2000 US$)	17,442	8.497	1.392	5.656	10.525
Log imp country population	17,442	17.253	1.846	9.937	20.977
Log exp country population	17,442	17.236	1.799	9.928	20.977
Log distance	17,442	8.463	0.790	4.922	9.853
Common language	17,442	0.183	0.387	0	1
Common border	17,442	0.035	0.183	0	1
Regional trade agreement	17,442	0.036	0.186	0	1
Exporter OECD member	17,442	0.374	0.484	0	1
Importer OECD member	17,442	0.405	0.491	0	1

trade partners i and j, at year t; i.e. the bilateral export variety from country i to country j. As a comparison, we will also use the intensive margin, the bilateral trade flow from i to j relative to the average world export to j in the same categories. As derived in Section 3 (Equation (15) in particular), the bilateral export variety from h to j is defined as the world's average export to j in categories that exported by h to j, at time t, relative to world's average export to j in all categories over all time periods. Accordingly, the intensive margin of exports from h to j is defined as value of exports from h to j, relative to the world's average export to j in all categories that h actually exports.

Among the right-hand side variables of the equation, the two conventional explanatory variables are *gdppc* and *pop*, which are the per capita GDP and population for trade partners in each year, respectively; *port* represents the log of bilateral port efficiency; *Tariff* represents the simple average of bilateral import tariffs; and $dist_{ij}$ represents the distance between nations i and j. We also add a set of binary indicators depending on whether both countries use the same common language (*comlang*), whether they share the same border (*border*), whether they are within a RTA (*regional*) and whether they are OECD members. Finally, we add τ_t as year fixed effect, θ_i as exporter fixed effect and λ_i as importer fixed effect, and ε_{ijt}, the orthogonal error term. Using separate importing and exporting country fixed effects, we are able to capture the "multilateral resistance" terms in Anderson and van Wincoop (2003). As described in Section 4, after combining data from various sources, our final sample for the benchmark regression covers 41 countries, 819 country pairs, and spans from 1991 to 2003. Table 1 gives the summary statistics for all major variables.

Hummels and Klenow (2005), who estimate cross-exporter extensive margins of exports using a sample of single-year observations, show that large countries export more, not only in greater volume but also a wider range. This is also confirmed by our benchmark regression reported in Table 2. Larger/richer countries also tend to import more, both in volume and in variety range. Columns (1) and (4) give the basic specification showing the positive and significant effect of port efficiency on trade in the extensive margin, and positive but insignificant effect on trade in the intensive margin. To control for the possible underestimation of standard errors, we cluster the standard errors by importer–exporter pairs in the benchmark specification and all the following regressions.

TABLE 2
Export variety and trade facilitating factors

	Extensive margin			Intensive margin		
	(1)	(2)	(3)	(4)	(5)	(6)
Port efficiency	0.218**	0.336**	0.154**	0.065	0.103	0.022
	(4.14)	(5.59)	(3.50)	(1.06)	(1.55)	(0.43)
Bilateral import tariff	−1.234**	−2.511**	−1.771**	0.676	−1.342**	0.382
	(2.87)	(7.45)	(3.38)	(1.69)	(3.36)	(0.79)
Log imp gdp p/c (2000 US$)	0.205	−0.13	1.012**	1.222**	0.289*	1.886**
	(1.34)	(1.20)	(6.21)	(7.56)	(2.34)	(10.66)
Log exp gdp p/c (2000 US$)	0.219	0.295**	0.131	0.503**	1.125**	−0.159
	(1.92)	(2.85)	(0.88)	(3.17)	(9.57)	(0.88)
Log imp country population	3.170**	3.454**	−0.386	0.779*	−0.266	0.51
	(9.30)	(11.77)	(0.37)	(2.15)	(0.87)	(0.36)
Log exp country population	2.819**	3.613**	−0.717	−0.735*	0.084	−1.69
	(8.44)	(12.17)	(0.72)	(2.13)	(0.28)	(1.64)
Log of distance	−0.606**		−0.606**	−0.416**		−0.412**
	(15.09)		(15.14)	(11.59)		(11.48)
Common language	0.455**		0.454**	0.262**		0.263**
	(7.27)		(7.25)	(4.42)		(4.45)
Land border dummy	−0.088		−0.087	0.334*		0.335*
	(0.50)		(0.49)	(2.30)		(2.31)
Regional agreement	−0.937**		−0.944**	0.540**		0.554**
	(3.95)		(3.99)	(5.23)		(5.42)
Exporter OECD member	−0.02	0.014	−0.023	0.152*	−0.129	0.072
	(0.36)	(0.25)	(0.33)	(2.00)	(1.70)	(1.05)
Importer OECD member	0.173*	0.146*	0.134*	0.047	0.538**	−0.044
	(2.39)	(2.42)	(2.26)	(0.54)	(6.82)	(0.60)
Year fixed effects	Yes	Yes	No	Yes	Yes	No
Country fixed effects	Yes	No	Yes	Yes	No	Yes
Country pair fixed effects	No	Yes	No	No	Yes	No
Year trend	No	No	Yes	No	No	Yes
Trend * country fixed effects	No	No	Yes	No	No	Yes
Observations	14,686	14,686	14,686	14,686	14,686	14,686
R^2	0.76	0.84	0.77	0.62	0.69	0.63

