NBER WORKING PAPER SERIES

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Working Paper 10353
http://www.nber.org/papers/w10353

NATIONAL BUREAU OF ECONOMIC RESEARCH
1050 Massachusetts Avenue
Cambridge, MA 02138
March 2004

We thank Danielken Molina and Natalia Perez for valuable research assistance, Ronald Fisher and participants at the IADB's seminar, LACEA 2001 and IASE 2003 conference. The views expressed herein are those of the authors and not necessarily those of the National Bureau of Economic Research.

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NBER Working Paper No. 10353
March 2004
JEL No. F1, L41, L92

ABSTRACT

Recent literature has emphasized the importance of transport costs and infrastructure in explaining trade, access to markets, and increases in per capita income. For most Latin American countries, transport costs are a greater barrier to U.S. markets than import tariffs. We investigate the determinants of shipping costs to the U.S. with a large database of more than 300,000 observations per year on shipments of products aggregated at six-digit HS level from different ports around the world. Distance, volumes and product characteristics matter. In addition, we find that ports efficiency is an important determinant of shipping costs. Improving port efficiency from the 25th to the 75th percentile reduces shipping costs by 12 percent. (Bad ports are equivalent to being 60% farther away from markets for the average country.) Inefficient ports also increase handling costs, which are one of the components of shipping costs. Reductions in country inefficiencies associated to transport costs from the 25th to 75th percentiles imply an increase in bilateral trade of around 25 percent. Finally, we try to explain variations in port efficiency and find that they are linked to excessive regulation, the prevalence of organized crime, and the general condition of the country's infrastructure.

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I. Introduction

Since the beginning of modern economics the literature concerning the determination of living standards has been interested in trade.[2] Despite some lingering controversy, empirical studies show a positive relationship between trade and growth. Frankel and Romer (1999) claim that "…trade has a quantitatively large, significant, and robust positive effect on income."[3]

The lack of initial consensus among researchers on the relationship between trade and growth has been mirrored by differences in the actual trade strategies of developing countries. During the 1960s and into the 1970s, many countries adopted import substitution policies to protect their infant industries, though a few economies in East Asia took a different approach. By the 1990s many developing countries, including most of the large ones, had shifted to an outward-oriented strategy and had seen accelerations in their growth rates.[4]

These recent liberalizations have reduced tariff and, in some cases, non-tariff barriers too. For instance, Asia reduced its average tariff rate from 30% at the beginning of the 1980s to 14% by the end of the 1990s, and Latin America reduced its average tariff rate from 31% to 11%.[5] These reductions in artificial trade barriers have implied that the relative importance of transport costs as a determinant of trade has increased.[6] As shown in Figure 1, in 1997 total import freight costs represented 5.25 percent of world imports. This percentage -which may seem low- is mainly driven by developed countries, which represent more than 70 percent of world imports and whose proximity to each other is reflected in a relatively low freight cost (4.2%). When disaggregating these costs by region, they turn out to be substantially higher. Although Latin America appears to have low freight costs relative to the other developing regions (7% compared to 8% for Asia

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[2] Adams Smith (*The Wealth of Nations*, 1776), in his discussion of specialization and the extent of the market stresses the relationship between wealth and trade between nations.

[3] Similarly, Ades and Glaeser (1999) find that openness accelerates growth of backward economies. For a skeptical view of the cross-national evidence, see Rodriguez and Rodrik (1999).

[4] See Dollar and Kraay (2001).

[5] Central America and the Caribbean reduced its average tariff rate from 21% to 9% between these periods, and African countries from 30% to 20%. These average tariff rates correspond to simple averages across countries of their unweighted tariff. If we consider weighted tariffs, the resulting average tariff rates by the end of the 90s should be smaller. (Source: World Bank)

and 11.5% for Africa), the Latin American figure is weighted by Mexico's proximity to its main trading partner, the United States, and consequently low freight costs. When Mexico is excluded, Latin American average freight costs rise to 8.3 percent, more similar to the rest of the developing countries.

As liberalization continues to reduce artificial barriers, the effective rate of protection provided by transport costs is now in many cases higher than the one provided by tariffs. Figure 2 presents a comparison of average tariffs and a measure of transport costs for various countries around the world, and Figure 3 presents an alternative comparison of transport costs to the US and average tariffs faced in the US market by a group of Latin American countries. From Figure 3, it is striking to realize that for some countries, such as Chile and Ecuador, transport costs exceed by more than twenty times the average tariffs they face in the US market. Consequently, any additional effort to integrate a country into the trading system should consider and analyze the effect of transport costs and its determinants.

As a result, some immediate questions arise. How much do these transport costs affect trade and growth? How much of these costs can be affected by government policies? The broad literature that applies the gravity approach to the study of international bilateral trade shows that geographical distance, which is used as proxy for transport costs, is negatively related to trade.[7] In a recent paper, Limao and Venables (2000, henceforth LV) show that raising transport costs by 10 percent reduces trade volumes by more than 20 percent. They also show that poor infrastructure accounts for more than 40% of predicted transport costs. In a different analysis, Radelet and Sachs (1998) show that shipping costs reduce the rate of growth of both manufactured exports and GDP per capita. These authors claim that "... doubling the shipping cost (e.g. from an 8% to 16% CIF band) is associated with slower annual growth of slightly more than-half of one percentage point."

In spite of the relevance of transport costs for trade and growth, there are not many other studies on transport costs. Moreover, these few studies rely on macro level data, which is certainly useful but misses the advantages that micro data can have. An

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[6] See Amjadi and Yeats (1995) and Radelet and Sachs (1998).
[7] An example of this literature is Bergstrand (1985).

exception is a recent study of Fink, Mattoo and Neagu (2000, henceforth FMN), which analyzes the determinants of maritime transport costs in 1998, focusing on the effect of non-competitive public and private policies. They find the latter have a significant effect on transport costs. But, what about other factors influencing transport costs, such as port efficiency? There is a wide consensus on the crucial importance of port activities for the transport services. However, there are no measures of how important are inefficiencies in transport costs within port level. This is one of the objectives of this study. We analyze the effect of port efficiency on transport costs (in addition to other standard variables), and then we explore the factors that lie behind port efficiency.[8]

We find that an increase in a 100 percent in the distance between the export country and the U.S, increases maritime transport costs in around 20 percent. A result that is quite consistent with the existent literature. With respect to port efficiency, we find that improving port efficiency from the 25th to 75th percentiles reduces shipping costs by more than 12%. This result is robust to different definitions of port efficiency as well as different years.

In turn, when looking at the determinants of port efficiency, we find that the level of infrastructure and organized crime exert a significant positive and negative influence respectively. In addition, policy variables reflecting regulations at seaports affect port efficiency in a non-linear way. This result suggests that having *some* level of regulation increases port efficiency, but an *excess* of regulation could start to reverse these gains.

The remainder of this paper is structured as follows. Section II presents a description of factors that may be behind transport costs. Section III describes the econometric model used to quantify the relative importance of these factors affecting transport costs. It also contains a description of the data used as well as the results of our analyses. In Section IV, we analyze how important are infrastructure, regulation and organized crime in explaining port efficiency. In Section V we construct an index of country-specific maritime transport costs that we include in a standard trade gravity model. Section VI concludes.

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[8] Our analysis departs from FMN (2000) by incorporating port efficiency variables and by redefining some variables. In addition, we address the problems of endogeneity and omitted variable bias that their

II. What Factors Explain Maritime Transport Costs?

As shown, transport costs may be an important barrier to trade and could have an important effect on income. But why do some countries have higher transport costs than others? What are the main determinants of these transport costs? Can government policies affect these costs? Following some previous studies,[9] this section addresses these questions, based on a qualitative and quantitative description of transport cost determinants. Given its relative importance (and also the availability of data), the main focus in this paper is on international maritime transport cost.

The nature of services provided by shipping companies forces them to be transnational companies serving more than one country. In general, these companies have access to international capital markets and they are able to hire workers from all over the world[10], although under some restrictions sometimes. In any case, we should not expect differences in capital or labor costs to be the main factors in explaining differences of transport costs across countries. There are many other important specific factors affecting transport costs across countries, which we present next.

The obvious and most studied determinant of transport cost is geography, particularly distance.[11] The greater the distance between two markets, the higher the expected transport cost is. Using shipping company quotes for the cost of transporting a standard container from Baltimore (USA) to selected worldwide destinations, LV(2000) find that an extra 1,000 km raises transport costs by $380 (or 8% for a median shipment). Moreover, breaking the journey into an overland and a sea component, an extra 1,000 km by sea raises costs by only $190 while the same distance by land raises costs by $1,380, 4 and 30 percent of a median shipment, respectively. In addition, if a country is landlocked,

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estimations present, and we also extend backward the period of analysis to 1995.

[9] This section follows McConville (1999) Fuchsluger (1999), Limao and Venables (2000), and Fink, Mattoo and Neagu (2000).

[10] Shipping companies prefer to sail their ships under open-registry flags. This explains that Panama, Liberia, Cyprus and Bahamas account for more than 40 percents of world fleet (measured in dead weight tons -dwt-) –UNCTAD (1998).

[11] It has long been recognized that bilateral trade patterns are well described empirically by the so-called gravity equation, which relates bilateral trade positively to both countries GDP and negatively to the distance (which is used as proxy for transport cost) between them. See Bergstrand (1985).

transport costs rise by $2,170, almost a 50 percent increase in the average cost.[12] In other words, being landlocked is equivalent to being located 10,000 km farther away from markets.

Trade composition additionally helps to explain transport costs differences across countries. First of all, due to the insurance component of transport costs, products with higher unit value have higher charges per unit of weight. On average, insurance fees are around 2 percent of the traded value and they represent around 15 percent of total maritime charges. Therefore, high value added exporting countries should have higher charges per unit weight due to this insurance component. On the other hand, some products require special transport features and therefore have different freight rates. [13]

Directional imbalance in trade between countries implies that many carriers are forced to haul empty containers back. As a result, either imports or exports become more expensive. Fuchsluger (2000) shows that this phenomenon is observed in the bilateral trade between the US and the Caribbean. In 1998, for instance, 72 percent of containers sent from the Caribbean to the US were empty. This excess of supply in the northbound route implied that a US exporter paid 83 percent more than a US importer for the same type of merchandise between Miami and Port of Spain (Trinidad and Tobago).[14] Similar phenomena occur in the Asian-US and the Asian-European trade routes, where excess of supply means that Asian exporters end up paying more than 50% of extra charge in transport costs compared to suppliers in the US and Europe.[15]

Maritime transport is a classic example of an industry that faces increasing returns to scale. Alfred Marshall put it clearly long ago: *"… a ship's carrying power varies as the cube of her dimensions, while the resistance offered by the water increases only a little*

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[12] This result controls by the extra overland distance that must be overcome by landlocked countries to reach the sea.

[13] LSU-National Ports and Waterways Institute (1998) shows that the average freight rates between Central America and Miami for cooled load merchandise is about twice the transport cost for textiles.

[14] The actual freight rates for a 20-feet dry container between Miami and Port of Spain were $1,400 and $750 for the southbound and northbound route, respectively.

