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Determinants of Maritime Transport Costs

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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 at the six-digit HS level from different ports around the world. Distance and containerization matter. In addition, we find that efficiency of ports 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 percent farther away from markets for the average country.) Inefficient ports also increase handling costs, which are one of the components of shipping costs. 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. Finally, we present a number of success stories in Latin America to show that private involvement in port management leads to efficiency and lower costs whenever it is accompanied by labor reform, and when monopoly power is reduced through either regulation or competition.

JEL number: [F1, L41, L92]
Keywords: maritime transport costs, port efficiency

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[*] Inter-American Development Bank. This paper only includes some experiences of Latin American countries relevant to the work of Ximena Clark, David Dollar, and Alejandro Micco (2002). Views expressed are those of the authors and do not necessarily reflect official views of the Inter-American Development Bank.

1. Introduction

Since the beginning of modern economics the literature concerning the determination of living standards has been interested in trade.[1] 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."[2]

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.[3]

These recent liberalizations have reduced tariff and, in some cases, non-tariff barriers too. For instance, Asia reduced its average tariff rate from 30 percent at the beginning of the 1980s to 14 percent by the end of the 1990s, and Latin America reduced its average tariff rate from 31 percent to 11 percent.[4] These reductions in artificial trade barriers have implied that the relative importance of transport costs as a determinant of trade has increased.[5] 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 percent). When these costs are disaggregated 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 percent compared to 8 percent for Asia and 11.5 percent for Africa), the Latin American figure is weighted by Mexico's proximity to its main trading partner, the United

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[1] In his discussion of specialization and the extent of the market in *The Wealth of Nations*, Adam Smith stresses the relationship between wealth and trade between nations.

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

[3] See Dollar and Kraay (2001).

[4] Central America and the Caribbean reduced its average tariff rate from 21 percent to 9 percent between these periods, and African countries from 30 percent to 20 percent. 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 1990s should be smaller (Source: World Bank http://www1.worldbank.org/wbiep/trade/TR_Data.html).

[5] See Amjadi and Yeats (1995) and Radelet and Sachs (1998).

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 their 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.[6] 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 percent 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 percent to a 16 percent 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 microdata can provide. An exception is a recent study by 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 widespread consensus on the crucial importance of port activities for transport services. However, there are no measures of the

[6] An example of this literature is Bergstrand (1985).

importance of port-level inefficiencies for transport costs. 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.

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 estimations present, and we also extend backward the period of analysis to 1995. We find that a 100 percent increase in distance raises maritime transport costs by around 20 percent, a result that is quite consistent with the existing 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 percent. This result is robust to different definitions of port efficiency as well as to 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 2 presents a description of factors that may be behind transport costs. Section 3 describes the econometric model used to quantify the relative importance of factors affecting transport costs. It also contains a description of the data used, as well as the results of our analyses. In Section 4, we analyze the importance of infrastructure, regulation and organized crime in explaining port efficiency. Section 5 presents several success stories in Latin American port management. Section 6 concludes.

2. What Factors Explain Maritime Transport Costs?

As discussed above, 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,[7] this section addresses these questions, based on a qualitative and quantitative description of transport cost determinants. Given its relative

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[7] This section follows McConville (1999), Furchsluger (2000a and 2000b), Limao and Venables (2000), and Fink, Mattoo and Neagu (2000).

importance (and also the availability of data), the main focus of 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,[8] although sometimes under certain restrictions. In any case, we should not expect differences in capital or labor costs to be the main factors in explaining differences in 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.[9] The greater the distance between two markets, the higher the expected transport cost for their trade. 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 percent 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, transport costs rise by $2,170, almost a 50 percent increase in the average cost.[10] 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 represent around 15 percent of total maritime charges. Therefore, high value-added exporting countries should have higher charges per unit weight due to this

[8] Shipping companies prefer to sail their ships under open-registry flags. This explains why Panama, Liberia, Cyprus and Bahamas account for more than 40 percent of world fleets as measured in dead weight tons, or dwt (UNCTAD, 1999).

[9] 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).

[10] This result controls for the extra overland distance that must be traversed by landlocked countries in order to reach the sea.

insurance component. On the other hand, some products require special transport features and therefore have different freight rates.[11]

Directional imbalance in trade between countries implies that many carriers are forced to haul empty containers on their return trips. As a result, either imports or exports become more expensive. Furchsluger (2000a) 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).[12] 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 percent in extra transport costs compared to suppliers in the US and Europe.[13]

Maritime transport is a classic example of example of an industry that faces increasing return 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 faster than the square of her dimensions."[14] 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[15] vessel but only $14 per container for a 1,000 TEU vessel.[16] 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.[17]

In addition, the development of containerized transport has been an important technological change in the transport sector during the last decades. Containers have allowed

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[11] Louisiana State University-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.

[12] 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.

[13] 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 $1,561/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 $1,353/TEU and $873/TEU respectively.

[14] 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).

[15] TEU is a standard container measure and it refers to Twenty Feet Equivalent Unit.

[16] See Fuchsluger (2000b).

large cost reductions in cargo handling, increasing cargo transshipment and therefore national and international cabotage.[18] 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.[19]

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, such as the UN Liner Code.[20] Private anti-competitive practices include, among others, the practice of fixing rates of maritime conferences.[21] Some authors have claimed that maritime conferences have lost power in recent years,[22] which has forced shipping companies to merge as a way to maintain their monopoly power.[23]

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.[24]

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 percent for landlocked ones.[25] 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.[26]

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[17] See PIERS, *On Board Review*, Spring 1997.

[18] Cabotage refers to transshipment of the merchandise before it arrives to its final destination.

[19] See Hoffman (2000).

[20] 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.

[21] Maritime conferences enjoy an exemption from competition rules in major trading countries, like the US and the European Union.

[22] 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.

[23] See Fink, Mattoo and Neagu (2000) and Hoffman (2000).

[24] 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 Cámara Chilena Maritima (1999) for a discussion of this case.

[25] 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 -0.3.

[26] 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

3. Maritime Transport Costs Estimation

Focusing on the factors affecting transport costs already described, this section attempts to quantify the importance of most[27] of them on maritime transport charges paid by U.S. imports carried by liner companies[28] from countries all over the world. This analysis closely follows FMN (2000). However, we add additional variables—notably a measure of port efficiency—to the analysis, we redefine some of the other relevant variables (including the dependent variable), and we also extend backward the period of analysis to 1995. In addition, we address the problems of endogeneity and omitted variable bias we believe their estimations present, which we explain in the rest of this section.

The Model

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}: 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

j: corresponds to US port, located in district J

k: product, aggregated at the 6 digit of the Harmonized System (HS) Classification

mc: marginal cost, in logarithm.

μ: markup, in logarithm.

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infrastructure from the 75th to the 25th percentiles reduces transport costs by 30 percent 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.

[27] We do not analyze the impact of trade imbalance in transport charges because of data unavailability.

[28] 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 in 2001.

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:

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

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.

PE_I: ports' efficiency of foreign country I.

The first term (α_J) in equation [2] takes into account potential differences in port efficiencies across US customs 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}) represents 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 variable (q_{IJ}) accounts for potential economies of scale, 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, and ω.

At this stage, we highlight three differences with respect to FMN (2000). The first two refer to the construction of the dependent variable and the variable measuring economies of scale. For the first, we use charges per weight (instead of charges per unit, as they do), because—despite the level of disaggregation of the data—there are still important differences inside product categories. This heterogeneity inside product categories is better captured when using our definition. With respect to the economy of scale variable, we define it as the *volume* of

imports departing from a particular foreign country and arriving to a particular coast in the US.[29] A third and more important difference lies in the inclusion of the weight-to-value variable. As already stated, this variable accounts for the effect of the insurance component on the transport cost and, as we show next, it turns out to be highly significant. FMN (2000) do not include a variable of this type, probably because of the inclusion of dummies per product. However, because of the insufficient level of disaggregation of the data, product dummies are not enough and the exclusion of this variable can cause important omitted variable bias.[30]

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

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

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, we obtain the econometric model to be estimated:

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

Where:

$\beta_k \equiv \lambda_k + \rho_k$

ε_{ijk}: error term.