Notes: Robust *t*-statistics are in parentheses. *Significant at 5%; **Significant at 1%.

The estimated coefficients are in line with our expectations. First, larger countries (in GDP per capita and in population) tend to export more varieties and import more varieties. The only exception is for the exporting country's population, which is negative. Second, having more efficient ocean ports will substantially facilitate trade; this is more pronounced for trade in variety, as in column (1). For the intensive margin of exports, the coefficient is positive but not significant, as in column (4). Furthermore, a bilateral import tariff significantly reduces exports in the extensive margin. In summary, improving ports' efficiency by 10% increases export variety by 2.18%, and increases the intensive margin of exports by 0.65%. A drop of 10% in the average bilateral import tariff leads to an increase in export variety by 12.3%, while the intensive margin of exports decreases by 6.8%. Notice that the intensive margin of exports from i to j is measured as the bilateral exports relative to the world's average exports to the same importing country in the product categories exported from i to j; therefore, a positive coefficient of port efficiency on the intensive margin does not necessarily mean trade costs such as tariffs promote trade volume in absolute values.

Not surprisingly, being more distant from each other significantly reduces trade, in both extensive and intensive margins, while speaking the same language appears to promote trade in both margins. Moreover, if two countries are geographically contiguous, or have regional RTA with each other, they trade more in the intensive margin, rather than in the extensive margin. Interestingly, it seems that the importing country's OECD membership matters more than the exporting country's, especially for the extensive margin of exports. This indicates that, controlling for other factors, OECD countries (i.e. developed countries) demand much more variety than non-OECD countries (i.e. developing countries).

In columns (2) and (5), we add country pair fixed effects, aiming to control for all time-invariant factors (both observed and unobserved) pertaining to the country pair. This treatment makes the identification of the bilateral port efficiency coefficient only depend on time-series variation and takes out all time-invariant features (both observed and unobserved), such as border dummy and distance. Benchmark results are confirmed. Efficient ocean ports help in facilitating export in variety, but have little to do with promoting relative export volume.