[15] Ships going from Asia to the US utilize more than 75 percent of their capacity, while when going back to Asia the utilization does not even attain a 50 percent rate. The rates from Asia to the US and in the opposite direction are $1561/TEU (twenty-feet equivalent unit) and $999/TEU respectively. The capacity utilization of ships from Asia to Europe is 75% and 58% in the opposite direction, while the rates charged by shipping companies are $1353/TEU and $873/TEU respectively. See Review of Maritime Transport 1999.

faster than the square of her dimensions".[16] Besides increasing returns at the vessel level, there are economies of scale at the seaport level. For instance, at the port of Buenos Aires (Argentina) the cost of using the access channel is $70 per container for a 200 TEU[17] vessel but only $14 per container for a 1000 TEU vessel.[18] In general, even though most of these economies of scale are at the vessel level, in practice they are related to the total volume of trade between two regions. Maritime routes with low trade volumes are covered by small vessels and *vice versa*. [19]

In addition, the development of containerized transport has been an important technological change in the transport sector during the last decades. Containers have allowed large cost reductions in cargo handling, increasing cargo transshipment and therefore national and international cabotage.[20] In turn, this increase in cabotage has induced the creation of hub ports that allow countries or regions to take advantage of increasing return to scale.[21]

Commercial routes more liable to competition and less subject to monopoly power will tend to have lower markups. Monopoly powers can be sustained either by government restrictive trade policies or by private anti-competitive practices (cartels). The former includes a variety of cargo reservation schemes, for example the UN Liner Code.[22] Private anti-competitive practices include, among others, the practice of fixing rates of maritime conferences.[23] Some authors have claimed that maritime conferences have lost power in recent years,[24] which has forced shipping companies to merge as a way to hold their monopoly power.[25]

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[16] Quoted by McConville (1999). Additional economies of scale come from both material to build the vessel and labor to operate it (especially that of navigation).
[17] TEU is a standard container measure and it refers to Twenty Feet Equivalent Unit.
[18] See Fuchsluger (2000).
[19] See PIERS, *On Board Review*, Spring 1997.
[20] Cabotage refers to transshipment of the merchandise before it arrives to its final destination.
[21] See Hoffman (2000).
[22] This agreement stipulates that conference trade between two economies can allocate cargo according to the 40:40:20 principle. Forty per cent of tonnage is reserved for the national flag lines of each exporting and importing economy and the remaining 20 per cent is to be allocated to liner ships from a third economy.
[23] Maritime conferences enjoy an exemption from competition rules in major trading countries, like the US and the European Union.
[24] In the last years there have been some reforms in the regulation affecting international shipping. For instance, the United States' Ocean Shipping Reform Act of 1998 eroded the power of conferences, creating greater scope for price competition.
[25] See Fink, Mattoo and Neagu (2000) and Hoffman (2000).

Similar restrictions and anti-competitive practices can induce inefficiencies and/or monopoly power in ports. For example, in many countries workers are required to have special license to be able to provide stevedoring services, and in general these restrictions imply high fees and low productivity.[26]

Finally, the quality of onshore infrastructure is an important determinant of transport costs. LV(2000) find that it accounts for 40 percent of predicted transport costs for coastal countries, and up to 60% for landlocked ones.[27] If a country with a relatively poor infrastructure, say at the 75th percentile in an international ranking, is able to upgrade to the 25th percentile, it will be able to reduce transport costs by between 30 and 50 percent.[28]

III. Maritime Transport Costs Estimation

Focusing on the described factors affecting transport costs, this section attempts to quantify them on maritime transport charges paid by U.S. imports carried by liner companies[29] from countries all over the world during the period 1995-2000. Following previous studies in the literature we use a reduced form price equation.[30] In our analysis we stress the effect of port efficiency on maritime transport costs and we address the problems of endogeneity and omitted variable bias that price equation has.

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[26] In 1981 the supply of seaport service were de-regulated in Chile, and the change in legislation induced a significant fall in seaport cost. See Trujillo and Nombela (1999) and Camara Chilena Maritima (1999) for a discussion of this case.

[27] Their infrastructure index is measured as a simple weighted average of kilometers of road, paved road, rail and telephone main line (per square Km of country area and population, respectively). In their regression, the authors use this index to the power of -.3.

[28] LV(2000) use two alternative measures of transport costs: CIF/FOB ratios reported for bilateral trade between countries by the IMF and quotes from a shipping company. According to them, an improvement in own infrastructure from the 75th to the 25th percentiles reduces transport costs by 30% based on shipping data (from $6,604 to $4,638) and by more than 50% based on the CIF/FOB ratio (from 1.40 to 1.11). In addition, an improvement in own *and* transit countries' infrastructures from the 75th to the 25th percentiles reduces by more than half the disadvantage associated with being landlocked.

[29] For most countries, US imports account for a significant share of their exports. For instance, US imports accounted for 56 percent of Latin American exports in 1999, and they accounted for 31 percent of Japan's exports this year.

[30] This analysis closely follows FMN (2000)

Empirical Framework

To estimate the importance of each factor in maritime transport costs we use a standard reduced form approach. Maritime charges are assumed to be equal to the marginal cost multiplied by shipping companies' markup. Expressed in logarithm, we have:

$$p_{ijk} = mc(i,j,k) + \mu(I, J, k) \qquad [1]$$

Where p_{ijk} is the charges per unit of weight, in logarithm, for the product k transported between locations i and j. i corresponds to foreign port, located in country I and j corresponds to US port, located in district J. k is the traded product, aggregated at the 6 digit of the Harmonized System (HS) Classification. Finally, mc and μ are the marginal cost and markup, respectively (in logarithm).

As expressed in equation [1], both the marginal cost and the markup should be a function of factors depending on the port or country of origin (i,I), the port or district of destiny in the US (j,J) and the type of product (k). In particular, we assume that the marginal cost has the following form:

$$mc_{ijk} = \alpha_J + \lambda_k + \psi\, wv_{ijk} + \gamma\, T_{ijk} + \partial\, d_{iJ} + \eta\, q_{IJ} + \theta\, Imb_I + \omega\, PE_I \qquad [2]$$

Where:

α_J: dummy variable referring to US district J.

λ_k: dummy variable referring to product k.

wv_{ijk}: value per weight for product k, transported from foreign port i to US port j, in logarithm. We also refer to this variable as the weight value.

T_{ijk}: fraction of k goods shipped (from i to j) in containers.

d_{iJ}: distance between foreign port i and US custom district J, in logarithm.

q_{IJ}: volume of imports carried by liner companies between country I and US coasts, in logarithm.

Imb_I: Directional imbalance in trade between the USA and country I, measured as US exports minus US imports divided by total trade between both countries.

PE_I: Foreign country I ports' efficiency.

The first term (α_J) in equation [2] takes into account potential differences in port efficiencies across US custom districts. The second term (λ_k) accounts for different marginal costs across products. The third term – weight value, (wv_{ijk}) – is used as a proxy for the insurance component of the maritime transport cost (p_{ijk}). The fourth term (T_{ijk}) represent a technological effect, and it captures reductions in costs induced by the utilization of containers. The fifth term (d_{iJ}) refers to the maritime distance between trade partners. The next two variables (q_{IJ} and Imb_I) account for potential economies of scale and directional imbalance in trade, and the last term (PE_I) accounts for port efficiency in the foreign country. Thus, we expect a positive sign for ψ and ∂, and a negative sign for γ, η, θ and ω.[31]

Finally, and following closely FMN (2000) formulation, we assume that shipping companies' markups have the following form:

$$\mu(I, J, k) = \rho_k + \psi^{PA} A_{IJ}^{PA} + \psi^{CA} A_{IJ}^{CA} \quad [3]$$

Where

A_{IJ}^{PA}: existence of price-fixing agreements between country I and US district J.

A_{IJ}^{CA}: existence of cooperative working agreement between country I and US district J.

The first term (ρ_k) in the above equation reflects a product-specific effect that captures differences in transport demand elasticity across goods (this is a derived demand from the final demand of good k in the US). The last two terms account for potential collusive agreements between shipping companies covering a same route. Two types of agreements are distinguished: price-fixing agreements (which include most maritime conferences), and cooperative working agreements that do not have binding rate setting authority. Substituting the second and third equations into the first one, we obtain the econometric model to be estimated:

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[31] Contrary to previous studies like FMN (2000), we include the weight-to-value variable to control for products difference within product at 6 digit HS set of goods. Even within this narrowly define sets, products still have important differences that may cause important omitted variable bias.

$$p_{ijk} = \alpha_J + \beta_k + \psi\, wv_{ijk} + \gamma\, T_{ijk} + \partial d_{iJ} + \eta q_{IJ} + \theta\, Imb_I + \omega\, PE_I + \psi^{PA} A_{IJ}^{PA} + \psi^{CA} A_{IJ}^{CA} + \varepsilon_{ijk} \quad [4]$$

Where:

$\beta_k \equiv \lambda_k + \rho_k$

ε_{ijk}: error term.

In the empirical section we use instrumental variables to control for the endogeneity problem in our reduced form specification. Following gravity literature on trade, we use foreign country's GDP as an instrument of the volume of imports.

Data and Results[32]

Data on maritime transport costs, value and volume of imports, and shipping characteristics – like the percentage of the goods transported through containers – come from the U.S. Import Waterborne Databank (U.S. Department of Transportation) for the years 1996, 1998 and 2000. Our dependent variable – transport costs – is constructed using *imports charges and import weight per product, aggregated at the six level HS system. The U.S. Census Bureau defines Imports charges* as: "...the aggregate cost of all freight, insurance, and other charges (excluding U.S. import duties) incurred in bringing the merchandise from alongside the carrier at the port of exportation -in the country of exportation- and placing it alongside the carrier at the first port of entry in the United States."

Even though the U.S. Import Waterborne Databank includes all U.S. imports carried by sea classified by type of vessel service (liner, tanker and tramp), we focus only on liner services to be able to estimate the effect of conferences and agreements in maritime charges.[33] Liner imports account for around 50 percent of total US imports and 65 percent of US maritime imports.[34] Given that our objective is to focus only on

[32] Appendix A gives a complete description of the data used.

[33] This also allow us to compare our results with FMN (2000) ones. Liner services are scheduled carriers that advertise in publications advance of sailing. They generally have a fix itinerary and tend to carry mixed types of containerized, non-bulk cargo. Tramp and tanker services, in turn, are (dry, liquid) bulk carriers and have no regular scheduled itineraries, but are more depending on momentary demand.

[34] The remaining US imports by sea are carried by tramp services.

maritime transport costs, we also drop all the observations for which the origin of the import is different from the port of shipment.[35]

The distance variable and the data on maritime conferences and working agreement between liners were kindly provided by FMN(2000). The first correspond to the distance between foreign ports and US custom districts; it is expressed in nautical miles, and comes in turn from a private service. The data on carrier agreements comes from the Federal Maritime Commission, it covers 59 countries and is available only for 1998. Therefore, when estimating for the other years, we have no choice but to use the same 1998 values.

Unfortunately, there is not much comparable information about port efficiency –at port level- to be used in a cross-country analysis.[36] So, we use an aggregated measure -per country- of port efficiency, consisting of a one-to-seven index (with 7 being the best score) from the Global Competitiveness Report (GCR). This annual data is available for the period 1995-2000. Given that this index does not vary over time, we use 1999 for all the years because it covers more countries[37]. As alternative measures, we also use proxies for seaport infrastructure (therefore for port efficiency). First, we use the total square number of largest seaports by country, normalized by the product between foreign country's population and area. A port is classified as large if it has lifts with a leverage capacity of 50 tons and above[38]. We also use foreign countries' GDP per capita as an alternative proxy of port efficiency. Countries' GDP per capita are correlated with their level of infrastructure. For our particular problem – explaining the cost of shipping the same product from different ports in the world to the U.S. – it is hard to see why the per capita GDP of the sending country would matter except to the extent that it is proxying for the quality of infrastructure. As noted, we will use these indirect measures and a direct measure of port efficiency in different specifications.

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[35] That is, in transit merchandise is not included.

[36] The World Bank is launching a program (*Global Facilitation Partnership for Transportation and Trade*) to focus on significant improvements in the invisible infrastructure of transport and trade in different member countries. However, the project is in its first stage and it does not cover all the countries of our sample yet.

[37] The report, in turn, is based on micro-data from annual surveys at firm level, made to a representative group of enterprises in every country. The particular question for port efficiency is: "*Port facilities and inland waterways are extensive and efficient. (1 = strongly disagree, 7 = strongly agree)*". The number of countries covered has been growing over time (from 44 in the 1996 report to 56 in the 2000 one).

[38] This information was obtained from the database found in the Portualia website: www.portualia.com

In addition to the number of large seaports and per capita GDP, we construct a third measure of infrastructure – this time an index à la LV (2000) – based on information at country level on paved road, paved airports, railways and telephone lines.[39] We incorporate this variable based on the assumption that the level of infrastructure of a country is highly correlated with the level of infrastructure of their ports, and also because it allows us to compare our results with LV (2000). We should note that, despite having a somewhat similar infrastructure index, our formulation differs from that of LV (2000) in many respects. First, one of their measures of transport costs is the CIF/FOB ratio, which has the disadvantage of being an aggregate measure for all products, while we use transport cost information at product level. Also, this measure is well known for having measurement deficiencies (although they try to control for that). Their second measure of transport costs – shipping rates (for a homogeneous product) from Baltimore to a group of different countries – tries to address these problems. However, as the same authors point out, the shipping rates from Baltimore are not necessarily representative - not even for the rest of the US ports. Our database, on the other hand, has information from many ports around the world to different ports in the US.[40] An advantage of their second measure, however, is that it allows them to construct an estimate of inland transport cost, which is not our purpose in this paper.