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[29] FMN (2000) define this variable as the total *value* of imports departing from a particular foreign port and arriving at a particular US district.

[30] We replicated FMN (2000) estimations with and without the unit value variable (which is the relevant variable to add in their specification, given their construction of the dependent variable). The variable turned out to be highly significant (even after using product dummies), but their results for the rest of the variables changed dramatically.

Data[31] and Results

Data on maritime transport costs, value and volume of imports, and shipping characteristics, such as the percentage of goods transported through containers, come from the U.S. Import Waterborne Databank (U.S. Department of Transportation). Our dependent variable, transport costs, is constructed using *imports charges*, defined by the U.S. Census Bureau 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."

The U.S. Import Waterborne Databank covers the period 1995-1999. Even though this database 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.[32] Liner imports account for around 50 percent of total US imports and 65 percent of US maritime imports.[33] Given that our objective is to focus only on maritime transport costs, we also drop all the observations for which the origin of the import is different from the port of shipment.[34]

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, used by FMN to construct their indices, comes from the Federal Maritime Commission; it covers 59 countries and is available only for 1998. Therefore, when estimating for the other years (1995-97, 1999), we have no choice but to use the same 1998 values for all them.

Unfortunately, there is not much comparable information about port efficiency, at the individual port level, to be used in a cross-country analysis.[35] We therefore use an aggregated per-country measure of port efficiency, consisting of a one-to-seven index (with 7 being the best

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

[32] 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 fixed 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 travel depending on momentary demand.

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

[34] That is, in-transit merchandise is not included.

score) from the Global Competitiveness Report (GCR). This annual data is available for the period 1995-1999.[36] As an alternative measure, we also use GDP per capita as a proxy for 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 both this indirect measure and a direct measure of port efficiency in different specifications.

In addition to the per capita GDP, we construct a second 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.[37] We incorporate this variable based on the assumption that the infrastructure level in a country is likely highly correlated with the infrastructure level at 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 (cost insurance freight/free on board) 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 LV try to control for that). LV's 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 authors point out, the shipping rates from Baltimore are not necessarily representative, not even for other US ports. Our database, on the other hand, has information from many ports around the world to different ports in the US.[38] 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]. We start by presenting the results only for 1998 because the variables on maritime conferences and working agreement between liners

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[35] 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 does not yet cover all the countries in our sample.

[36] 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 report).

[37] See Appendix A for a description of its construction.

[38] 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.

refer to this particular year. The first three columns show the coefficients using OLS, while the rest of the estimations use an Instrumental Variable (IV) technique.[39] Columns (1) and (4) report the results using GDP per capita as a proxy for port efficiency, columns (2) and (5) use the variable port efficiency from the GCR, and columns (3) and (6) use the index of infrastructure we constructed. As can be seen, in both types of estimations most of the variables are highly significant and with the expected sign.

Distance has a significant (at 1 percent) positive effect on transport costs. A doubling in distance, for instance, generates a roughly 20 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 at the six-digit HS level. One might think that unit values would be quite similar across countries at that level of disaggregation, but this is 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.[40]

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 percent) in two specifications.[41] This result seems to suggest that maritime conferences have been exerting some mild monopoly power, adding an estimated 6 percent to

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[39] In all the estimations (OLS, IV), 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.

[40] 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.*

[41] FMN (2000) find the price-fixing agreement dummy variable to be significant and much larger in magnitude: between 0.4 and 0.51; that is, the maritime agreements add at least 40 percent to transport costs. They also use policy variables referring to cargo reservation policies (not significant), cargo handling services (significant in one

transport costs in 1998, ceteris paribus. However, as we will see later, this estimated effect of price-fixing agreements is not always significant for other years.

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.

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, has a significant negative coefficient (as expected).[43] However, the direct incorporation of this variable into the estimations presents a problem of endogeneity. On one hand, one should expect the more the trade the lower the transport costs. But, at the same time, lower transport costs induce more trade. We address this problem in columns (4) to (6).

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 result is robust to the three alternative measures of port efficiency (columns 1 to 3). In particular, the coefficient for the measure from the Global Competitiveness Report (column 2), 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 12 percent.[44] 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 12 percent. Similar results are obtained for the other measures.[45]

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estimation but with wrong sign, and not significant in another), and mandatory port services (significant, correct sign).

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

[45] When proxying port efficiency with the per capita GDP, an increase from the 25th to the 75th percentile reduces maritime transport charges in 14 percent. When using the infrastructure index, the reduction in transport costs is around 8 percent. This last variable could be showing a smaller effect because in fact it is measuring the existence of infrastructure, but not necessarily its quality, while the other measures should capture also quality.

To solve the endogeneity problem mentioned above, we use countries' GDP as an 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. Columns (4) to (6) in Table 1 present the results for the instrumental variable (IV) estimations. Most coefficients remain stable, with the expected signs, and they continue to be significant. Using the instrumental variables, the economy of scale variable remains negative and significant, but the magnitude of the coefficient increases in absolute value when we use the GCR measure of port efficiency (-0.04 v/s -0.02). Thus, we estimate that doubling the volume of trade between a particular port and the U.S. reduces transport costs by 3-4 percent. As we already mentioned, the coefficients for the rest of the variables—in particular, for the three port efficiency measures, in particular—are quite stable.

We performed similar estimations for the rest of the years for which we have data. For brevity of space, Table 2 presents the estimated coefficients only for the IV regressions using the GCR variable for port efficiency.[46]

For each year, the coefficients on distance and weight-to-value are quite stable and significant (at 1 percent).[47] Prior to 1999, the first year after the US eroded the power of Conferences, the price-fixing rate agreement has the expected sign but it is only significant (at 10 percent) in 1997. In 1999, the coefficient turns negative, a result that may be related to a war in prices between shipping companies that were previously members of conferences. Cooperative agreement is significant only in 1995, but with the wrong sign. In addition, when we use the infrastructure index that we created (not shown here) none of these policy variables is significant. From these results it is difficult to conclude whether conferences have been exerting monopoly power.

From Table 2 we can see that the coefficient on containerization is significant only in 1998.[48] In the case of Total Liner Volumes, the coefficient is in general significant and quite stable over time. Finally, the estimated coefficient for port efficiency is stable and significant from both an economic and statistical point of view. When we used the infrastructure index from

[46] 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.

[47] 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).

[48] The low variance on the containerization levels in liner transport services may be explaining this non-significance.

the GCR (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, if countries like Ecuador, India or Brazil improved 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 percent each.

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

4. 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, such as 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."[49,50]

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

[49] 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.
[50] See Raven (2001) for a description of relevant issues concerning trade and transport facilitation.

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 the 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, especially, from region to region. It is well know that some Asian countries (Singapore, Hong Kong) have the 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 3 presents some estimates of port efficiency per geographic region.[51]

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 and 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[52]). The most striking results are those 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 the longest delays in clearing customs; while Cameroon (20 days), Nigeria (18 days) and Malawi (17 days) are the West African countries with the biggest delays.[53] 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 3 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.[54]

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[51] We must note that these efficiency variables, per region, 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 complementary rather than substitute measures.

[52] 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?"

[53] 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).

[54] Cámara Maritima y Portuaria de Chile (1999) and Louisiana State University National Ports and Waterways Institute (1998).

Despite the fact that the sample of countries for this variable is much 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, Latin American ports have the most expensive handling services. This relationship is even clearer when we take into account wage differentials across countries. Table 4 presents the regression of handling costs, adjusted by wage or its proxy, on port efficiency and an index of infrastructure (the same as used in Table 1). This index, at the country level, is included under the assumption that infrastructure at the country level is highly correlated with infrastructure at the port level. In Column (1) handling costs are adjusted by manufacturing wages,[55] in Column (2) and (3) we adjust by per capita GDP (as proxy for wages), and in Column (4) and (5) handling costs are adjusted by PPP GDP per capita.