TABLE 3
Export variety and trade facilitating factors: Extension

	Extensive margin			Intensive margin		
	(1)	(2)	(3)	(4)	(5)	(6)
Exporter port efficiency	0.003	0.117**	0.015	−0.021	0.003	0.017
	(0.14)	(4.39)	(1.00)	(0.81)	(0.09)	(0.84)
Importer port efficiency	0.096**	0.075*	0.044**	0.073**	0.064	0.004
	(4.43)	(2.55)	(2.73)	(2.95)	(1.63)	(0.24)
Bilateral import tariff	−1.229**	−2.499**	−1.781**	0.673	−1.353**	0.382
	(2.86)	(7.42)	(3.40)	(1.68)	(3.40)	(0.79)
Log imp gdp p/c (2000 US$)	0.21	−0.12	1.063**	1.220**	0.284*	1.889**
	(1.37)	(1.11)	(6.45)	(7.57)	(2.32)	(10.66)
Log exp gdp p/c (2000 US$)	0.217	0.302**	0.16	0.501**	1.125**	−0.16
	(1.89)	(2.91)	(1.08)	(3.17)	(9.58)	(0.90)
Imp country population	3.169**	3.445**	−0.306	0.781*	−0.276	0.508
	(9.29)	(11.70)	(0.29)	(2.16)	(0.91)	(0.36)
Exp country population	2.784**	3.603**	−0.602	−0.753*	0.074	−1.695
	(8.30)	(12.10)	(0.61)	(2.18)	(0.24)	(1.64)
Log of distance	−0.605**		−0.606**	−0.416**		−0.412**
	(15.08)		(15.13)	(11.59)		(11.48)
Common language	0.455**		0.454**	0.262**		0.263**
	(7.28)		(7.25)	(4.42)		(4.45)
Land border dummy	−0.089		−0.087	0.334*		0.335*
	(0.50)		(0.49)	(2.30)		(2.31)
Regional agreement	−0.936**		−0.944**	0.540**		0.554**
	(3.95)		(3.99)	(5.23)		(5.42)
Exporter OECD member	−0.028	0.007	−0.018	0.148	−0.131	0.072
	(0.52)	(0.12)	(0.26)	(1.95)	(1.73)	(1.05)
Importer OECD member	0.171*	0.136*	0.142*	0.053	0.539**	−0.045
	(2.36)	(2.25)	(2.42)	(0.60)	(6.82)	(0.60)
Year fixed effects	Yes	Yes	No	Yes	Yes	No
Country fixed effects	Yes	No	Yes	Yes	No	Yes
Country pair fixed effects	No	Yes	No	No	Yes	No
Year trend	No	No	Yes	No	No	Yes
Trend * country fixed effects	No	No	Yes	No	No	Yes
Observations	14,686	14,686	14,686	14,686	14,686	14,686
R^2	0.76	0.84	0.77	0.62	0.69	0.63

Notes: Robust *t*-statistics are in parentheses. *Significant at 5%; **Significant at 1%.

TABLE 4
Export variety and trade facilitating factors: Within OECD countries

	Extensive margin			Intensive margin		
	(1)	(2)	(3)	(4)	(5)	(6)
Port efficiency	0.013	0.294	0.471*	−0.066	−0.15	−0.272
	(0.34)	(1.84)	(2.60)	(1.23)	(0.66)	(0.80)
Bilateral import tariff	−1.493*	−1.006	−0.995	−0.529	−0.556	−1.458
	(2.20)	(1.33)	(1.24)	(0.53)	(0.44)	(0.99)
Log imp gdp p/c (2000 US$)	0.424*	0.572**	0.484*	2.237**	2.254**	1.974**
	(2.29)	(2.89)	(2.29)	(6.17)	(6.32)	(5.32)
Log exp gdp p/c (2000 US$)	−0.429	−0.328	−0.715*	0.720*	0.583	0.326
	(1.95)	(1.48)	(2.60)	(2.15)	(1.68)	(0.91)
Log imp country population	1.393**	1.672**	1.681**	0.907	1.972	1.76
	(2.85)	(2.85)	(3.24)	(0.98)	(1.82)	(1.42)
Log exp country population	2.439**	2.772**	3.619**	−0.307	0.895	1.308
	(4.45)	(4.49)	(4.71)	(0.42)	(0.95)	(1.08)
Log of distance	−0.260**	−0.252**	−0.246**	−0.842**	−0.831**	−0.825**
	(5.64)	(5.57)	(5.56)	(8.43)	(7.95)	(7.57)
Common language	0.245**	0.254**	0.245**	0.215	0.235	0.238
	(3.95)	(3.97)	(4.22)	(1.54)	(1.45)	(1.55)
Land border dummy	−0.266**	−0.257**	−0.268**	0.212	0.12	0.14
	(2.96)	(2.81)	(3.00)	(1.02)	(0.48)	(0.55)
Regional agreement	−0.201	−0.205	−0.18	−0.107	−0.138	−0.126
	(1.77)	(1.79)	(1.61)	(0.58)	(0.69)	(0.61)
Lagged port efficiency	No	3 period	5 period	No	3 period	5 period
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Country fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	2,220	1,741	1,482	2,220	1,741	1,482
R^2	0.76	0.77	0.77	0.88	0.88	0.88

Notes: Robust *t*-statistics are in parentheses. *Significant at 5%; **Significant at 1%.