Table 1 reports our estimations for equation [4] using an Instrumental Variable (IV) technique to control for the endogeneity of total volume. We use countries' GDP as instrument. We make the identifying assumption that if country size affects transport costs, it does so through the volume of trade and economies of scale in shipping. In all the estimations, we allow the observations to be independent across exporting countries, but not necessarily independent within countries. At the same time, the standard errors presented in the table correspond to the consistent Huber/White ones. We start presenting the results only for 1998 because the variables on maritime conferences and working agreement between liners refer to this particular year. The first column report the results using the variable "Port Efficiency" from the GCR as a proxy for port competence, columns (2) uses the square number of large ports normalized by foreign country's area

[39] See the Appendix for a description of its construction.

and population, columns (3) uses the index of infrastructure we constructed, finally column (4) reports the results using GDP per Capita as a proxy for port efficiency. As it can be seen, in all estimations most of the variables are highly significant and with the expected sign.

Distance has a significant (at 1%) positive effect on transport costs. A doubling in distance, for instance, roughly generates an 18 percent increase in transport costs. This distance elasticity close to 0.2 is consistent with the existent literature on transport costs. The value per weight variable is also positive and highly significant, with a t-statistic around 50. As already stated, these regressions include dummy variables for products aggregated at the six-digit HS level. One might think that unit values would be quite similar across countries at that level of desagregation; not so. Feenstra (1996) shows that there is a large variation in unit values even at the 10-digit HS level. He cites the examples of men's cotton shirts, which the U.S. imports from fully half of its 162 trading partners. The unit values range from $56 (Japan) to $1 (Senegal). These differences in unit values lead to large differences in insurance costs per kilogram, even for "homogeneous" products. So, it is not surprising that we find that the more expensive the product, per unit of weight, the higher the insurance and hence the overall transport cost.[41]

The next variable, the level of containerization, presents a significant negative effect on transport costs. As explained before, this variable represents technological change at both vessels and seaport level. The idea behind this result is that containerization reduces services cost, such as cargo handling, and therefore total maritime charges. Our results suggest that containers reduce transport costs in around 4 percent. It is important to note that in 1998, most of the cargo coming through liners was in containers (90%), in particular the cargo that came from developed countries.

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[40] In addition, we believe their second sample is biased in favor of African countries. The bad infrastructure and port quality of African countries may be biasing upward the coefficient estimates they obtain.

[41] In addition, there is the possibility that the unit weight variable could be capturing some measurement errors. The argument is as follows. One should expect that the variables *charges* and (total) *import value* were very carefully measured, because the US custom constructs the *dutiable value of imports* by excluding the former to the latter (and it should have a special interest in calculating it correctly). However, this could not be case for the measurement of weight. If so, measurement errors in the weight variable would induce a positive correlation between *charges per weight* (our dependent variable) and *value per weight.*

Directional imbalance in trade between USA and the source country has the expected negative sign and is significant in half of the specifications. Move from a favorable imbalance of 50 percent to a negative one of the same amount increases transport costs in around 6 percent.

The variable capturing economies of scale is the level of trade that goes through a particular maritime route.[42] This variable, calculated in terms of volume (weight), has a significant negative coefficient (as expected).[43] As theory and previous studies shows maritime transport presents economies of scale. These may come from the fact that more transited routes are covered by the largest ships, which in fact have a larger rate of occupancy, or they present more competition due to the higher number of liner companies covering the route. In our sample, an increase in export volume from the level of Cyprus to the one of Indonesia reduces transport costs in around 20%.[44]

With respect to the two variables referring to agreements between liner companies, only the first of them (price fixing binding agreements) turns out to be positive -as expected- but only significant (at 10%) in only one specification[45] (column 4). This result seems to suggest that maritime conferences have been exerting some mild monopoly power – adding at most an estimated of around 5% to transport costs, ceteris paribus. However, as we will see later, this effect is not always significant for other years and in some specifications it has the opposite sign.[46]

Finally, the coefficient related to port efficiency is negative and significant (at 1% in all cases): the greater the efficiency at port level, the lower the transport costs. This

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[42] Each couple foreign country and US coast is defined as a maritime route. We define three coasts in the US: East, West and Golf coast.

[43] We must note that this variable differs from the one presented by Fink, Mattoo and Neagu (2000) in two aspects. First, they use the value of imports while we use the volume of imports (in tons). Second, the definitions of maritime route through which economies of scale arise are different: they use the trade (in value) between foreign ports and US districts (31), while we use the trade (in volume) between foreign countries and US coasts (3).

[44] In term of countries (not of observations), Cyprus and Indonesia are in the percentile 15 and 85 respectively.

[45] FMN (2000) find the price-fixing agreement dummy variable to be significant and much larger in magnitude: between .4 and .51; that is, the maritime agreements add at least 40% to transport costs. They also use policy variables referring to cargo reservation policies (not significant), cargo handling services (significant in one estimation but with wrong sign, and not significant in another), and mandatory port services (significant, correct sign).

[46] This result differs from FMN (2000). If we run our regressions without including our weight value variable we obtain their results (significant effect of price agreement on transport costs), therefore it seems that their results are driven by an omitted variable bias effect.

result is robust for our four alternative measures of port efficiency (columns 1 to 4). In particular, the coefficient for the measure from the Global Competitiveness Report (column 1), along with the distribution of the port efficiency index among countries, indicates that an improvement in port efficiency from the 25th to the 75th percentile reduces transport charges a little more than 10%.[47] In terms of particular countries, if China, Indonesia and/or Mexico -for instance- improved their port efficiency to levels observed in countries like France and/or Sweden, their reductions in transport costs would be around 10%. When using our two proxies for seaport infrastructure we find similar results but slightly smaller, and higher when we use GDP per capita. [48] This may reflect the fact that our infrastructure indexes are a more noisy measure of port efficiency because they do not capture the quality of infrastructure nor of services.

To see if our results hold within income country groups (Table 2), we include a dummy variable that takes the value of one if the foreign country is a developed country, and zero otherwise. We find that all of our previous results are robust to the inclusion of this dummy, except for the "price fixing binding agreements" variable, which is not significant and changes sign in some specifications. All of our "port efficiency" measures remain very significant and their coefficient increases by around 20%. The coefficient for the variable port efficiency from the GCR indicates that an improvement in port efficiency from the 25th to the 75th percentile reduces transport charges a little more than 12%.

We performed similar estimations for the years 1996 and 2000. For brevity of space, Table 3 presents the estimated coefficients only for the IV regressions using the GCR variable for port efficiency with and without our developed country dummy.[49]

For each year, the coefficient on distance is very significant and oscillates around 0.2. Weight-to-value are quite stable and significant (at 1%).[50] Prior to 1999 (96-98), the

[47] That is, when port efficiency is measured with the GCR index, an improvement in port efficiency from 25th to 75th percentile (i.e., from a score of 3.4 to 5.6 respectively) generates a maritime transport costs decline of around 12%.
[48] When proxying port efficiency with the per capita GDP, an increase from the 25th to the 75th percentile reduces maritime transport charges in 14%.
[49] We use the port efficiency index from the 1999 GCR for all years, in order to avoid a drastic decrease in the number of countries covered by the report.
[50] The exception is the coefficient for distance in 1999, which increases to 0.25. One reason why distance may be having a bigger effect this year could be the increase in oil prices (from an average of $13/barrel in 1998 to $18/barrel in 1999).

first year after the US eroded the power of Conferences, the price-fixing rate agreement has the expected sign in some specifications but it is significant only in some specifications (10%).[51] In 2000, the coefficient turns negative, a result that may be related to a war in prices between shipping companies that were previously members of the conferences. Cooperative agreement is only significant for the 1996 specification, but it has the wrong sign. From these results it is difficult to conclude whether conferences have been exerting some monopoly power or not.

From Table 3 we can see that the coefficient on containerization is negative in 1996 but shifts sign in 2000[52]. In this year, almost all products came in containers, in fact this year our median value for containerization is 100 percent and the percentile 90 is 93 percent. Therefore is possible that this year our containerization variable is capturing a specific characteristic of one set of product coming from some particular countries. In the case of directional imbalance, the coefficients reported have the expected sign, but they are not significant in all the specifications. Total Liner Volumes coefficient is negative in all the specifications, and is significant at standard levels.[53] Finally, the estimated coefficient for port efficiency is stable and significant from both an economic and statistical point of view. When we use our infrastructure indexes (not shown here) we obtain similar results in terms of stability and significance. These results allow us to conclude that port efficiency is an important determinant of maritime transport costs. For example, using the estimated coefficient for year 2000, if countries like Ecuador, India or Brazil improve their port efficiency from their current level to the 75th percentile -that is, to a level attained by France or Sweden- they would reduce their maritime transport costs by more than 15% each.

A final caveat about these results. Our model assumes that, if inefficiency in a port raises shipping costs by 10% for a shipment of shirts, it will increase the shipping costs for a shipment of cars by the same 10%. Suppose, instead, that the "tax equivalent" of port inefficiency varies by product. Then, products for which the tax is excessively

[51] This variable is significant at 10 % when we use the number of large seaport as proxy for efficiency (not reported).
[52] The low variance on the containerization levels in liner transport services may be explaining the non-significance.
[53] For the year 2000 this variable is significant in some non-reported regressions (when we include a variable capturing regulations- equivalent to Table 7-).

high will not be exported and we will not observe them in the data. In other words, we have estimated the effect of port inefficiency for *products that are actually shipped.* The effect may be higher for some products, which are then not exported. In this sense our estimate of the cost of port inefficiency may be conservative.

IV. Determinants of Port Efficiency

The previous subsection stresses the importance of port efficiency on maritime transport cost, but what are the factors behind port efficiency? The activities required at port level are sometimes crucial for international trade transactions. These include not only activities that depend on port infrastructure, like pilotage, towing and tug assistance, or cargo handling (among others), but also activities related to customs requirements. It is often claimed that "...the (in)efficiency, even timing, of many of port operations is strongly influenced (if not dictated) by customs".[54,55]

Some legal restrictions can negatively affect port performance. For example, in many countries workers are required to have special license to be able to provide stevedoring services, artificially increasing seaport costs. Other deficiencies, associated with port management itself, are also harmful to country competitiveness. For instance, some ports still receive cargo without specifying the presentation of a Standard Shipping Note, which is inconceivable in modern port practice. In many ports, it is quite impossible to obtain a written and accurate account of the main port procedures, and sometimes port regulations are not clear about the acceptance of responsibilities (for cargo in shed or on the quay, for instance). All of this generates unreasonably long delays, increases the risks of damage and pilferage of products (in turn raising the insurance premiums), and as a consequence considerably increases costs associated with port activities.

Port efficiency varies widely from country to country and, specially, from region to region. It is well know that some Asian countries (Singapore, Hong Kong) have the

[54] Thus, any unexpected delay at ports due to extra custom requirements or cargo inspections, for instance, may increase considerably the associated port costs (due to moving containers and storage of frozen products, for example) and hence reduce exporters competitiveness.
[55] See John Raven (2000), for a description of relevant issues concerning trade and transport facilitation.

most efficient ports in the world, while some of the most inefficient are located in Africa (Ethiopia, Nigeria, Malawi) or South America (Colombia, Venezuela, Ecuador). Table 4 presents some estimates of port efficiency, per geographic region.[56]

The first column is a subjective index based on surveys reported by the World Economic Forum's 1999 *Global Competitiveness Report*. North America and Europe have the best rankings, followed by the Middle East, and East Asia & the Pacific. Latin America and South Asia, in turn, are the regions perceived as having the least efficient ports. The second column indicates the time, in median days, to clear customs (taken from business surveys performed by the Inter-American Development Bank and World Bank[57]). The striking results are the ones for Africa -Southeast Africa and West Africa- for which the median number of days to clear customs is 12. Among East and South African countries, Ethiopia (30 days), Kenya, Tanzania and Uganda (14 days each) are the countries with bigger delays in clearing customs; while Cameroon (20 days), Nigeria (18 days) and Malawi (17 days) are the West African countries with the biggest delays.[58] The second region presenting big problems at custom levels is Latin America, with a median delay in clearing customs of 7 days. In this group, Ecuador (15 days) and Venezuela (11 days) appear as the worst performers.