Port efficiency is an important determinant of 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 4). The clear negative relationship shows that countries where ports are considered the most efficient (e.g., Singapore and Belgium, not shown 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 and Ecuador, not shown in the figure) are among the worst ranked in term of their efficiency and also present the highest charges per services (after controlling for the level of infrastructure).[56]

Finally, we try to explain what factors underlie 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,[57] we include among the explanatory variables two policy variables, one referring to *Cargo Handling Restrictions* and the other to *Mandatory Port Services*. Both variables are zero-to-one indices from FMN (2000). The first captures restrictions and special requirements imposed on foreign suppliers of cargo handling services,

[55] Manufacturing wages are taken from UNIDO Industrial Statistics Database.
[56] 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.
[57] We use the index of country infrastructure we constructed as proxy for port infrastructure.

where foreign suppliers refer to local companies with foreign participation.[58] The second captures the extent to which port services are mandatory for incoming ships.[59] 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 mentioned above, 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 5 some estimations of the effects of these variables on port efficiency, calculated for 1998.

As 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 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 by roughly one point. This in turn would generate a reduction of maritime transport costs of around 6 percent.

[58] 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.
[59] This variable is constructed by adding 0.125 for each of the following services if they are mandatory: pilotage, towing, tug assistance, navigation aids, berthing, waste disposal, anchorage and other mandatory services.

Finally, 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 regulation can 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.

The previous discussion of regulation introduces us to an important topic: ownership structure. Many countries have allowed the private sector to be involved in common-using public ports in the last decade. The main purposes of this new trend were to improve seaport efficiency and/or to reduce the fiscal burden induced by port losses and public debt. The following section describes the role played by recent reforms and the private sector in Latin American's seaports and their impact on efficiency.

5. Towards a Latin American Model of Port Management?[60]

Because the regulatory and institutional environment is so important for port efficiency, many countries have welcomed the private sector in port management (see Box 1). This has been a global trend affecting both developed and developing economies. In the latter, private investment commitments in 112 projects amounted to more than $9 billion between 1990 and 1999. In Latin America alone, the private sector has become involved in 64 projects worth $3.9 billion. Although the main purpose of these initiatives has been to improve seaport efficiency, privatization has also been motivated by the need to reduce the fiscal burden of port losses. Even though it is too soon to pass final judgment, the Latin American experience sees to show that private involvement increases port efficiency when supported by labor reform, and when seaport monopoly power is either adequately regulated or reduced by competition.[61]

[60] This section of the paper is based on Baird (1999), Cámara Marítima y Portuaria de Chile (1999), Estache and Carbajo (1996), Foxley and Mardones (2000), Gaviria (1998), Hoffman (2000, 1999a), Nombela and Trujillo (1999), and Viloria (2000)

Box 1. Organizational Models for Ports

Maritime transport literature characterizes ports according to the ownership of their infrastructure and superstructure. Accordingly, there are three types of ports: service ports, tool ports and landlord ports. Under the service port model—commonly used for public ports in Latin America in the 1960s—the Port Authority is in charge of infrastructure and superstructure, as well as overall operation of the port. The Port of Singapore is a publicly owned port of the service type, but there can also be private service ports, such as that of Hong Kong. The tool port can be best described as one in which the Port Authority owns the infrastructure and the superstructure, and its services are licensed to private firms. Most public ports in Latin America functioned under this scheme during the 1980s, and many Central American countries continue to do so. (Panama is an exception). Finally, under the landlord port system, the infrastructure belongs to and is managed by the Port Authority, which grants concessions to private firms for port superstructure and to provide all port services. The concessionaire can undertake the investments deemed necessary to best provide services.

Private involvement in public seaports has been the result of new market conditions and global trends in maritime transportation. The new export-led growth paradigm adopted by many countries has put pressure on port authorities to improve seaport efficiency, while containerization and other technological changes in maritime transport have forced seaports to modernize their installations and operational methods. New investments and administrative and labor reforms have been required for ports to successfully compete for cargo handling. More often than not, however, governments have been unable to financially commit to this challenge, so private sector involvement has become critical. Still, changes have been gradual and followed different paths. At the beginning of the 1980s some countries allowed private participation in seaport services such as towing, pilotage and stevedoring.[62] Since 1981, private stevedore firms have been allowed to perform all transfer services in Chilean state-owned ports, a system known as the multi-operator model. Meanwhile, Colombia allowed private operation of terminals and berths alongside major port districts.[63] As a first step toward privatization in the United Kingdom, the National Dock Labor scheme was abolished, liberalizing the labor market. In

[61] Private involvement in managing and financing ports to date has been largely limited to captive facilities. These facilities, typically for bulk cargo, are often vertically integrated into production processes and not actively promoted for use by third parties.
[62] In the United Kingdom, Thatcherism went further and privatized the ports and the Port Authority.
[63] These private berths would handle mainly liquid and solid bulk.

Asia, concessions for container operations in the port of Kelang (Malaysia) and the Manila International Container Terminal were awarded in 1986 and 1988, respectively. Most of the initial experiences had a positive impact on port efficiency.

During the 1990s, private participation in public ports became more pronounced and led the way to concession contracts that allowed private firms to operate ports and make investments to improve the quality of services. Pioneering this process in Latin America were Panama and Colombia. The former granted its first concession at Manzanillo International Terminal in 1993, which started operations by 1995, and the latter offered its port concession in 1993. Mexico was also an early reformer. The Ports Law enacted in 1994 allowed private firms to provide all port services. The major container terminals have since adopted the single-operator scheme.

Most public ports in Latin America are currently implementing the landlord port model. Under this system, the infrastructure of the port belongs to the port authority and the superstructure (including services such as pilotage and towage) is given in concession to a private firm. However, the reasons why countries have turned to this model have varied, as have the ways in which they have carried out the process. Argentina and Brazil, with little transcontinental commerce but with a large fiscal burden, were mainly driven by the fiscal impact of concessions. Colombia and Venezuela were mostly concerned with opening their economies and improving port efficiency.

Regulation regimes also differed: countries with little intra or inter-port competition implemented more restrictive regulations in order to curtail monopoly practices. The ports of the Andean Community, which are far away form each other and have poor road connections, became more regulated. On the other hand, given the proximity of MERCOSUR ports to one another, there was less regulation in order to ensure competitive price levels. A good example is the competition for cargo between the ports of southern Brazil and those of Buenos Aires and Montevideo. Competition between them has been enhanced by improved highway infrastructure that allows for more rapid connections with the interior of those countries.

Reforms have not reached all countries, however. Central American ports such as those in El Salvador, Guatemala, Honduras and Nicaragua are still service ports where modernization and labor reforms are yet to come. In Costa Rica, ports have already licensed stevedoring services, but investment and prices at the ports are still controlled by the government. The exception in the Central American region has been Panama.

Initiatives by most countries of the region in the 1990s to reform the maritime sector have led experts to define a new "Latin American model" encompassing the following features:[64]

- Public ports are part of the landlord type and mostly serve import cargo, while a high percentage of bulk goes through privately owned and operated terminals. For example, in 1998, 86 percent of Chilean liquid bulk went through such ports.
- Opportunities are available for private firms and foreign investors to establish new ports. An example is the new private terminal in Zarate, Argentina.
- Concessions have been granted for 12 to 30 years in order to promote private investment in modernization of port infrastructure and superstructure.

Though not enough time has elapsed to pass final judgment on the reforms, several results are clear. In most cases, labor productivity has increased and handling cargo costs have decreased. Efforts have been made to promote competition between proximate ports, but land transport infrastructure sill poses a serious obstacle to such competition.

National experiences have been diverse, and each one brings a lesson. The Chilean case shows that better management can significantly improve efficiency even without any additional investment. The Brazilian experience stresses the key role of labor reform. Argentina shows that competition is a good substitute for regulation, while Panama highlights the increasing importance of cabotage in international trade.