One concern with using country fixed effects or country pair fixed effects is that it does not adequately control for time varying "multilateral resistance effects", as pointed out in Anderson and van Wincoop (2003) and Baldwin and Taglioni (2006). To deal with this, in columns (3) and (6) we use a time trend, country fixed effects, as well as the interaction between time trend and country dummies.[7] The results confirm the previous estimations that port efficiency substantially promotes trade in the extensive margin, although to a lower magnitude. A 10% improvement in port efficiency leads to a 1.5% increase in the extensive margin of exports. Furthermore, lowering bilateral import tariffs also significantly promotes the extensive margin of exports.

In Table 3, we further separate the importer port efficiency and the exporter port efficiency.[8] The findings are mostly consistent with those of Table 2. Furthermore, importer port efficiency plays a substantial role in increasing the extensive margin of exports from the source country. The exporter port efficiency also matters but is not precisely estimated, except for the specification with country pair fixed effects. In most cases, both importer and exporter port efficiency do not matter for the intensive margin of exports.

[7] Ideally we should use country-year fixed effects. However, given the limited variation of our sample, using country-year fixed effects generates serious multicollinearity problem.

[8] We thank an anonymous referee for suggesting this estimation.

TABLE 5
Export variety and trade facilitating factors: Importing OECD countries

	Extensive margin			Intensive margin		
	(1)	(2)	(3)	(4)	(5)	(6)
Port efficiency	0.117*	0.404**	0.550**	−0.14	−0.112	−0.367
	(1.96)	(3.16)	(3.10)	(1.67)	(0.54)	(1.33)
Bilateral import tariff	−5.352**	−5.771**	−5.989**	0.969	0.96	0.677
	(5.22)	(5.46)	(5.51)	(0.94)	(0.82)	(0.55)
Log imp gdp p/c (2000 US$)	0.434	0.854*	0.933*	1.269**	1.233**	0.984*
	(1.27)	(2.37)	(2.36)	(3.30)	(2.96)	(2.21)
Log exp gdp p/c (2000 US$)	0.156	0.347*	0.373*	0.617**	0.799**	0.869**
	(1.44)	(2.44)	(2.22)	(3.42)	(3.64)	(3.71)
Log imp country population	3.147**	2.976**	2.770**	1.285	4.085**	4.784**
	(4.82)	(4.11)	(2.74)	(1.65)	(4.16)	(4.01)
Log exp country population	1.289**	1.964**	2.508**	−1.053	−1.5	−1.859*
	(3.20)	(4.04)	(3.68)	(1.68)	(1.96)	(1.98)
Log of distance	−0.512**	−0.467**	−0.456**	−0.294**	−0.267**	−0.255**
	(9.13)	(8.24)	(7.97)	(4.07)	(3.46)	(3.24)
Common language	0.280**	0.257**	0.259**	0.277**	0.288**	0.237*
	(4.65)	(3.89)	(3.84)	(3.16)	(2.96)	(2.44)
Land border dummy	−0.21	0.173	0.185	0.359	−0.106	−0.062
	(0.82)	(0.83)	(0.85)	(0.76)	(0.39)	(0.23)
Regional agreement	−0.413**	−0.471**	−0.478**	0.640**	0.597**	0.568**
	(3.52)	(3.48)	(3.28)	(4.43)	(4.15)	(3.81)
Lagged port efficiency	No	3 period	5 period	No	3 period	5 period
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Country fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	4,195	3,250	2,657	4,195	3,250	2,657
R^2	0.87	0.87	0.87	0.59	0.59	0.6

Notes: Robust *t*-statistics are in parentheses. *Significant at 5%; **Significant at 1%.