Finally, the third column of Table 4 presents some estimates of the costs of handling containers inside the ports (in US$/TEU). This variable was constructed based on information provided by the Transport Division of the World Bank and information from additional papers.[59] Despite the fact that the sample of countries for this variable is a lot more restricted than for the previous ones, the estimates are quite consistent with the previous variables. While the efficient ports in East Asia present lower charges, the Latin American ports have one of the most expensive handling services. This relationship is

[56] We must note that these efficiency variables -per regions- are not directly comparable to each other, because the availability of countries is not the same for each of the variables. Thus, we should think of these as complement rather than substitute measures.
[57] The specific question is: "If you import, how long does it typically take from the time your goods arrive at their port of entry until the time you can claim them from customs?"
[58] The African countries' results from this survey are totally consistent with the results presented by the African Competitiveness Report 2000/2001 (World Economic Forum), which performed the same custom clearance question (though the average time presented by the latter are slightly higher).
[59] Camara Maritima y Portuaria de Chile (1999) and LSU-National Ports and Waterways Institute (1998).

even clearer when we take into account wage differential across countries. Table 5 presents the regression of handling costs -adjusted by wage or its proxy- on port efficiency and an index of infrastructure[60] (same as used in table 1 column 3). This latter index -at country level- is included under the assumption that infrastructure at country level is highly correlated with infrastructure at port level. We obtain similar results when we use our seaport infrastructure index. In column (1) handling costs are adjusted by manufacturing wages,[61] in column (2) and (3) we adjust by GDP per capita (as a proxy of wages), and in Column (4) and (5) handling costs are adjusted by GDP PPP per capita.

Port efficiency is highly correlated with handling cost. Countries with inefficient seaports have higher handling costs. Also, countries with good infrastructure have lower seaport costs. Figure 4 presents the relationship between handling costs and port efficiency, controlling for PPP GDP per capita (as a proxy for wages) and infrastructure level (Column 4 specification of Table 5). The clear negative relationship shows that countries where ports are considered the most efficient (e.g. Singapore and Belgium, not marked in the figure) are at the same time the ones whose ports charge the least for their services (in comparable units). In turn, some Latin American countries (e.g. Brazil, Ecuador, not marked in the figure) are among the worst ranked in term of their efficiency and also present the highest charges per services (after controlling by the level of infrastructure).[62]

Finally, we try to explain which are the factors behind port efficiency. As we already mentioned in the case of transport costs, it is reasonable to think that the determinants of port efficiency will not only consist of infrastructure variables, but also of management and/or policy variables. Therefore, besides a proxy for port infrastructure,[63] we include among the explanatory variables two policy variables, one referring to *Cargo Handling Restrictions* and the other to *Mandatory Port Services*. Both

[60] The index corresponds to the index we construct a la LV.
[61] Manufacturing wages are taken from UNIDO Industrial Statistics Database.
[62] A similar result is obtained when manufacturing wages (from the UNIDO Industrial Statistics Database) are used -instead of GDP per capita- to adjust handling costs. Appendix B presents the values used to construct these series.
[63] We use the index of country infrastructure we constructed as proxy for port infrastructure.

variables are zero-to-one indices from FMN (2000). The first captures restrictions and special requirements imposed on foreign suppliers of cargo handling services, where foreign suppliers refer to local companies with foreign participation.[64] The second captures the extent to which port services are mandatory for incoming ships.[65] Both indices represent restrictions at port level that could limit competition, so we can expect a negative relationship between them and port efficiency. However, due to some quality and security considerations, we also have to consider that it may be beneficial to have a certain level of regulation at the seaports. Thus, we also explore the possibilities of non-linearities of the effect of each of these indices on port efficiency.

As we already mentioned, we consider the overall level of infrastructure, which we assume to be positively correlated with a country's level of seaport infrastructure. We expect the better the infrastructure the higher the probability of an efficient port; that is, a positive coefficient for this variable. Finally, we also include a *Crime Index*, taken from the Global Competitiveness Report, and consisting of a one-to seven index ranking how severe is organized crime in a particular country (with 7 meaning "not a problem"). The idea behind the inclusion of this variable is that organized crime constitutes a direct threat to port operations and merchandise in transit. With all of this in mind, we present in Table 6 some estimations of the effects of these variables on port efficiency calculated for 1998.

As it can be seen, the coefficient on infrastructure is always positive and significant. The results for the policy variables are somehow mixed, but make some sense. Cargo handling restrictions are not significant, no matter the specification. The variable for mandatory port services, on the other hand, is significant both in level and square level, presenting a positive and negative sign, respectively. This result **suggests** that having *some* level of regulations increases port efficiency, however, an *excess* of it

[64] The index takes a value of 0 if no restriction exists, 0.25 for minor restrictions, 0.5 if a joint venture condition is imposed, 0.75 if a very high national participation in the company is required, and 1 if foreign companies are simply forbidden to provide cargo handling services.

[65] This variable is constructed adding .125 for each of the following services if they are mandatory: pilotage, towing, tug assistance, navigation aids, berthing, waste disposal, anchorage and others mandatory services.

may start to reverse these gains. In terms of the countries in our sample, this result **suggests** that Argentina is taking advantage of a moderate level of regulation in its seaports, but instead Brazil is reducing its seaport efficiency because of excess regulation. Using a non-parametric method (adjusted spline), figure 5 presents this non-linear relationship between regulation and port efficiency.

Finally, the crime variable also turns out to be highly significant and with the expected positive sign (remember that the variable is defined as crime "not being a problem"). In terms of this sample, an increase in organized crime from the 25th to 75th percentiles implies a reduction in port efficiency from 50th to 25th percentiles. In other words, if countries like Brazil, China or India (all with indices around the 75th percentile) reduced their organized crime to levels attained by countries like Australia, New Zealand or the United Kingdom (all around the 25th percentile), then they would be able to increase their port efficiency index roughly one point. This in turn would generate a reduction of maritime transport costs of around 6%.

To corroborate the previous results, Table 7 re-estimates equation [4] from section III, but we only include as a measure of port efficiency our measures of port infrastructure plus mandatory port services and organized crime. In the first two columns we do not include the developed country dummy whereas in the last two we do. As in our previous results, the coefficient on seaport infrastructure is negative and significant at conventional levels (it is slightly larger in absolute value than before). In all specification mandatory port services have the inverted U shape, although their coefficient by themselves are not always significant at standard level. Nonetheless, in all the specifications the joint test for the two coefficients of mandatory services are significant at standard levels. Finally, our measure of organized crime has the expected sign an it is highly significant. In terms of this sample, an increase in organized crime from the 25th to 75th percentiles implies an increase maritime transport costs between 6 to 8 percent depending on the specification used. Summarizing, these results using transport costs confirms our previous results.

V Transport Costs and Trade.

In this section we construct a set of four indexes of country-specific maritime transport costs that we include later in a standard gravity equation to check for their explanatory power. Each of these indexes is derived from equations 1 to 4 respectively of table 7.

To estimate each of our four indexes, we compute the residuals of each of the equations specified in columns 1 to 4 of table 7, to which we add the predicted component of the country-specific costs identified by the following variables: level of containerization, seaport infrastructure level, regulatory environment, organize crime and developed country dummy (the latter only for regressions 3 and 4). For each of the four specifications in Table 7, the simple average per country is our costs index. Formally, and following the nomenclature presented in Section III, for each specification the computed index (TCI_k) is:

$$TCI_k = \frac{1}{N_i}\sum_{\in i}\left(p_{ijk} - \hat{\alpha}_j - \hat{\beta}_k - \hat{\psi} wvi_{jk} - \hat{\delta} d_{jk} - \hat{\theta}\,\mathrm{Im} b_j - \hat{\eta} qij\right) \quad \forall \;\; k = 1,..,4$$

where N_i is the number of observation from country i, and $\hat{\alpha}$, as the other coefficients, is estimated using all independent variables in table 7 as controls[66]. It is important to note that our indexes are independent of how far the country is from the US, which allows us to use it in a more general framework (not only whenever trading with the US). Table 8 reports the pair-wise correlation among the four different indexes and the variable "Port Efficiency" from the GCR. All correlations have the expected sign and are significant at one percent. Pair-wise correlations among constructed indexes are extremely high. Appendix B reports the estimated index derived from column 3 of table 7 (TCI_3).

In Table 9 we estimate a standard bilateral trade gravity model using Rose and Glick (2002) specification and dataset, and the previously estimated country specific transport costs indexes (TCI_k). In column 1, we replicate Rose and Glick (2002) results for the year 1997. In columns 2 - 6 we restrict the sample to countries from which we are able to compute our transport cost indexes (43 countries). Even though the sample is reduced in

90 percent,[67] the results remain qualitatively equal to the ones reported in column 1, except that the variable Regional Trade Agreement lost significance, and the variables of Currency Union and Landlocked Countries are dropped because the lack variability in the restricted sample. In columns 3 to 6 we check the explanatory power of each of our indexes, which, as we already mentioned, do not account for the costs associated with bilateral distance[68]. As shown, country costs indexes have the expected negative sign and they are highly significant. In terms of this sample, an increase in country-specific transports costs from the 25th to 75th percentiles implies a reduction in bilateral trade of around 22 percent. In other words, if a country like Peru or Turkey (1998) decreases its seaport's inefficiencies to a level similar to Iceland or Australia, it would be able to increase its trade by roughly 25 percent.

VI. Conclusion

By the 1990s many countries had adopted a development strategy emphasizing integration with the global economy and therefore had reduced their tariff and non-tariff barriers to trade. This reduction in artificial trade barriers has raised the importance of transport costs as a remaining barrier to trade. Therefore, any strategy aimed at integrating a country into the trading system has to take into account transport costs seriously.

Besides distance and other variables that governments can't change, an important determinant of maritime transport costs is seaport efficiency. An improvement in port efficiency from 25^{th} to 75^{th} percentiles reduces shipping costs by more than 12%, or the equivalent of 5,000 miles in distance. This result is robust to different definition of port efficiency as well as to different years. Inefficient ports also increase handling costs.

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[66] To construct our indexes we use the specification in table 7, but we do not include the agreement variables due to their lack of significance.
[67] We only have costs indexes for 43 countries, whereas Rose(2002) use more than 300 countries/territories in his sample.
[68] The variable included in the regression is the sum of the countries' indexes in the pair.

Focusing on country specific maritime transport costs indexes, which are constructed independently of how far the country is from their trading partners, a decrease in inefficiencies associated to transport costs from the 25th to 75th percentiles implies a reduction in bilateral trade of around 25 percent.

Seaport efficiency, though, is not just a matter of physical infrastructure. Organized crime has an important negative effect on port services, increasing transport costs. In terms of our sample, an increase in *organized crime* from the 25th to 75th percentiles implies a reduction in port efficiency from 50th to 25th percentiles. In addition our results suggest that some level of regulation increases port efficiency, but excessive regulation can be damaging.

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Appendix A. Data Description

Cargo Handling Restrictions: zero-to-one index that captures restrictions and special requirements imposed to foreign suppliers of cargo handling services. The index takes a value of 0 if no restriction exists, 0.25 for minor restrictions, 0.5 if a joint venture condition is imposed, 0.75 if a very high national participation in the company is required, and 1 if foreign companies are simply forbidden to provide cargo handling services. Source: Fink, Mattoo and Neagu (2000).

Colonial Relationship: This variable was kindly provided by Rose. A (2002). For more details, you can read "Does A Currency Union Affect Trade? The Time Series Evidence". The European Economic Review , June 46(6).

Common Colonizer post 1945: This variable was kindly provided by Rose. A (2002). For more details, you can read "Does A Currency Union Affect Trade? The Time Series Evidence". The European Economic Review , June 46(6).

Common Language: This variable was kindly provided by Rose. A (2002). For more details, you can read "Does A Currency Union Affect Trade? The Time Series Evidence". The European Economic Review , June 46(6).