Chile

Prior to 1981, the *Empresa Portuaria de Chile* (EMPORCHI) was in charge of 11 major public ports and also had a monopoly on cargo handling. The main aim of EMPORCHI was to improve port efficiency and increase investment, especially in the ports of San Antonio and San Vicente, which by the early 1970s were unable to receive wheat, corn, sugar and many other bulk commodities. As a monopolist, EMPORCHI created a system of cargo handling under which two groups of workers coexisted: stevedores required to have a license to operate, and workers hired directly by EMPORCHI to handle cargo from the ship to the port. Because of high wages for night work, ports did not operate at night, and EMPORCHI shifts did not match those of the stevedores. These conditions led to high costs and port inefficiency.

[64] See Hoffman (2000, 1999a)

In 1981, EMPORCHI's monopoly was abolished and a multi-operator system was introduced under which all cargo-handling services were licensed to private firms that could meet quality and security requirements. The personal licenses of stevedores were abolished, eliminating their monopoly power. Although the state compensated 2,700 workers with $50 million, this scheme proved to be very successful.

In 1979, experts advised the Chilean government to invest $200 million in seaports to improve port services, an expenditure that was beyond the country's fiscal capabilities at that time. However, cargo handling (including cabotage) of all public ports increased from 22 million tons in 1979 to 66 million in 1998 without any significant investment during this period (see Figure 6). Port tariffs remained low and competitive, although Chile did not modernize its ports, as did most Latin American countries during the 1990s.

In spite of this initial success, the division of cargo among several stevedore companies limited incentives to invest in modern transfer equipment and did not permit an efficient use of limited backup yard space. This problem was exacerbated by the huge increase in trade during the 1980s and 1990s. The issue was finally addressed in 1997, when the Port Modernization Law was enacted and 11 port authorities were created. The law prohibited port authorities from handling cargo or berthing. Instead, they are required to lease the ports to private firms under a single-operator scheme. In addition, port authorities are encouraged to share revenues derived from annual rent and operational revenues with the private firms. The concessions are granted for periods of 15 or 20 years, with the possibility of extension to a maximum of 30 years. In 2000, four of the concessions, San Vicente, San Antonio, Valparaíso and Iquique, initiated operations. The lease of these four ports in 1999 represented $300 million in income for the government. No lease was granted for the Port of Arica, in part because port authorities imposed excessively high infrastructure requirements, which made the project unprofitable and would likely have led to excessive investment.

The concession process prompted labor unrest at public ports. As a result, the government reached an agreement with workers to create a safety net that, if fully used, would cost about $30 million. One consequence of the plan was that 760 of 1,750 workers accepted early retirement.

Three important lessons can be derived from the Chilean experience: (i) improvements in efficiency may not require additional investments in infrastructure; (ii) even though a multi-

operator system may be successful, it may not provide the right incentives for investment; and (iii) concessions may provide an important service by preventing white elephant investments.

Brazil

In a country as diverse as Brazil, any generalization is bold. Still, it seems safe to say that until 1993, when the Port Modernization Law was enacted, most Brazilian ports were highly inefficient, excessively bureaucratic, and constantly under-funded. The results were tariffs three to six times higher than the international average, long waiting times for ships, and deficient service provision. The situation has since improved, but inefficiency is still rampant in some ports.

The government decentralized the port system and started dismantling the public agency Protobras in 1990. Three years later, the Port Modernization Law allowed private participation in cargo handling services and liberalized port tariffs in order to promote competition between neighboring ports. The original plan was to award concessions for 36 public ports, but the process has lagged putting Brazil at a disadvantage with neighboring Argentina, where the reform ahs been more aggressive. One reason is that reforms at Brazil's ports have faced constant resistance from labor unions.[65] The Port Modernization Law gave more flexibility to the number of workers per "squadron," but this has not been fully implemented in many ports. Difficulties in reducing the number of employees have constrained the possibility of decreasing port costs. For example, in 1998, the average cost of handling a 10-foot container in Buenos Aires was $180, while in Santos, Brazil, it was $350. An important reason is that 50 workers are required for handling the cargo of a ship at Santos, compared to only 14 in Buenos Aires.

However, in two Santos terminals currently operated by private firms, waiting time for ships went from several days in 1997 to less than a day by 1999. Concessions of small ports such as Itaji, Laguna, Cabedelo and Porto Velho were well advanced in 1999: 75 percent of all port infrastructure had been leased to the private sector. The operation of ports by private firms reduced waiting time for ships and ports have become more competitive within the region. The tariff structure at Santos has been also modified, allowing a more market-oriented structure that

[65] By 1998, the Brazilian Port Union had 66,000 affiliated workers, compared to 690 unionized port workers in Argentina.

has resulted in reduced tariffs for users of these port terminals. Container handling charges were $328 per TEU in 1998, down from $550 in 1996.

The main conclusion of the Brazilian experience is that labor reform in port activity is essential to accomplish port concessions that increase productivity and reduce tariffs.

Argentina

As early as the 1970s, Argentina allowed the private sector to manage stevedoring at the public port of Buenos Aires. This early modernization effort never rendered satisfactory results in terms of productivity because of the over-regulation and the overlapping supervisory functions of state entities, strong labor unions that separated stevedoring and loading services, and a lack of investment by the port authority. In addition, other public ports were still operating under the service model, functioning inefficiently and charging very high tariffs for cargo handling.

In 1990, the first steps were taken to deregulate and decentralize public ports in a more comprehensive fashion. Deregulation consisted of abolishing restrictive working practices at ports and on vessels, and liberalizing rates for pilotage, towage and stevedoring. In addition, foreign ships were allowed to practice cabotage. The government dismantled the Ports Administration and transferred property of the major ports to the provinces, which were given the responsibility of establishing their own port authorities in charge of maintaining the port infrastructure and granting concessions to private firms.[66]

The Buenos Aires port was divided into the Dock Sud and Puerto Nuevo. The central government kept the latter and leased its six terminals to five different firms handling different types of cargo. In each terminal, a single stevedoring firm was allowed to operate under a single operator scheme. To date, the achievements of this port have been remarkable. Cargo handling increased 50 percent and labor productivity surged by 275 percent from 1990 to 1995. This progress has allowed Puerto Nuevo to compete with South America's largest port, Santos in Brazil. As of 1997, Puerto Nuevo's cargo handing had surpassed that of Santos (see Figure 7).

Currently, foreign firms can also participate in the construction of new private ports in Argentina, as has been the case of a terminal in Zárate, which is being remodeled for container handling.

[66] Smaller ports—some of them long since out of service—were transferred to provinces, which were allowed to operate or lease them to private firms or shut them down

The Argentine case shows that even when some port services are supplied by the private sector –as was the case before 1993- excessive regulation can constrain improvements in port efficiency. The country's experience since then indicates that competition, whenever possible, is preferable to regulation.

Panama

Panama was one of the first Latin American countries to privatize a public port. The first privatization took place in 1993, when a concession was granted to the Manzanillo International Terminal (MIT). The MIT started operation in 1995 and was so successful that it opened the way for other port operating concessions. The Colón Container Terminal (CCT) and the Port of Cristóbal started operations in 1997, while the Port of Balboa did so in 2000.

This process also led to the dismantling of the National Port Authority and the establishment of the Panama Maritime Authority (PMA) in 1998. The PMA is the landlord authority that awards port operating concessions to private firms and also regulates the maritime industry. The advantage of Panamanian ports such as MIT is their proximity to the Panama Canal, making them ideal hubs. MIT currently handle 70 percent of all containers that go through Panama. MIT's throughput increased from 161,000 TEUs in 1995 to 878,000 TEUs in 19999, and most of the cargo is for trans-shipment. In fact, 70 percent of all containers handled in Panamanian ports are for trans-shipment.

The experience of Panama highlights the increasing importance of cabotage in international trade.

6. 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 transport costs seriously.

Besides distance and other variables that no government can change, an important determinant of maritime transport costs is seaport efficiency. An improvement in port efficiency

from 25th to 75th percentiles reduces shipping costs by more than 12 percent, 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.