Through Tables 4 to 8, we investigate alternative specifications to our benchmark model. We first investigate port efficiency and trade among OECD member countries in Table 4. Then, in Table 5, we investigate a subsample where only the importing country is an OECD member, while the exporting country is not. Table 6 examines the case where only the exporting country is an OECD member while the importing country is not. Finally, in Table 7, we consider the case where none of the trading partners belongs to the OECD. We run three regressions for each subsample. Column (1) redoes the regression as specified in Equation (16) but only a subsample of data is used. Columns (2) and (3) run the same regression, lagging port efficiency by 3 and 5 years, respectively.[9] This is to at least partially control for the potential endogeneity of port efficiency: countries that have large trade transactions with each other are more likely to invest to improve port efficiency. Then columns (4) to (6) repeat the same regression from columns (1) to (3), with the intensive margin of exports as the dependent variable.

It is expected that more trade in varieties will be observed among industrial countries, rather than between North–South country pairs or among South countries. This is because intra-industry trade, which is mainly in differentiated products, is dominant between the industrial nations, who have similar income levels and consumer preference. In columns

[9] Lag by 1 year gives similar results as using current year port efficiency.

TABLE 6
Export variety and trade facilitating factors: Exporting OECD countries

	Extensive margin			Intensive margin		
	(1)	(2)	(3)	(4)	(5)	(6)
Port efficiency	−0.045	0.635**	0.380*	0.220*	−0.041	−0.39
	(0.69)	(2.97)	(2.05)	(2.52)	(0.21)	(1.58)
Bilateral import tariff	0.533*	0.368	0.714*	1.127**	0.687	−0.117
	(1.98)	(1.21)	(2.20)	(3.07)	(1.57)	(0.29)
Log imp gdp p/c (2000 US$)	0.290*	0.619**	0.622**	1.734**	2.467**	2.591**
	(2.30)	(5.05)	(5.33)	(8.39)	(12.71)	(12.56)
Log exp gdp p/c (2000 US$)	−0.114	−0.04	−0.063	0.428	0.146	−0.236
	(0.36)	(0.10)	(0.15)	(0.93)	(0.33)	(0.47)
Log imp country population	2.389**	2.625**	2.745**	3.255**	3.393**	−0.566
	(4.30)	(4.17)	(5.08)	(4.84)	(3.75)	(0.54)
Log exp country population	6.129**	5.274**	2.833**	−2.320*	−0.491	0.872
	(7.75)	(5.19)	(3.95)	(2.14)	(0.40)	(0.71)
Log of distance	−0.529**	−0.465**	−0.433**	−0.764**	−0.762**	−0.780**
	(8.92)	(8.42)	(8.38)	(13.97)	(13.63)	(13.78)
Common language	0.369**	0.378**	0.345**	0.489**	0.498**	0.466**
	(6.35)	(6.27)	(5.93)	(5.72)	(5.32)	(5.03)
Land border dummy	0.279	0.403*	0.325*	0.171	0.148	0.205
	(1.62)	(2.57)	(2.32)	(0.86)	(0.64)	(0.94)
Regional agreement	0.062	0.061	0.053	0.442	0.482*	0.565**
	(0.58)	(0.65)	(0.59)	(1.55)	(1.99)	(2.59)
Lagged port efficiency	No	3 period	5 period	No	3 period	5 period
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Country fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	3,185	2,507	2,081	3,185	2,507	2,081
R^2	0.76	0.77	0.81	0.72	0.75	0.77

Notes: Robust *t*-statistics are in parentheses. *Significant at 5%; **Significant at 1%.

(1) and (4) of Table 4, we redo the regression as specified in Equation (16) but only look at trade among OECD countries. Countries who are OECD members are, on average, larger and richer than non-OECD countries, and trade between two OECD members is expected to be more pronounced in differentiated products and more on the extensive margin. As expected, the importing country's GDP per capita has a more pronounced positive effect than that of the full sample. In contrast, the coefficient of port inefficiency becomes insignificant, probably reflecting the fact that a high level of port efficiency has already been obtained within the OECD. When we are using lagged port efficiency, it regains significance as in column (3).

Table 5 examines the case in which only the importing country is an OECD member. In this case, port efficiency significantly promotes exports in the extensive margin, while bilateral import tariff significantly discourages exports in the extensive margin. Both variables have no significant effects on trade in the intensive margin. In this case, GDP per capita and population of both importing country (OECD member) and exporting country (non-OECD member) become important in determining export variety.