Container Handling Charges: Correspond to containers handling charges inside the ports, expressed in US$ per TEU (Twenty Feet Equivalent Unit). For nineteen countries we have information from the Transport Division of the World Bank. For twelve countries, from which eight are in the World Bank sample, we have information (as an index) from the Cámara Marítima y Portuaria de Chile A.G. Finally, for four Central American countries from which only Panama is in the previous samples, we have information from the LSU- National Ports and Waterways Institute. Using ratios, we put all samples in the same unit used by the data from the World Bank.

Containerization: Percentage of cargo transported by containers. Source: US Import Waterborne Databank (US Department of Transportation).

Cooperative agreement: Dummy variable signaling the presence of carrier agreements on maritime routes: cooperative working agreements that do not have a binding rate authority. Source: Fink, Mattoo and Neagu (2000).

Custom Clearance: Correspond to time (days, median) to clear customs, based on surveys performed (by the World Bank) to importers in each country. The specific question is "If you import, how long does it typically take from the time your goods arrive at their port of entry until the time you can claim them from customs?" Source: The World Bank.

Developed Country Dummy: This variable was constructed using The World Bank country classification. We define as 1 the countries classified as high income countries, and 0 all the other cases.

Distance: Correspond to the distance between the foreign port i and the US custom district J. Data provided by Fink, Mattoo and Neagu (2000).

Directional Trade Imbalance: Correspond to the ratio between the difference of U.S. exports and imports, and bilateral trade. The data was obtained from U.S. Imports and Exports Waterborne Databank Database, 2000.

Infrastructure Index: Correspond to the simple average of three normalized indices that take into account the country level of communications (telephones) and its physical transport infrastructure (paved roads, railroads and airports). The exact definition of the index is:

$$INFi = Avg\{AI_i, TI_i, TTI_i\} \qquad \text{if there are a least two of them}$$

where

$$AI_i = \frac{PA_i^2 / P_i * S_i}{\Sigma_j \, PA_j^2 / P_j * S_j} \qquad TI_i = \frac{T_i / P_i}{\Sigma_j \, T_j / P_j} \qquad TTI_i = avg\left\{ \frac{PR_i^2 / P_i * S_i}{\Sigma_j \, PR_j^2 / P_j * S_j}, \frac{RR_i^2 / P_i * S_i}{\Sigma_j \, RR_j^2 / P_j * S_j} \right\}$$

and T_i is the fixed and mobile telephone lines per capita of country i, PA_i is the number of paved airports, P_i refers to the population, S_i refers to the surface area, PR_i is paved roads, and RR_i is railroads. The sources for the variables are: World Development Indicators 2000 (The World Bank) and The World Factbook 2000 (Central Intelligence Agency).

Foreign GDP per capita: GDP per capita of the exporting countries to the US. Source: World Development Indicators 2000 (The World Bank).

GDP PPP per capita: This variable was obtained from The World Bank 2002, World Development Indicators Database.

Islands: This variable was kindly provided by Rose. A (2002). For more details, you can read "Does A Currency Union Affect Trade? The Time Series Evidence". The European Economic Review , June 46(6).

Landlocked: This variable was kindly provided by Rose. A (2002). For more details, you can read "Does A Currency Union Affect Trade? The Time Series Evidence". The European Economic Review , June 46(6).

Mandatory Port Services: zero-to-one index that captures the extent to which port services are mandatory for incoming ships. This variable is constructed adding 0.125 for each of the following services if they are mandatory: pilotage, towing, tug assistance, navigation aids, berthing, waste disposal, anchorage and others mandatory services. Source: Fink, Mattoo and Neagu (2000).

Manufactures wages: Source: UNIDO Industrial Statistics Database.

Maritime Transport costs: calculated as import charges divided by weight. Source: calculated from data of the US Import Waterborne Databank (US Department of Transportation).

Organized Crime: one-to-seven index ranking "organized crime as not been a problem", based on surveys performed to representative firms of each country. The specific question is "Organized crime does not impose significant costs on business and is not a burden (1=strongly disagree, 7=strongly agree)". Source: The Global Competitiveness Report, various years (1996-2000)

Population: The Data was obtained from the World Bank 2002, World Development Indicators Database.

Port Efficiency: one-to-seven index ranking port efficiency, based on surveys performed to representative firms of each country. The specific question is "Port facilities and inland waterways are extensive and efficient (1=strongly disagree, 7=strongly agree)". Source: The Global Competitiveness Report, various years (1996-2000)

Ports normalized by country surface and population: Correspond to the logarithm of the ratio between the number of ports (square) that have lifts with leverage capacity of 50 tons. or above (p_c), and the product between country surface $(surf_c)$ and country population (pop_{ct}) .

$$Number\,of\;ports = \ln\left(\frac{p_c^2}{surf_c * pop_{ct}}\right) \qquad where\; t\; is\; year$$

The number of ports per country was obtained from Portualia S.A. world port database.

Price-Fixing agreement: Dummy variable signaling the presence of carrier agreements on maritime routes: conferences and other price-fixing agreements. Source: Fink, Mattoo and Neagu (2000).

Strict Currency Union: This variable accounts for the countries that have a currency union, and was kindly provided by Rose. A (2002). For more details, you can read “Does A Currency Union Affect Trade? The Time Series Evidence”. The European Economic Review , June 46(6).

Surface: The Data was obtained from the World Bank 2002 World Development Indicators.

Real GDP: The Data was obtained from the World Bank 2002 World Development Indicators.

Real GDP per capita: The Data was obtained from the World Bank 2002 World Development Indicators.

RTA Dummy: This variable accounts for the countries that have trade agreements and was kindly provided by Rose. A (2002). For more details, you must read “Does A Currency Union Affect Trade? The Time Series Evidence”. The European Economic Review , June 46(6).

Total Liner Volume: Total volume of imports transported per maritime route (where we define routes as "from foreign country to US coast"). Source: constructed from data of US Import Waterborne Databank (US Department of Transportation).

Unit Weight: Value of total US imports divided by its total weight, and calculated per maritime route (where we define routes as "from foreign ports to US custom districts"). Calculated from data of the US Import Waterborne Databank (US Department of Transportation).

Appendix B. Data Used

Country	Cargo Handling Restriction Index	Mandatory Services Index	Price Fixed Agreements Index	Cooperative Agreements Index	Median Clearance time (Days)	Port Efficiency Index (1-7)	Crime Index (1-7)	Container Handling Charges		
								World Bank US$/TEU	CMPCH Index	LSU Index
Argentina	0	0.13	0	1	7	3.81	4.52	n.a.	139	n.a.
Armenia	n.a.	n.a.	n.a.	n.a.	4	n.a.	n.a.	n.a.	n.a.	n.a.
Australia	0	0.13	1	1	n.a.	4.79	6.19	199	n.a.	n.a.
Azerbaijan	n.a.	n.a.	n.a.	n.a.	5	n.a.	n.a.	n.a.	n.a.	n.a.
Belarus	n.a.	n.a.	n.a.	n.a.	4	n.a.	n.a.	n.a.	n.a.	n.a.
Belgium	0	0.06	1	0	n.a.	6.17	5.73	120	n.a.	n.a.
Belize	n.a.	n.a.	n.a.	n.a.	5	n.a.	n.a.	n.a.	n.a.	n.a.
Benin	1	0	0	0	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Bolivia	n.a.	n.a.	n.a.	n.a.	9.5	1.61	4.38	n.a.	n.a.	n.a.
Botswana	n.a.	n.a.	n.a.	n.a.	4	n.a.	n.a.	n.a.	n.a.	n.a.
Brazil	0.5	0.75	0	1	10	2.92	4.45	328	292	n.a.
Brunei	0	0	0	0	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Bulgaria	n.a.	n.a.	n.a.	n.a.	2	3.68	3.23	n.a.	n.a.	n.a.
Cambodia	n.a.	n.a.	n.a.	n.a.	7	n.a.	n.a.	n.a.	n.a.	n.a.
Cameroon	n.a.	n.a.	n.a.	n.a.	20	n.a.	n.a.	n.a.	n.a.	n.a.
Canada	0	0.13	0	0	2	6.42	6.27	190	n.a.	n.a.
CDI	n.a.	n.a.	n.a.	n.a.	8.5	n.a.	n.a.	n.a.	n.a.	n.a.
Chile	0	0.25	0.43	1	3	3.76	6.05	202	100	n.a.
China	0.5	0	0	0	7	3.49	4.44	110	n.a.	n.a.
Colombia	0.5	0.13	0.5	1	7	2.26	1.88	n.a.	n.a.	n.a.
Costa Rica	0	0	0	1	4	2.46	3.28	n.a.	n.a.	68
Croatia	n.a.	n.a.	n.a.	n.a.	2	n.a.	n.a.	n.a.	n.a.	n.a.
Cyprus	1	0.31	0	0	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Czech Rep.	n.a.	n.a.	n.a.	n.a.	2	3.27	4.41	n.a.	n.a.	n.a.
Trinidad and Tobago	n.a.	n.a.	n.a.	n.a.	7	n.a.	n.a.	n.a.	n.a.	n.a.
Denmark	0	0.06	1	0	n.a.	6.16	6.71	n.a.	n.a.	n.a.
Dominican Republic.	0.25	0.25	0.5	1	7	n.a.	n.a.	n.a.	n.a.	n.a.
Ecuador	0	0	0.43	1	15	2.63	3.65	n.a.	139	n.a.
Egypt	0.75	0.75	0	0	5.5	3.72	6.37	n.a.	n.a.	n.a.
El Salvador	0	0	0	1	4	2.95	2.3	n.a.	n.a.	61
Estonia	n.a.	n.a.	n.a.	n.a.	1	n.a.	n.a.	n.a.	n.a.	n.a.
Ethiopia	n.a.	n.a.	n.a.	n.a.	30	n.a.	n.a.	n.a.	n.a.	n.a.
Finland	0	0.25	0	0	n.a.	6.26	6.63	n.a.	n.a.	n.a.
France	0	0.38	1	0	3	5.39	6.58	201	n.a.	n.a.
Georgia	n.a.	n.a.	n.a.	n.a.	2	n.a.	n.a.	n.a.	n.a.	n.a.
Germany	0	0.38	1	0	5	6.38	6.02	163	117	n.a.
Ghana	1	0.5	0	1	5	n.a.	n.a.	n.a.	n.a.	n.a.
Greece	1	0.19	0	0	n.a.	4.28	5.6	n.a.	n.a.	n.a.
Guatemala	n.a.	n.a.	n.a.	n.a.	7	n.a.	n.a.	n.a.	n.a.	55
Haiti	n.a.	n.a.	n.a.	n.a.	15	n.a.	n.a.	n.a.	n.a.	n.a.