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. Moreover, a number of success stories in Latin America show that private involvement in port management leads to efficiency and lower costs whenever it is accompanied by labor reform, and when monopoly power is reduced through either regulation or competition.

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Appendix A. Data Description

Transport Costs Estimation (Tables 1 and 2)

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

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

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).

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).

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).

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

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).

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

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=stronlgy agree)." Source: World Economic Forum, *Global Competitiveness Report*, various years (1996-2000)

Port Efficiency Variables (Tables 3 and 4)

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 Louisiana State University National Ports and Waterways Institute. Using ratios, we put all samples in the same unit used by the data from the World Bank.

Port Efficiency: Same as above.

Custom Clearance: Corresponds 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: World Bank.

Manufactures wages: Source: UNIDO Industrial Statistics Database.

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:

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

$$where$$

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

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 (World Bank) and World Factbook 2000 (Central Intelligence Agency).

Port Efficiency Estimation (Table 5)

Infrastructure Index: same as above.

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).

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).

Organized Crime: one-to-seven index ranking "organized crime has 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: World Economic Forum, *Global Competitiveness Report*, various years (1996-2000)

Appendix B. Data Used

Country	Cargo Hand. 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 Worl Bank US$/TEU	CMPCH Index	LSU Index
Argentina	0.00	0.13	0.00	1.00	7.0	3.81	4.52	na	139	na
Armenia	na	na	na	na	4.0	na	Na	na	na	na
Australia	0.00	0.13	1.00	1.00	na	4.79	6.19	199	na	na
Azerbija	na	na	na	na	5.0	na	na	na	na	na
Belarus	na	na	na	na	4.0	na	na	na	na	na
Belgium	0.00	0.06	1.00	0.00	na	6.17	5.73	120	na	na
Belize	na	na	na	na	5.0	na	na	na	na	na
Benin	1.00	0.00	0.00	0.00	na	na	na	na	na	na
Bolivia	na	na	na	na	9.5	1.61	4.38	na	na	na
Botswana	na	na	na	na	4.0	na	na	na	na	na
Brazil	0.50	0.75	0.00	1.00	10.0	2.92	4.45	328	292	na
Brunei	0.00	0.00	0.00	0.00	na	na	na	na	na	na
Bulgaria	na	na	na	na	2.0	3.68	3.23	na	na	na
Cambodia	na	na	na	na	7.0	na	na	na	na	na
Cameroon	na	na	na	na	20.0	na	na	na	na	na
Canada	0.00	0.13	0.00	0.00	2.0	6.42	6.27	190	na	na
CDI	na	na	na	na	8.5	na	na	na	na	na
Chile	0.00	0.25	0.43	1.00	3.0	3.76	6.05	202	100	na
China	0.50	0.00	0.00	0.00	7.0	3.49	4.44	110	na	na
Colombia	0.50	0.13	0.50	1.00	7.0	2.26	1.88	na	na	na
Costa Rica	0.00	0.00	0.00	1.00	4.0	2.46	3.28	na	na	68
Croatia	na	na	na	na	2.0	na	na	na	na	na
Cyprus	1.00	0.31	0.00	0.00	na	na	na	na	na	na
Czech Rep	na	na	na	na	2.0	3.27	4.41	na	na	na
Trinidad and T.	na	na	na	na	7.0	na	na	na	na	na
Denmark	0.00	0.06	1.00	0.00	na	6.16	6.71	na	na	na
Dominican R.	0.25	0.25	0.50	1.00	7.0	na	na	na	na	na
Ecuador	0.00	0.00	0.43	1.00	15.0	2.63	3.65	na	139	na
Egypt	0.75	0.75	0.00	0.00	5.5	3.72	6.37	na	na	na
El Salvador	0.00	0.00	0.00	1.00	4.0	2.95	2.30	na	na	61
Estonia	na	na	na	na	1.0	na	na	na	na	na
Ethiopia	na	na	na	na	30.0	na	na	na	na	na
Finland	0.00	0.25	0.00	0.00	na	6.26	6.63	na	na	na
France	0.00	0.38	1.00	0.00	3.0	5.39	6.58	201	na	na
Georgia	na	na	na	na	2.0	na	na	na	na	na
Germany	0.00	0.38	1.00	0.00	5.0	6.38	6.02	163	117	na
Ghana	1.00	0.50	0.00	1.00	5.0	na	na	na	na	na
Greece	1.00	0.19	0.00	0.00	na	4.28	5.60	na	na	na
Guatemala	na	na	na	na	7.0	na	na	na	na	55
Haiti	na	na	na	na	15.0	na	na	na	na	na

(continued)

Country	Cargo Hand. 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	na	na	na	na	4.0	na	na	na	na	na
Hong Kong	0.00	0.25	0.00	0.00	na	6.38	5.46	na	na	na
Hungary	na	na	na	na	3.0	2.59	4.14	na	na	na
Iceland	0.00	0.13	0.00	0.00	na	5.78	6.64	na	na	na
India	0.00	0.00	0.00	1.00	na	2.79	4.28	na	na	na
Indonesia	1.00	0.06	0.00	0.38	5.0	3.41	4.06	na	na	na
Ireland	0.00	0.13	1.00	0.00	na	4.28	5.12	na	na	na
Italy	0.25	0.50	0.38	0.00	2.0	4.11	3.29	228	na	na
Ivory Coast	0.00	0.25	0.00	1.00	na	na	na	na	na	na
Jamaica	0.50	0.00	0.00	0.60	na	na	na	na	na	na
Japan	0.75	0.13	0.89	1.00	na	5.16	5.16	250	202	na
Kazakhst	na	na	na	na	9.0	na	na	na	na	na
Kenya	na	na	na	na	14.0	na	na	na	na	na
Korea	0.00	0.38	0.00	0.00	na	4.12	5.22	na	na	na
Kyrghizs	na	na	na	na	10.0	na	na	na	na	na
Lithuani	na	na	na	na	1.0	na	na	na	na	na
Madagascar	na	na	na	na	10.0	na	na	na	na	na
Malawi	na	na	na	na	17.0	na	na	na	na	na
Malaysia	0.00	0.25	0.00	0.38	7.0	4.95	5.76	75	na	na
Mauritius	1.00	0.38	0.00	0.00	na	5.35	5.53	na	na	na
Mexico	0.50	0.38	0.00	1.00	4.0	3.34	2.61	na	na	na
Moldova	na	na	na	na	5.0	na	na	na	na	na
Morocco	0.50	0.13	0.00	0.00	na	na	na	na	na	na
Namibia	na	na	na	na	4.0	na	na	na	na	na
Netherlands	0.00	0.50	1.00	0.00	na	6.64	5.42	156	84	na
New Zealand	0.00	0.38	1.00	1.00	na	5.82	6.14	na	na	na
Nicaragua	0.00	0.00	0.00	1.00	5.0	na	na	na	na	na
Nigeria	0.00	0.50	0.00	1.00	18.0	na	na	na	na	na
Panama	na	na	na	na	5.0	na	na	na	234	100
Papa N.Guinea	0.50	0.00	0.00	0.00	na	na	na	na	na	na
Peru	0.50	0.00	0.50	1.00	7.0	2.88	3.32	na	142	na
Philippines	0.50	0.00	0.00	0.38	7.0	2.79	3.51	118	na	na
Poland	0.25	0.00	0.00	0.00	3.0	3.34	3.41	na	na	na
Portugal	0.00	0.13	1.00	0.00	8.0	3.81	6.50	na	na	na
Romania	0.00	0.63	0.00	0.00	3.0	na	na	na	na	na
Russia	na	na	na	na	7.0	3.33	2.23	na	na	na
Senegal	0.00	0.00	0.00	1.00	7.0	na	na	na	na	na
Singapore	1.00	0.38	0.00	0.33	2.0	6.76	6.72	117	na	na
Slovakia	na	na	na	na	2.0	3.50	4.35	na	na	na
Slovenia	na	na	na	na	2.0	na	na	na	na	na

(continued)