Table 6 is the other side of the coin for Table 5: in this case, the exporting country is an OECD member while the importing country is not. Estimates of port efficiency show the same pattern as in the benchmark regression and Table 5, when we use lagged measures of port efficiency. However, the coefficients on tariffs are controversially positive for both

TABLE 7
Export variety and trade facilitating factors: Non-OECD countries

	Extensive margin			Intensive margin		
	(1)	(2)	(3)	(4)	(5)	(6)
Port efficiency	0.31	0.397*	0.126	0.405	0.558*	0.285
	(1.66)	(1.97)	(0.39)	(1.83)	(2.41)	(0.81)
Bilateral import tariff	−1.283*	−1.278	−2.145*	−0.205	−0.597	−0.031
	(2.34)	(1.87)	(2.49)	(0.31)	(0.74)	(0.03)
Log imp gdp p/c (2000 US$)	0.288	0.869**	1.009**	1.011**	1.163**	1.652**
	(1.11)	(3.04)	(3.03)	(3.58)	(3.40)	(4.47)
Log exp gdp p/c (2000 US$)	0.283	0.403	0.431	0.507	0.732*	0.698*
	(1.27)	(1.55)	(1.51)	(1.76)	(2.35)	(2.10)
Log imp country population	4.593**	4.115**	4.271**	2.220*	1.263	−0.467
	(4.94)	(3.84)	(2.78)	(2.20)	(1.10)	(0.29)
Log exp country population	2.939**	3.181**	2.642	−0.981	−0.764	−0.04
	(3.60)	(3.22)	(1.90)	(1.25)	(0.73)	(0.03)
Log of distance	−0.796**	−0.731**	−0.710**	−0.360**	−0.382**	−0.395**
	(13.25)	(12.29)	(11.82)	(5.51)	(5.43)	(5.42)
Common language	0.338**	0.339**	0.339**	0.241	0.264*	0.279*
	(2.92)	(2.92)	(2.83)	(1.93)	(2.01)	(2.02)
Land border dummy	−0.076	−0.017	−0.007	0.29	0.278	0.283
	(0.48)	(0.10)	(0.04)	(1.48)	(1.38)	(1.41)
Regional agreement	2.163**	2.167**	2.109**	1.246**	1.245**	1.325**
	(6.82)	(6.08)	(5.74)	(5.78)	(5.55)	(5.56)
Lagged port efficiency	No	3 period	5 period	No	3 period	5 period
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Country fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	5,086	4,001	3,198	5,086	4,001	3,198
R^2	0.75	0.76	0.76	0.51	0.54	0.55

Notes: Robust *t*-statistics are in parentheses. *Significant at 5%; **Significant at 1%.

extensive and intensive margins. This reflects that for less developed importing countries, higher tariffs probably make it even harder to import from other less developed countries and, therefore, relatively increases imports from OECD countries in both margins.

Table 7 examines trade between non-OECD country pairs. This time, port efficiency is positive and marginally significant (at the 10% level) in promoting export variety in column (1), while a bilateral import tariff has a negative and significant effect on export variety.

In regressions shown in Tables 2 to 7, trade flows are not distinguished by its transport mode. This potential raises doubt regarding the validity of using the ocean port efficiency measure adopted from Blonigen and Wilson (2008). Due to a lack of detailed data on trade with different transport modes, we instead investigate a special case where no country pairs share any common border, shown in Table 8. Most of the regression estimates are quite similar in magnitude and in economic meaning to the story that Table 2 delivers, and are not discussed in detail.

It is interesting to note that the coefficient estimates for RTA show diverging patterns for estimations with different groups of countries. Namely, for our benchmark regressions (Tables 2 and 3) with all countries, or regressions with OECD importing countries, or regressions with countries that do not share common borders, RTA seem to discourage the export at the extensive margin while increase the export at the intensive margin (the effect