(continue)

Country	Cargo Handling Restriction Index	Mandatory Services Index	Price Fixed Agreements Index	Cooperative Agreements Index	Median Clearance time (Days)	Port Efficiency Index (1-7)	Crime Index (1-7)	Container Handling Charges		
								World Bank US$/TEU	CMPCH Index	LSU Index
Honduras	n.a.	n.a.	n.a.	n.a.	4	n.a.	n.a.	n.a.	n.a.	n.a.
Hong Kong	0	0.25	0	0	n.a.	6.38	5.46	n.a.	n.a.	n.a.
Hungary	n.a.	n.a.	n.a.	n.a.	3	2.59	4.14	n.a.	n.a.	n.a.
Iceland	0	0.13	0	0	n.a.	5.78	6.64	n.a.	n.a.	n.a.
India	0	0	0	1	n.a.	2.79	4.28	n.a.	n.a.	n.a.
Indonesia	1	0.06	0	0.38	5	3.41	4.06	n.a.	n.a.	n.a.
Ireland	0	0.13	1	0	n.a.	4.28	5.12	n.a.	n.a.	n.a.
Italy	0.25	0.5	0.38	0	2	4.11	3.29	228	n.a.	n.a.
Ivory Coast	0	0.25	0	1	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Jamaica	0.5	0	0	0.6	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Japan	0.75	0.13	0.89	1	n.a.	5.16	5.16	250	202	n.a.
Kazakhstan	n.a.	n.a.	n.a.	n.a.	9	n.a.	n.a.	n.a.	n.a.	n.a.
Kenya	n.a.	n.a.	n.a.	n.a.	14	n.a.	n.a.	n.a.	n.a.	n.a.
Korea	0	0.38	0	0	n.a.	4.12	5.22	n.a.	n.a.	n.a.
Kyrgyzstan	n.a.	n.a.	n.a.	n.a.	10	n.a.	n.a.	n.a.	n.a.	n.a.
Lithuania	n.a.	n.a.	n.a.	n.a.	1	n.a.	n.a.	n.a.	n.a.	n.a.
Madagascar	n.a.	n.a.	n.a.	n.a.	10	n.a.	n.a.	n.a.	n.a.	n.a.
Malawi	n.a.	n.a.	n.a.	n.a.	17	n.a.	n.a.	n.a.	n.a.	n.a.
Malaysia	0	0.25	0	0.38	7	4.95	5.76	75	n.a.	n.a.
Mauritius	1	0.38	0	0	n.a.	5.35	5.53	n.a.	n.a.	n.a.
Mexico	0.5	0.38	0	1	4	3.34	2.61	n.a.	n.a.	n.a.
Moldova	n.a.	n.a.	n.a.	n.a.	5	n.a.	n.a.	n.a.	n.a.	n.a.
Morocco	0.5	0.13	0	0	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Namibia	n.a.	n.a.	n.a.	n.a.	4	n.a.	n.a.	n.a.	n.a.	n.a.
Netherlands	0	0.5	1	0	n.a.	6.64	5.42	156	84	n.a.
New Zealand	0	0.38	1	1	n.a.	5.82	6.14	n.a.	n.a.	n.a.
Nicaragua	0	0	0	1	5	n.a.	n.a.	n.a.	n.a.	n.a.
Nigeria	0	0.5	0	1	18	n.a.	n.a.	n.a.	n.a.	n.a.
Panama	n.a.	n.a.	n.a.	n.a.	5	n.a.	n.a.	n.a.	234	100
Papua N.Guinea	0.5	0	0	0	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Peru	0.5	0	0.5	1	7	2.88	3.32	n.a.	142	n.a.
Philippines	0.5	0	0	0.38	7	2.79	3.51	118	n.a.	n.a.
Poland	0.25	0	0	0	3	3.34	3.41	n.a.	n.a.	n.a.
Portugal	0	0.13	1	0	8	3.81	6.5	n.a.	n.a.	n.a.
Romania	0	0.63	0	0	3	n.a.	n.a.	n.a.	n.a.	n.a.
Russia	n.a.	n.a.	n.a.	n.a.	7	3.33	2.23	n.a.	n.a.	n.a.
Senegal	0	0	0	1	7	n.a.	n.a.	n.a.	n.a.	n.a.
Singapore	1	0.38	0	0.33	2	6.76	6.72	117	n.a.	n.a.
Slovakia	n.a.	n.a.	n.a.	n.a.	2	3.5	4.35	n.a.	n.a.	n.a.
Slovenia	n.a.	n.a.	n.a.	n.a.	2	n.a.	n.a.	n.a.	n.a.	n.a.

(continue)

Country	Cargo Handling Restriction Index	Mandatory Services Index	Price Fixed Agreements Index	Cooperative Agreements Index	Median Clearance time (Days)	Port Efficiency Index (1-7)	Crime Index (1-7)	Container Handling Charges		
								World Bank US$/TEU	CMPCH Index	LSU Index
South Africa	n.a.	n.a.	n.a.	n.a.	5	5.24	2.08	n.a.	n.a.	n.a.
Spain	0	0.06	1	0	4	4.88	6.08	200	105	n.a.
Sweden	0	0.06	1	0	2	5.73	6.46	n.a.	n.a.	n.a.
Taiwan	0.5	0	0	0	n.a.	5.18	4.49	140	163	n.a.
Tanzania	n.a.	n.a.	n.a.	n.a.	14	n.a.	n.a.	n.a.	n.a.	n.a.
Thailand	0.5	0.63	0	0.38	4	3.98	5.12	93	n.a.	n.a.
Togo	0	0	0	0	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Tunisia	0.5	0.13	0	0	5.5	n.a.	n.a.	n.a.	n.a.	n.a.
Turkey	0	0	0.43	0	n.a.	3.81	5	n.a.	n.a.	n.a.
Uganda	n.a.	n.a.	n.a.	n.a.	14	n.a.	n.a.	n.a.	n.a.	n.a.
Ukraine	n.a.	n.a.	n.a.	n.a.	10	3.41	3.28	n.a.	n.a.	n.a.
United Kingdom	0	0.31	1	0	4	5.37	6.17	173	n.a.	n.a.
United States	n.a.	n.a.	n.a.	n.a.	5	6.27	5.4	259	336	n.a.
Uruguay	0	0	0	1	5	n.a.	n.a.	n.a.	n.a.	n.a.
Uzbekistan	n.a.	n.a.	n.a.	n.a.	7	n.a.	n.a.	n.a.	n.a.	n.a.
Venezuela	0	0	1	1	11	3.28	3.63	n.a.	n.a.	n.a.
Vietnam	0	0	0	0.5	n.a.	3.81	5.02	n.a.	n.a.	n.a.
Zambia	n.a.	n.a.	n.a.	n.a.	10	n.a.	n.a.	n.a.	n.a.	n.a.
Zimbabwe	n.a.	n.a.	n.a.	n.a.	10	3.29	5.15	n.a.	n.a.	n.a.

n.a. : Not Available

Source: Data for the first 4 columns was kindly provided by Carsten Fink, Aaditya Mattoo, and Ileana Cristina Neagu* (2000).

Country	TC_3	Port Infrastructure	Infrastructure Index
Argentina	0.242	-28.082	-2.351
Australia	0.328	-27.193	-0.910
Belgium	0.234	-24.348	0.212
Brazil	0.306	-29.918	-2.825
Canada	0.399	-26.902	-0.845
Chile	0.318	-26.465	-2.310
China	0.508	-33.752	-4.527
Colombia	0.312	-28.251	-3.075
Costa Rica	0.355	-24.566	-1.140
Germany	0.333	-25.730	0.155
Denmark	0.249	-21.549	0.478
Ecuador	0.401	-26.097	-2.577
Egypt	0.424	-29.555	-3.296
Spain	0.418	-24.734	-0.631
Finland	0.293	-24.027	-0.136
France	0.349	-25.558	0.267
United Kingdom	0.382	-22.822	0.273
Greece	0.376	-25.186	-0.135
Hong Kong	0.309	-22.685	n.a.
Indonesia	0.493	-28.986	-3.110
India	0.554	-32.116	-3.429
Ireland	0.503	-24.901	-0.024
Iceland	0.312	-22.677	-0.280
Italy	0.456	-24.396	-0.202
Japan	0.417	-24.833	-0.245
Republic of Korea	0.393	-25.267	-0.919
Mexico	0.564	-29.640	-2.550
Mauritius	0.410	-36.841	-1.225
Malaysia	0.371	-29.620	-1.683
Netherlands	0.368	-23.984	-0.207
New Zealand	0.480	-24.884	-0.290
Peru	0.468	-27.874	-3.758
Philippines	0.544	-26.823	-2.979
Poland	0.551	-27.959	-0.948
Portugal	0.380	-24.772	-0.430
Senegal	0.146	-21.612	0.475
El Salvador	0.247	-25.567	-2.623
Sweden	0.347	-23.597	0.456
Thailand	0.375	-28.282	-2.736
Turkey	0.463	-27.633	-2.285
Taiwan	0.278	-25.194	n.a.
Venezuela	0.358	-25.140	-2.060
Vietnam	0.699	-27.646	-4.054

n.a.: Data not available. All the indexes are in logarithms

$TC_{3,}$ is the infrastructure index estimated

Port Infrastructure Index: Is the ratio between the number of ports per country (square) and the product of country surface and population. Number of ports where obtained form Portualia S.A., and surface and population were obtained form World Bank WDI - 2002

Infrastructure Index: GCR port index

Figure 1
Estimates of Total Imports Freight Costs Relative to Imports (CIF), 1997

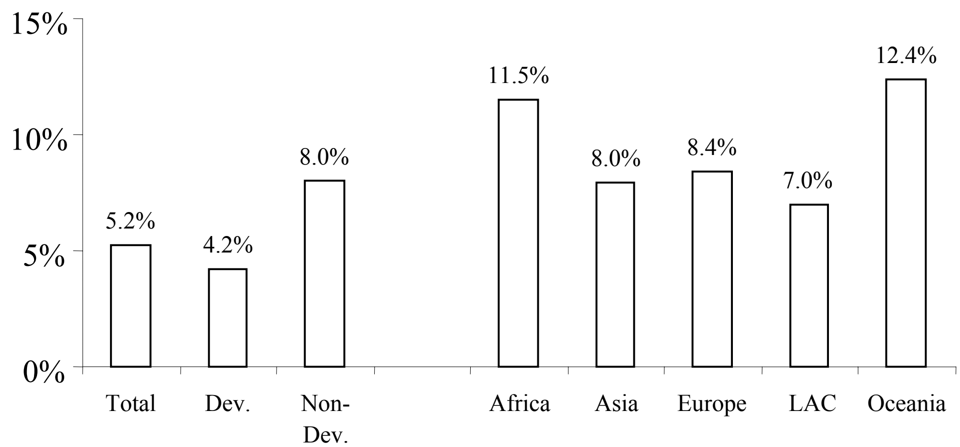


Figure 2
Imports Freight Costs (CIF/FOB ratio) and Import Tariffs relative to Import value, 1996-97