Country	Cargo Hand. Restriction Index	Mandatory Services Index	Price Fixed Agreements Index	Cooperative Agreements Index	Median Clearence time Days	Port Efficiency Index (1-7)	Crime Index (1-7)	Container Handling Charges Worl Bank US$/TEU	CMPCH Index	LSU Index
South Africa	na	na	na	na	5.0	5.24	2.08	na	na	na
Spain	0.00	0.06	1.00	0.00	4.0	4.88	6.08	200	105	na
Sweden	0.00	0.06	1.00	0.00	2.0	5.73	6.46	na	na	na
Taiwan	0.50	0.00	0.00	0.00	na	5.18	4.49	140	163	na
Tanzania	na	na	na	na	14.0	na	na	na	na	na
Thailand	0.50	0.63	0.00	0.38	4.0	3.98	5.12	93	na	na
Togo	0.00	0.00	0.00	0.00	na	na	na	na	na	na
Tunisia	0.50	0.13	0.00	0.00	5.5	na	na	na	na	na
Turkey	0.00	0.00	0.43	0.00	na	3.81	5.00	na	na	na
Uganda	na	na	na	na	14.0	na	na	na	na	na
Ukraine	na	na	na	na	10.0	3.41	3.28	na	na	na
United Kingdom	0.00	0.31	1.00	0.00	4.0	5.37	6.17	173	na	na
United States	na	na	na	na	5.0	6.27	5.40	259	336	na
Uruguay	0.00	0.00	0.00	1.00	5.0	na	na	na	na	na
Uzbekist	na	na	na	na	7.0	na	na	na	na	na
Venezuela	0.00	0.00	1.00	1.00	11.0	3.28	3.63	na	na	na
Vietnam	0.00	0.00	0.00	0.50	na	3.81	5.02	na	na	na
Zambia	na	na	na	na	10.0	na	na	na	na	na
Zimbabwe	na	na	na	na	10.0	3.29	5.15	na	na	na

na: not available

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

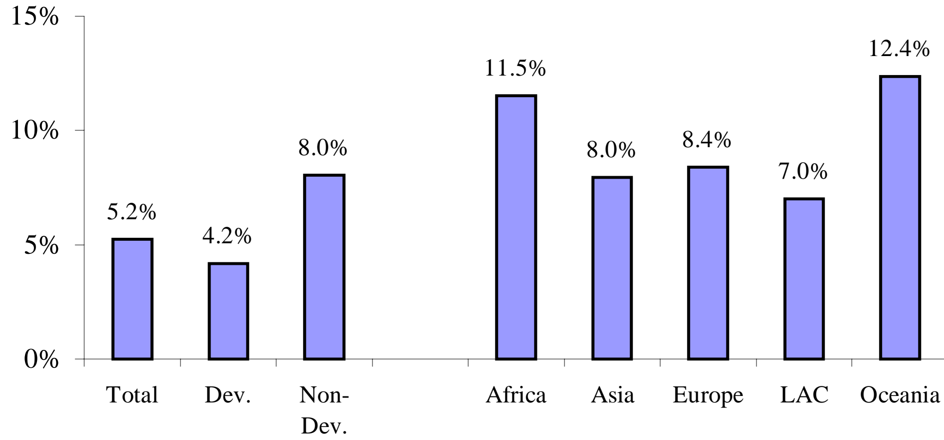


Figure 2
Imports Freight Costs (CIF/FOB ratio) and Import Tariffs relative to Import value, 1996-97

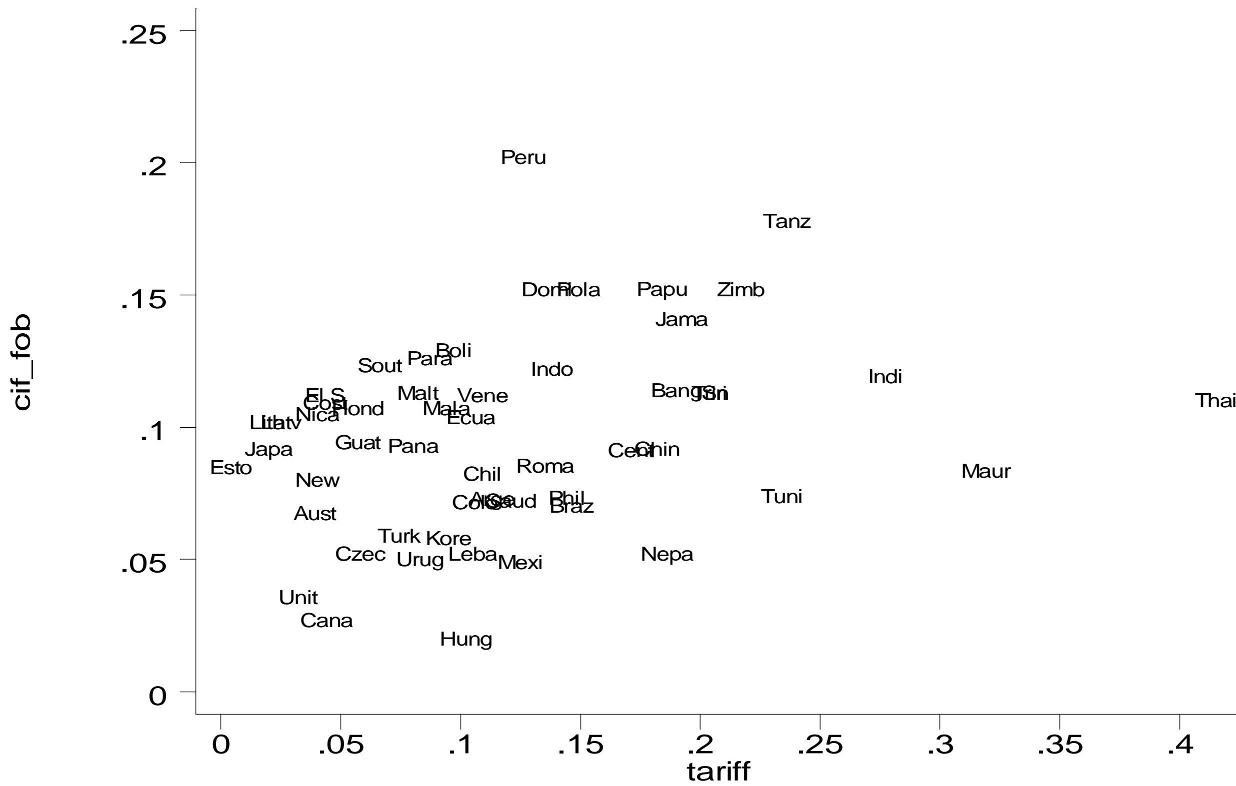
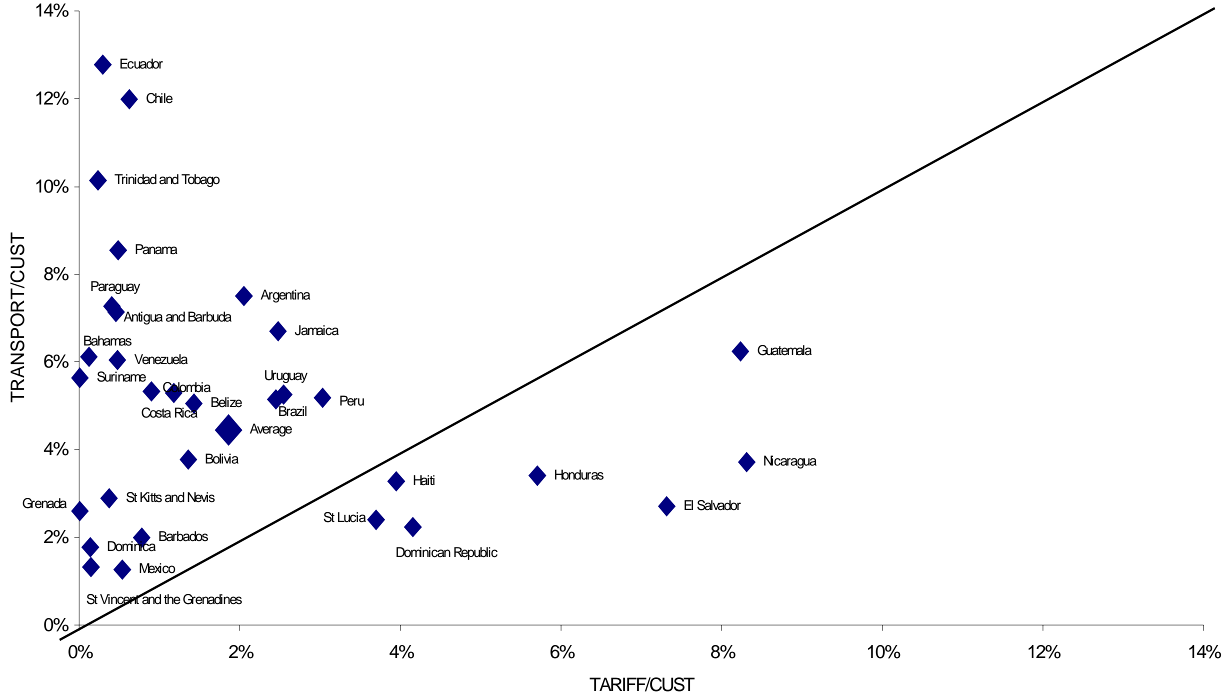