TABLE 8
Export variety and trade facilitating factors: No common border

	Extensive margin			Intensive margin		
	(1)	(2)	(3)	(4)	(5)	(6)
Port efficiency	0.223**	0.420**	0.390**	0.041	0.165	−0.09
	(4.11)	(3.97)	(2.70)	(0.66)	(1.33)	(0.53)
Bilateral import tariff	−1.284**	−1.503**	−2.168**	0.707	0.566	0.433
	(2.95)	(2.76)	(3.23)	(1.69)	(1.18)	(0.72)
Log imp gdp p/c (2000 US$)	0.228	0.639**	0.813**	1.234**	1.770**	1.959**
	(1.46)	(4.00)	(4.67)	(7.38)	(9.18)	(9.73)
Log exp gdp p/c (2000 US$)	0.226	0.316*	0.319*	0.514**	0.733**	0.715**
	(1.91)	(2.20)	(2.02)	(3.19)	(4.14)	(3.80)
Log imp country population	3.188**	2.437**	2.285**	0.597	0.912*	0.161
	(9.15)	(6.16)	(4.22)	(1.61)	(2.00)	(0.28)
Log exp country population	2.818**	2.959**	3.207**	−0.813*	−0.346	0.292
	(8.29)	(7.17)	(5.42)	(2.29)	(0.77)	(0.50)
Log of distance	−0.599**	−0.544**	−0.530**	−0.415**	−0.424**	−0.435**
	(14.88)	(13.90)	(13.84)	(11.39)	(11.05)	(11.23)
Common language	0.445**	0.445**	0.416**	0.286**	0.314**	0.300**
	(7.09)	(7.05)	(6.86)	(4.92)	(5.02)	(4.81)
Regional agreement	−0.865**	−0.754**	−0.725**	0.604**	0.578**	0.587**
	(3.52)	(3.22)	(3.32)	(5.93)	(5.29)	(5.22)
Exporter OECD member	−0.036	−0.105	−30.197**	0.161*	−0.021	−1.915
	(0.65)	(1.05)	(5.35)	(2.08)	(0.22)	(0.35)
Importer OECD member	0.177*	0.082	3.196*	0.042	−0.012	−8.531**
	(2.43)	(1.03)	(2.36)	(0.47)	(0.14)	(5.48)
Lagged port efficiency	No	3 period	5 period	No	3 period	5 period
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Country fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	14,170	11,087	9,082	14,170	11,087	9,082
R^2	0.77	0.78	0.79	0.61	0.63	0.64

Notes: Robust *t*-statistics are in parentheses. *Significant at 5%; **Significant at 1%.

is similar but weaker in significance for country pairs with OECD exporting countries). However, the effects of RTA seem to be small, both econometrically and economically, for OECD country pairs. Yet the RTA matter positively and substantially for both the extensive margin and the intensive margin for non-OECD country pairs. This seems to suggest for non-OECD countries, to facilitate trade, it is very important to have good institutional arrangements, such as regional trade agreements. Because those countries are starting to be integrated into the world trade system, RTA help increase their exports at both margins. In contrast, trade within OECD countries does not depend on RTA, because they are already very integrated with each other. Indeed, the largest RTA within OECD countries is the European Union, which vary little over our sample period.

6. Conclusions

International trade provides an important engine for countries' development and productivity growth. The importance of lowering trade costs and facilitating trade are now increasingly recognized by governments as well as academia. However, questions such as what factors contribute the most to facilitating trade, or what policies should be in countries' priority list to lower trade costs and facilitate trade have not been answered satisfactorily. This project aims to provide some empirical evidence on the impacts of different sources of trade costs on trade, in particular, on the extensive margin of trade.

We construct an empirical gravity regression model to address the impact of ocean port efficiency, trade restrictiveness, international institutions, such as the OECD, and RTA. An improvement in port operating efficiency tends to increase export variety, especially when at least one of the trade partners is not an OECD country. A reduction in bilateral import tariffs also promotes trade in the extensive margin in most cases. Being OECD members seems to promote a range of export variety. While our further specification using smaller sample or changing dependent variable gives weaker results, we believe that port inefficiency and tariffs contribute significantly to trade costs. Removing those trade costs, which also include but are not limit to standardization of various goods classification systems, harmonization of varying standards across nations, larger investment and better technology to reduce information asymmetry, for instance, would constitute a major project of cross-nation cooperation. Among others, international institutions, such as the OECD, and RTA should play important roles in promoting these policies and facilitating trade.

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