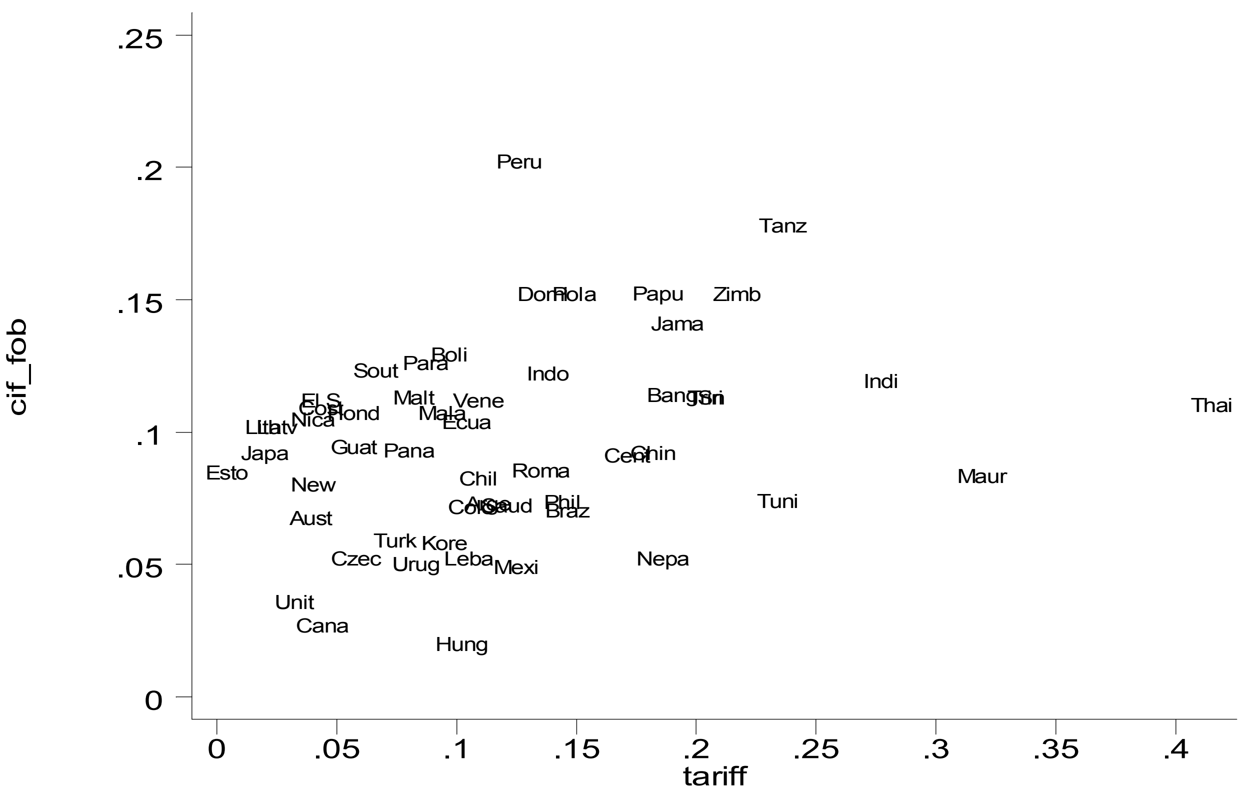
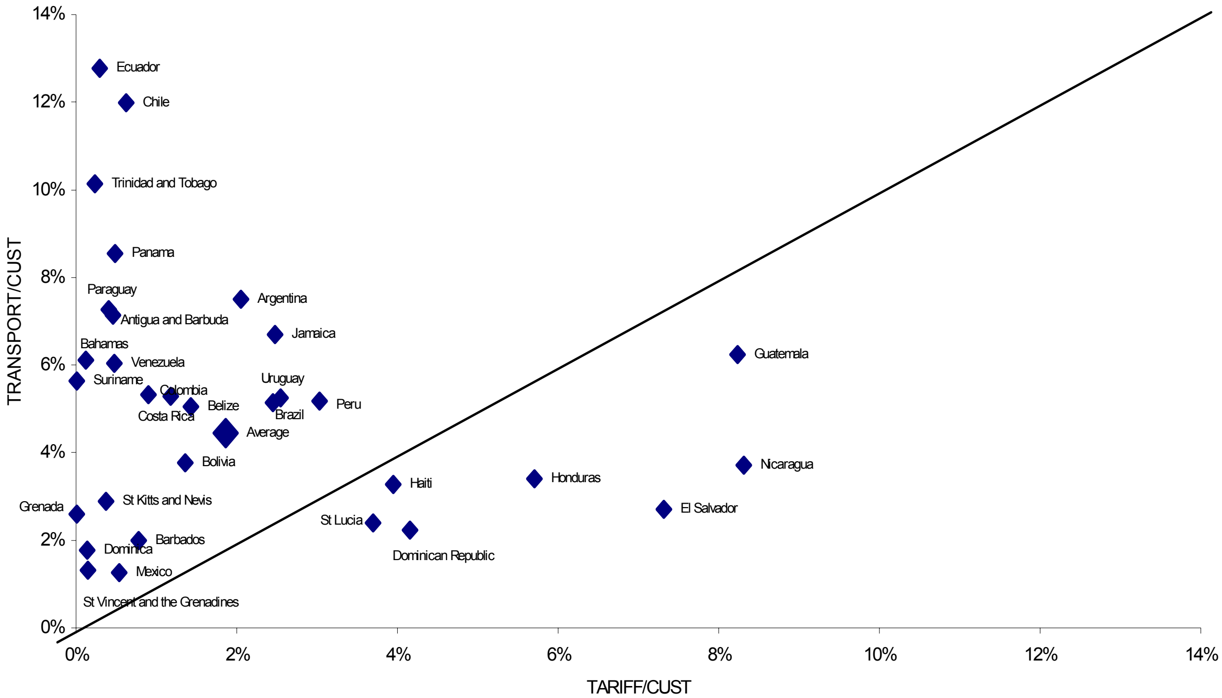


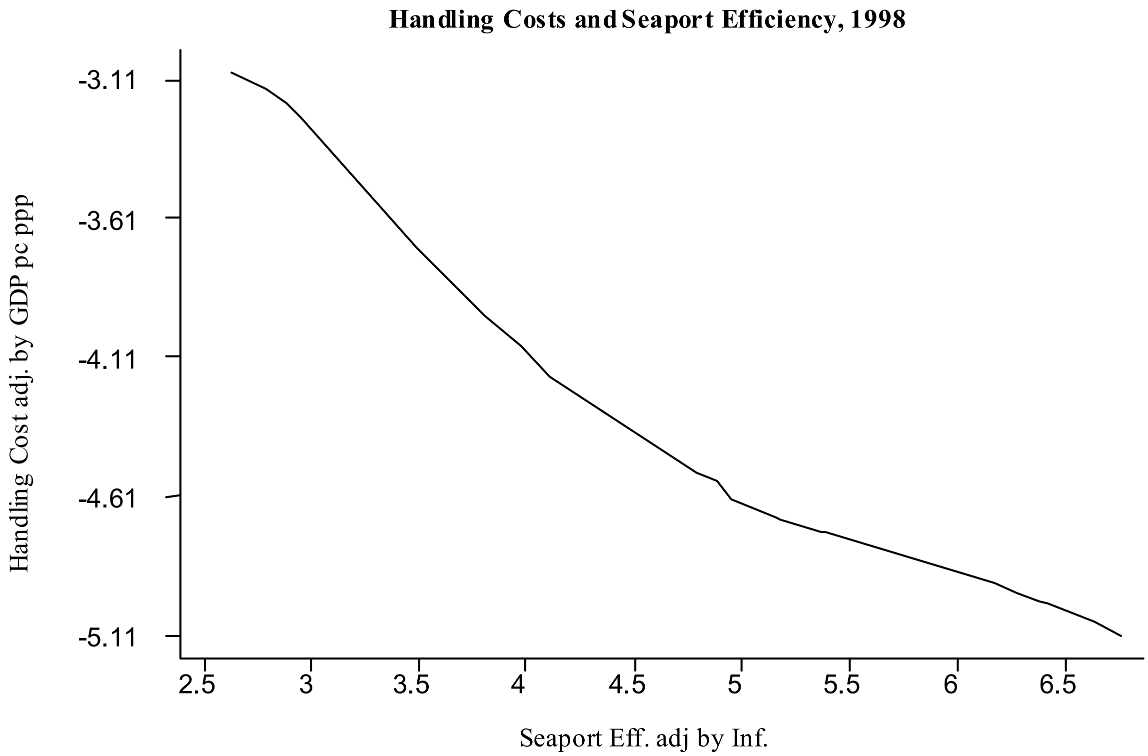
Figure 3
Export Freight Costs and US Tariff,
Latin American Countries, 1998



Sources: U.S. Census Bureau, Department of Commerce.[69]

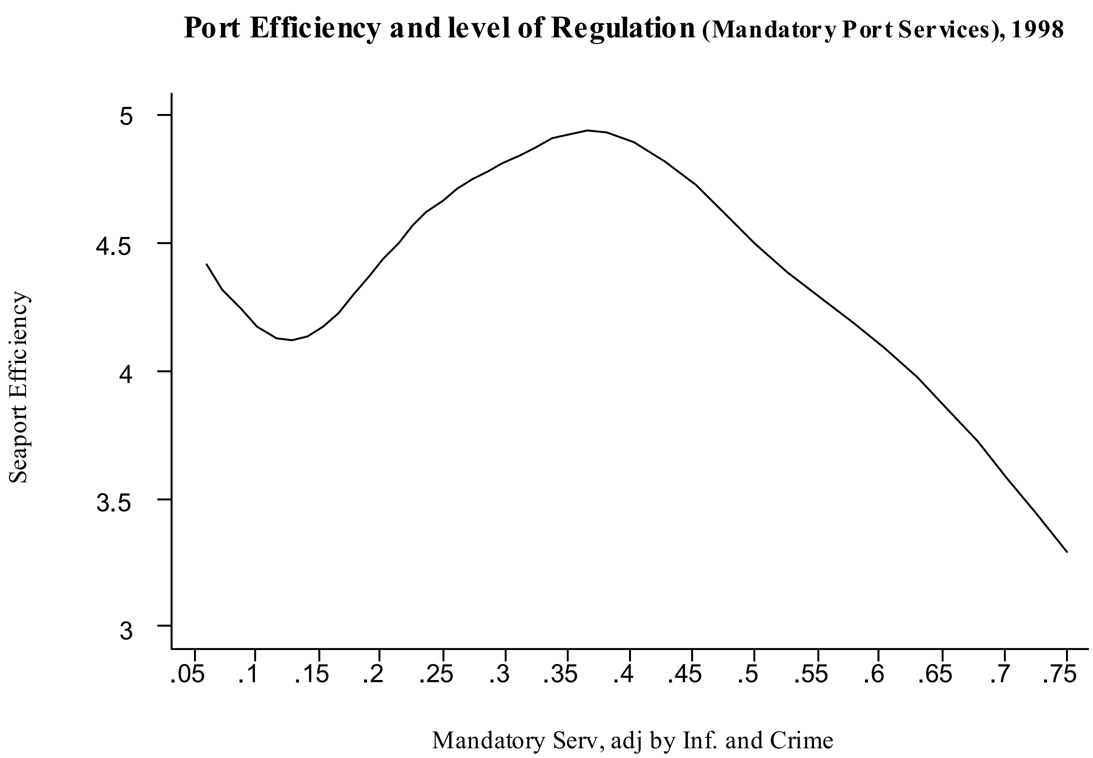
[69] The high calculated duty presented by Central American countries are due to textile products (code 6 in HTSUSA).

Figure 4



Natural Cubic Spline

Figure 5



Natural Cubic Spline

Table 1: Determinants of Maritime Transport Costs, 1998
Dependent Variable: TC=(Charges / Weight)

Variables:	(1)	(2)	(3)	(4)
Distance (ln)	0.183	0.166	0.170	0.180
	(8.04)***	(10.44)***	(10.66)***	(10.52)***
Weight value (ln)	0.551	0.550	0.553	0.555
	(51.55)***	(53.09)***	(49.69)***	(53.86)***
Containerization (%)	-0.034	-0.038	-0.036	-0.037
	(2.55)**	(2.90)***	(2.71)***	(2.96)***
Directional Imbalance (%)	-0.065	-0.060	-0.036	-0.037
	(2.34)**	(1.90)*	(1.48)	(1.46)
Total liner volume (ln)	-0.037	-0.038	-0.032	-0.022
	(3.01)***	(3.57)***	(3.50)***	(2.70)***
Policy variables				
Price fixing rate agreement	0.024	0.005	0.015	0.058
	(0.71)	(0.15)	(0.45)	(1.75)*
Cooperative agreement	-0.018	0.001	-0.014	-0.007
	(0.83)	(0.04)	(0.61)	(0.39)
Foreign port efficiency				
Port efficiency GCR	-0.043			
	(3.83)***			
Ports normalized by size and Pop.		-0.009		
		(2.43)**		
Infrastructure Index			-0.030	
			(3.23)***	
Foreign GDPpc (ln)				-0.048
				(4.99)***
Observations	314439	332348	296277	332480
R-squared	0.47	0.47	0.48	0.47

Robust t-statistics in parentheses computed using clusters by foreign country. *, **, *** significant at 10%; 5% and 1%.

All regressions include fixed effect for products (4848 HS 6 digits products) and for US customs districts (31).
Directional Imbalance is computed as US export minus import divided by bilateral trade.
Total liner volume is computed as the total volume of merchandized from the foreign country to one coast in the US.
Port efficiency GCR is a one to seven index ranking port efficiency, based on surveys performed to representative firms.
Ports normalized by size and GDP is the number of large seaport in the foreign country (squared) divided by area and GDP.
Infrastructure index is a foreign country infrastructure index constructed using telephones, roads, railroads and airports.

Table 2: Determinants of Maritime Transport Costs Controlling by Income Group, 1998
Dependent Variable: TC=(Charges / Weight)

Variables:	(1)	(2)	(3)
Distance (ln)	0.179	0.161	0.165
	(8.90)***	(10.42)***	(10.48)***
Weight value (ln)	0.549	0.549	0.553
	(52.34)***	(53.74)***	(49.93)***
Containerization (%)	-0.030	-0.037	-0.035
	(2.20)**	(2.84)***	(2.67)***
Directional Imbalance (%)	-0.068	-0.056	-0.036
	(3.26)***	(1.90)*	(1.49)
Total liner volume (ln)	-0.044	-0.042	-0.036
	(3.77)***	(3.78)***	(3.64)***
Policy variables			
Price fixing rate agreement	-0.028	-0.012	0.001
	(0.83)	(0.38)	(0.02)
Cooperative agreement	-0.021	0.001	-0.013
	(1.04)	(0.05)	(0.56)
Foreign port efficiency			
Port efficiency GCR	-0.056		
	(5.34)***		
Ports normalized by size and Pop.		-0.011	
		(2.23)**	
Infrastructure Index			-0.038
			(3.72)***
Developed Country	0.086	0.030	0.045
(Dummy Variable)	(2.46)**	(0.69)	(1.15)
Observations	314439	332348	296277
R-squared	0.48	0.47	0.48

Robust t-statistics in parentheses computed using clusters by foreign country. *, **, *** significant at 10%; 5% and 1%.
All regressions include fixed effect for products (4848 HS 6 digits products) and for US customs districts (31).
Directional Imbalance is computed as US export minus import divided by bilateral trade.
Total liner volume is computed as the total volume of merchandized from the foreign country to one coast in the US.
Port efficiency GCR is a one to seven index ranking port efficiency, based on surveys performed to representative firms.
Ports normalized by size and GDP is the number of large seaport in the foreign country (squared) divided by area and GDP.
Infrastructure index is a foreign country infrastructure index constructed using telephones, roads, railroads and airports.