Figure 3
Export Freight Costs and US Tariff,
Latin American Countries, 1998



Sources: U.S. Census Bureau, Department of Commerce.[67]

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

Figure 4
Handling Costs and Seaport Efficiency, 1998

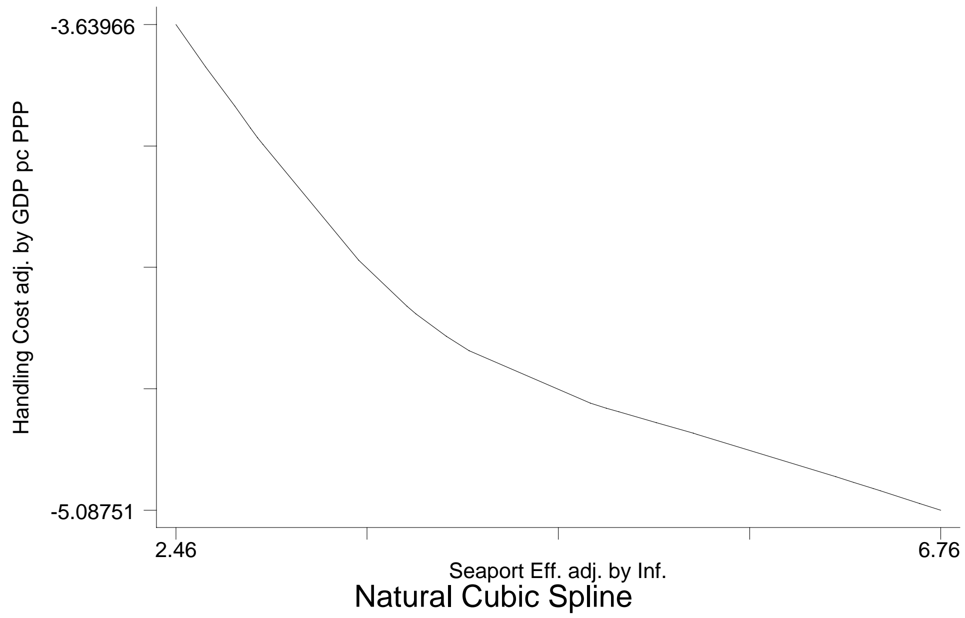


Figure 5
Port Efficiency and Level of Regulation (Mandatory Port Services), 1998

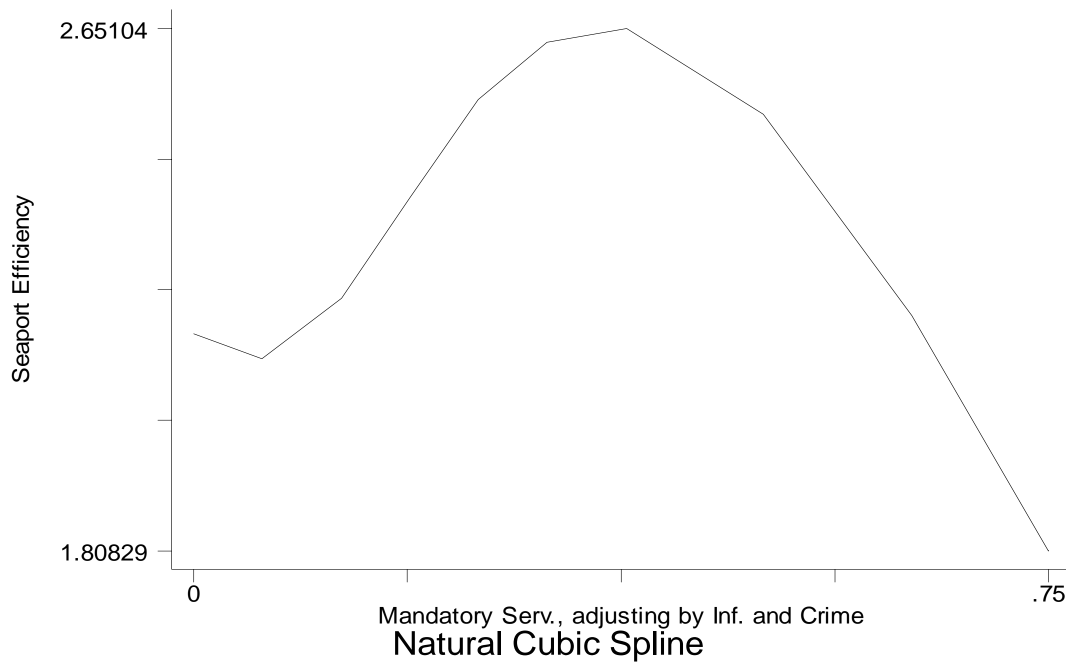
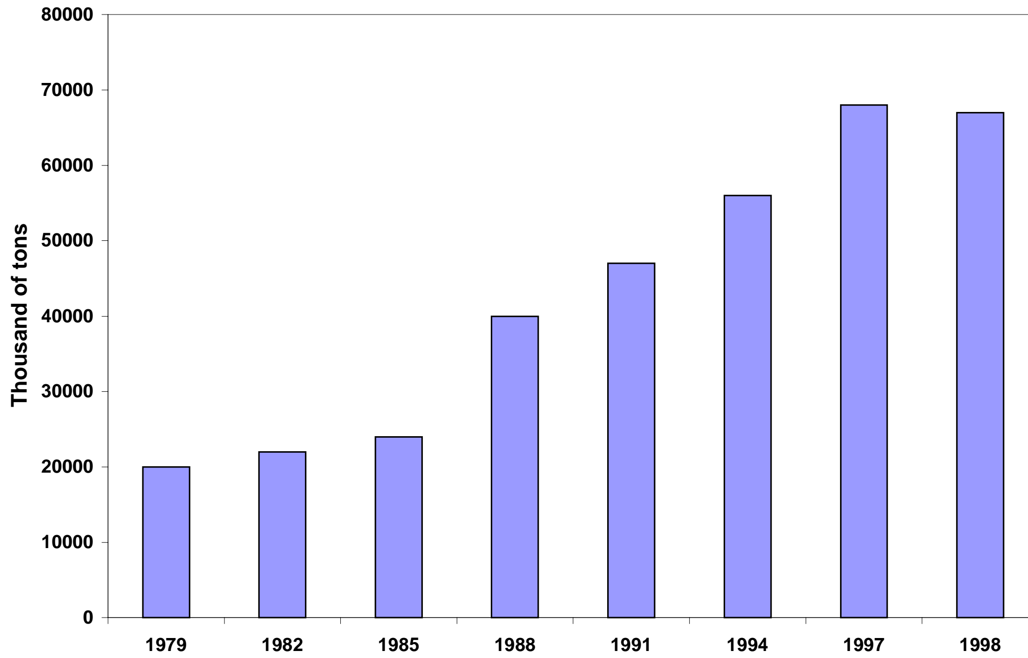
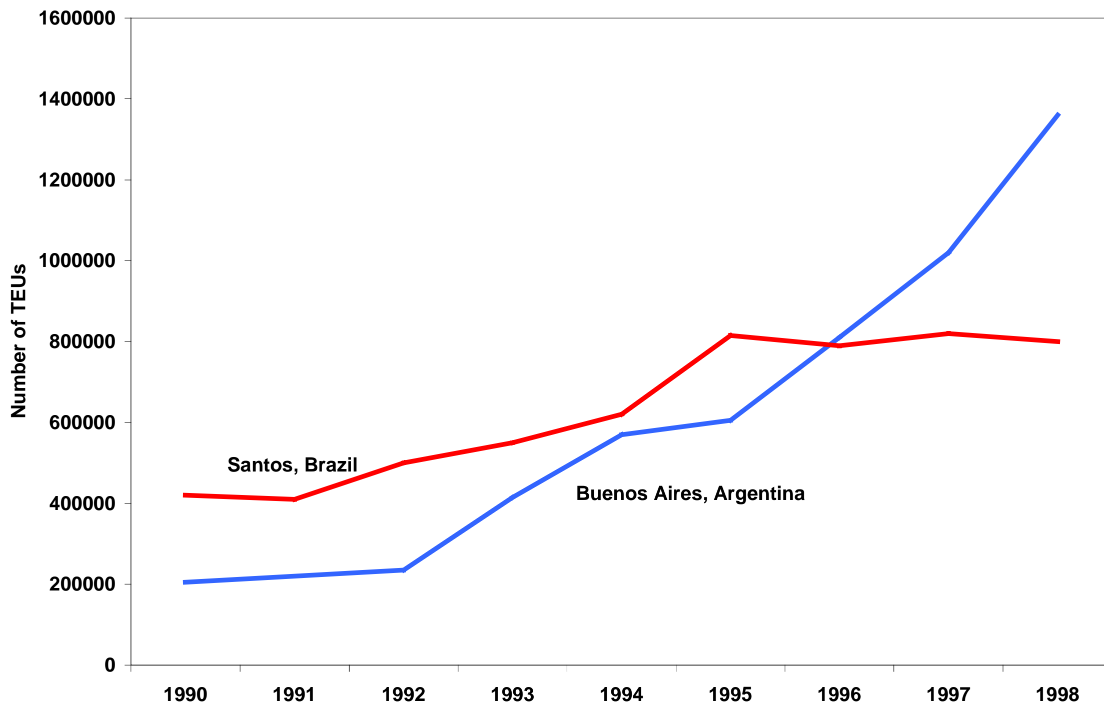