Table 3: Determinants of Maritime Transport Costs, 1996-2000
Dependent Variable: TC=(Charges / Weight)

	(1)	(2)	(3)	(4)
Distance (ln)	0.179	0.168	0.245	0.243
	(6.15)***	(6.57)***	(13.83)***	(14.37)***
Weight value (ln)	0.552	0.549	0.528	0.527
	(43.42)***	(44.32)***	(52.90)***	(52.29)***
Containerization (%)	-0.021	-0.021	0.057	0.058
	(1.18)	(1.12)	(2.48)**	(2.54)**
Directional Imbalance (%)	-0.079	-0.080	-0.032	-0.034
	(2.44)**	(3.52)***	(1.09)	(1.22)
Total liner volume (ln)	-0.033	-0.041	-0.003	-0.006
	(2.47)**	(3.21)***	(0.22)	(0.45)
Policy variables				
Price fixing rate agreement	0.059	-0.017	-0.046	-0.070
	(1.52)	(0.55)	(1.72)*	(3.02)***
Cooperative agreement	-0.031	-0.032	-0.007	-0.009
	(1.37)	(1.86)*	(0.40)	(0.51)
Foreign port efficiency				
Port efficiency GCR	-0.061	-0.078	-0.060	-0.066
	(4.13)***	(7.48)***	(5.48)***	(5.75)***
Developed Country		0.119		0.041
(Dummy Variable)		(3.40)***		(1.40)
Observations	273063	273063	361691	361691
R-squared	0.50	0.50	0.46	0.46
Year	1996		2000	

Robust t-statistics in parentheses computed using clusters by foreign country. *, **, *** significant at 10%; 5% and 1%.

All regressions include fixed effect for products (4848 HS 6 digits products) and for US customs districts (31).

Directional Imbalance is computed as US export minus import divided by bilateral trade.

Total liner volume is computed as the total volume of merchandized from the foreign country to one coast in the US.

Port efficiency GCR is a one to seven index ranking port efficiency, based on surveys performed to representative firms.

Ports normalized by size and GDP is the number of large seaport in the foreign country (squared) divided by area and GDP.

Infrastructure index is a foreign country infrastructure index constructed using telephones, roads, railroads and airports.

Table 4: Determinants of Maritime Transport Costs, Port Efficiency Variables

Region	Port Efficiency (7=best, 1=worst)	Custom Clearance (days)	Container Handling Charges in Ports (US$/TEU)
North America	6.35	3.50	261.7
Europe (excl. East)	5.29	4.00	166.7
Middle East	4.93	n.a.	n.a.
East Asia & the Pacific	4.66	5.57	150.5
East & South Africa	4.63	12.00	Na
North Africa	3.72	5.50	Na
Former Soviet Union	3.37	5.42	Na
East Europe	3.28	2.38	Na
Latin Am. & the Caribbean	2.90	7.08	251.4
South Asia	2.79	n.a.	n.a.
West Africa	n.a.	11.70	n.a.

Sources: Global Competitiveness Report (1999), World Bank Surveys, Camara Maritima y Portuaria de Chile. A.G. (1999), and LSU (1998). (n.a: Data not available)

Table 5: Handling Costs and Port Efficiency, 1998

Dependent variable: Container Handling Charges, divided by wage or proxy (in logarithm)

	(1)	(2)	(3)[a]	(4)	(5)[a]
Variables:	(Adj. By m.wage)	(Adj. By GDPpc)	(Adj. By GDPpc)	(Adj. By GDPpc PPP)	(Adj. By GDPpc PPP)
Port Efficiency	-0.459	-0.366	-0.288	-0.350	-0.321
(GCR 1999)	(0.043)***	(0.059)***	(0.063)***	(0.051)***	(0.069)***
Infrastructure Index [b]	-0.164	-0.418	-0.520	-0.150	-0.162
(proxy for port infrastructure)	(0.081)*	(0.064)***	(0.034)***	(0.040)***	(0.047)***
Constant	-2.386	-2.848	-3.331	-2.866	-3.024
	(0.284)***	(0.357)***	(0.378)***	(0.295)***	(0.406)***
Observations	12	23	18	23	18
R-squared	0.947	0.931	0.959	0.893	0.884

Notes: Robust t-statistics in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%. a: regression uses handling cost data form the World Bank only. b: the infrastructure index is in logarithm.

Table 6: Determinants of Port Efficiency, 1998

Dependent var.: Port Efficiency (Global Competitiveness Report 1999)			
Variables:	(1)	(2)	(3)
Infrastructure	0.328	0.325	0.319
	(0.101)***	(0.104)***	(0.101)***
Cargo Handling Restrictions	0.602	0.103	
	(1.177)	(0.352)	
Cargo Handling Restrictions (square)	-0.544		
	(1.239)		
Mandatory Port Services	3.206	3.147	3.231
	(1.530)**	(1.526)**	(1.471)**
Mandatory Port Services (square.)	-4.783	-4.558	-4.600
	(2.182)**	(2.097)**	(2.087)**
Organized Crime	0.509	0.492	0.488
(Org. crime in not a problem)	(0.117)***	(0.089)***	(0.087)***
Constant	2.064	2.163	2.183
	(0.739)***	(0.593)***	(0.587)***
Observations	41	41	41
R-squared	0.772	0.770	0.770

Robust standard errors in parentheses

* significant at 10%; ** significant at 5%; *** significant at 1%

Table 7: Determinants of Maritime Transport Costs, Regulation and Org. Crime (1998)

Dependent Variable: TC=(Charges / Weight)

Variables	(1)	(2)	(3)	(4)
Distance (ln)	0.152	0.162	0.136	0.145
	(5.51)***	(7.24)***	(5.07)***	(6.34)***
Weight value (ln)	0.552	0.554	0.551	0.553
	(49.73)***	(46.59)***	(50.20)***	(46.62)***
Containerization (%)	-0.041	-0.040	-0.038	-0.037
	(3.25)***	(3.01)***	(2.81)***	(2.75)***
Directional Imbalance (%)	-0.026	-0.017	-0.018	-0.002
	(0.600)	(0.620)	(0.370)	(0.080)
Total liner volume (ln)	-0.064	-0.051	-0.077	-0.064
	(3.32)***	(4.03)***	(3.83)***	(4.25)***
Policy variables				
Price fixing rate agreement	0.016	0.009	-0.037	-0.02
	(0.560)	(0.270)	(1.150)	(0.520)
Cooperative agreement	-0.007	-0.021	-0.01	-0.013
	(0.390)	(1.050)	(0.570)	(0.660)
Foreign port efficiency				
Ports normalized by size and Pop.	-0.015		-0.019	
	(1.84)*		(2.37)**	
Infrastructure Index		-0.028		-0.056
		(1.71)*		(2.88)***
Mandatory Port Services	0.37	0.188	0.229	0.347
	(1.570)	(0.820)	(1.090)	(1.530)
Mandatory Port Services (square)	-0.659	-0.434	-0.463	-0.633
	(2.02)**	(1.320)	(1.510)	(2.04)**
Organized Crime	-0.036	-0.032	-0.041	-0.03
(Org. crime is not a problem)	(3.26)***	(3.62)***	(4.65)***	(4.31)***
Developed Country			0.100	0.100
(Dummy Variable)			(2.24)**	(2.25)**
Observations	308529	273403	308529	273403
R-squared	0.470	0.480	0.470	0.480

Robust t-statistics in parentheses computed using clusters by foreign country. *, **, *** significant at 10%; 5% and 1%.
All regressions include fixed effect for products (4848 HS 6 digits products) and for US customs districts (31).

Directional Imbalance is computed as US export minus import divided by bilateral trade.

Total liner volume is computed as the total volume of merchandized from the foreign country to one coast in the US.
Port efficiency GCR is a one to seven index ranking port efficiency, based on surveys performed to representative firms.
Ports normalized by size and GDP is the number of large seaport in the foreign country (squared) divided by area and GDP.
Infrastructure index is a foreign country infrastructure index constructed using telephones, roads, railroads and airports.

Table 8: Country-Specific Maritime Transport Cost Indexes: Pair-wise Correlations

	TCI_1	TCI_2	TCI_3	TCI_4	Port Efficiency GCR
TCI_1	1				
TCI_2	0.97*	1			
TCI_3	0.97*	0.97*	1		
TCI_4	0.93*	0.99*	0.97*	1	
Port Efficiency GCR	-0.36*	-0.39*	-0.42*	-0.38*	1

* Significant at 1%. TC_k represents each of the country-specific maritime transport costs indexes estimated and explained in section V.

Source: Authors own estimations

Table 9: Bilateral Trade and Country-Specific Transport Costs

Dependant Variable: Log Value of Bilateral Trade in Real $

Variables:	(1)	(2)	(3)	(4)	(5)	(6)
Log of Distance	-1.273	-0.942	-0.975	-0.969	-0.976	-0.964
	(37.97)***	(16.57)***	(17.60)***	(16.68)***	(17.65)***	(16.58)***
Log of Product of Real GDPs	0.941	0.969	0.977	0.973	0.996	0.983
	(63.70)***	(36.73)***	(37.53)***	(35.27)***	(37.85)***	(35.45)***
Log of Product of Real GDPs per capita	0.424	0.766	0.689	0.696	0.683	0.702
	(18.58)***	(15.75)***	(12.97)***	(12.39)***	(12.75)***	(12.56)***
1 for Common Language	0.421	0.653	0.644	0.667	0.644	0.668
	(6.46)***	(6.54)***	(6.52)***	(6.23)***	(6.51)***	(6.24)***
Land Border Dummy	0.745	0.276	0.138	0.109	0.142	0.124
	(4.78)***	(1.24)	(0.64)	(0.49)	(0.66)	(0.56)
RTA Dummy	0.893	-0.124	-0.119	-0.093	-0.133	-0.089
	(6.22)***	(0.84)	(0.84)	(0.63)	(0.94)	(0.60)
# Landlocked 0/1/2	-0.302					
	(6.27)***					
# Islands 0/1/2	-0.083	-0.004	0.073	0.076	0.063	0.075
	(1.54)	(0.04)	(0.86)	(0.83)	(0.75)	(0.82)
Log of Product of Land Areas	-0.093	-0.120	-0.115	-0.098	-0.111	-0.095
	(7.69)***	(7.37)***	(7.16)***	(4.90)***	(6.85)***	(4.68)***
Dummy for Common Colonizer post 1945	0.386	0.533	0.502	0.675	0.496	0.686
	(3.51)***	(1.76)*	(1.83)*	(1.80)*	(1.80)*	(1.83)*
Dummy for pairs ever in Colonial Relationship	1.310	0.254	0.293	0.302	0.290	0.299
	(9.92)***	(1.51)	(1.77)*	(1.71)*	(1.74)*	(1.69)*
Strict Currency Union	0.904					
	(3.25)***					
TC_1			-1.342			
			(4.41)***			
TC_2				-1.291		
				(3.64)***		
TC_3					-1.439	
					(4.47)***	
TC_4						-1.238
						(3.43)***
Observations	7996	809	809	769	809	769
R-squared	0.68	0.84	0.85	0.84	0.85	0.84

Robust t-statistics in parentheses. * Significant at 10%; ** significant at 5%; *** significant at 1%

TC_1, TC_2, TC_3 and TC_4 account for the country - specific maritime transport costs index, explained in section V.

Variables: Landlocked, # of Islands, Log of Product of Land Areas, Strict Currency Union, Dummy of Common Colonizers post 1945 and Colonial Relationship were kindly provided by Rose(2002).