Figure 6
Throughput of Chilean Ports



Source: Cámara Marítima y Portuaria de Chile (1999).

Figure 7
Container Throughput in Buenos Aires and Santos



Source: Hoffman (1999a).

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

	OLS estimations			IV estimations		
Variables	(1)	(2)	(3)	(4)	(5)	(6)
Distance	0.18	0.19	0.18	0.18	0.17	0.17
	(11.37)***	(9.83)***	(11.41)***	(10.21)***	(8.47)***	(10.37)***
Weight value	0.55	0.55	0.55	0.55	0.55	0.55
	(54.77)***	(51.66)***	(48.78)***	(54.75)***	(50.96)***	(48.81)***
Policy variables						
Price fixing rate agreement	0.06	0.02	-0.00	0.06	0.02	0.01
(=1 if agreement exist)	(1.88)*	(0.64)	(0.14)	(1.71)*	(0.51)	(0.28)
Cooperative agreement	-0.01	-0.03	-0.02	-0.01	-0.03	-0.02
(=1 if agreement exist)	(0.89)	(1.30)	(0.78)	(0.90)	(1.23)	(0.83)
Containerization	-0.04	-0.03	-0.03	-0.04	-0.03	-0.03
	(2.78)***	(2.30)**	(2.22)**	(2.87)***	(2.27)**	(2.28)**
Total liner volume	-0.02	-0.02	-0.03	--	--	--
(foreign country to US coast)	(3.70)***	(2.85)***	(4.47)***	--	--	--
Total liner volume (Instr)	--	--	--	-0.02	-0.04	-0.04
(foreign GDP)	--	--	--	(2.19)**	(2.72)***	(3.85)***
Foreign port efficiency						
Foreign GDP per capita	-0.05	--	--	-0.05	--	--
(proxy for infrastructure)	(5.78)***	--	--	(5.16)***	--	--
Port efficiency	--	-0.05	--	--	-0.05	--
(Global Compet. Report)	--	(3.87)***	--	--	(3.53)***	--
Infrastructure Index	--	--	-0.03	--	--	-0.03
(proxy for port infrast.)	--	--	(3.36)***	--	--	(3.50)***
Observations	332,593	314,462	289,834	332,593	314,462	289,834
R-squared (adj.)	0.47	0.47	0.47	0.47	0.47	0.47

Notes: Robust t-statistics in parentheses; * significant at 10%; ** significant at 5%; *** significant at 1%. All estimations include fixed effects for products (4848 products) and for US districts (31 districts). Regressions allow the observations to be independent across exporting countries, and interdependent within each country.

Table 2: Determinants of Maritime Transport Costs, 1995-1999
Dependent Variable: TC=(Charges / Weight)

	1995	1996	1997	1998	1999
Distance	0.17	0.16	0.17	0.17	0.25
	(6.30)***	(5.61)***	(6.34)***	(8.47)***	(9.86)***
Weight value	0.55	0.55	0.55	0.55	0.53
	(49.87)***	(42.34)***	(56.63)***	(50.96)***	(54.48)***
Policy variables					
Price fixing rate agreement	0.02	0.06	0.08	0.02	-0.07
(=1 if agreement exist)	(0.51)	(1.13)	(1.72)*	(0.51)	(1.98)**
Cooperative agreement	-0.05	-0.04	-0.03	-0.03	0.01
(=1 if agreement exist)	(1.67)*	(1.56)	(0.99)	(1.23)	(0.35)
Containerization	-0.03	0.02	-0.002	-0.03	0.003
	(1.32)	(0.91)	(0.15)	(2.27)**	(0.12)
Total liner volume (Instr)	-0.03	-0.03	-0.04	-0.04	0.0001
(foreign GDP)	(1.75)*	(2.05)**	(2.58)**	(2.72)***	(0.01)
Foreign port efficiency					
Port efficiency	-0.080	-0.072	-0.068	-0.053	-0.057
(Global Compet. Report)	(4.07)***	(4.07)***	(4.03)***	(3.53)***	(4.41)***
Observations	273,337	273,063	297,825	314,462	346,868
R-squared	0.52	0.49	0.49	0.47	0.45

Notes: Robust t-statistics in parentheses; * significant at 10%; ** significant at 5%; *** significant at 1%. All estimations include fixed effects for products (4848 products) and for US districts (31). Regressions allow the observations to be independent across exporting countries, and interdependent within each country.

Table 3: Port Efficiency Variables

	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	na	na
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	--	na
West Africa	na	11.70	na

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

Table 4: Handling Costs and Port Efficiency, 1998

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

Variables	(1) (adj. by m. wage)	(2) (adj. by GDPpc)	(3) [a] (adj. by GDPpc)	(4) (adj. by GDPpc PPP)	(5) [a] (adj. by GDPpc PPP)
Port Efficiency	-0.48	-0.37	-0.31	-0.33	-0.31
(Global Compet. Report)	(14.69)***	(7.69)***	(3.95)***	(6.02)***	(5.09)***
Infrastructure Index [b]	-0.14	-0.36	-0.42	-0.14	-0.14
(proxy for port infrastructure)	(2.04)*	(9.09)***	(12.89)***	(3.81)***	(4.24)***
Constant	-2.28	-2.82	-3.20	-3.00	-3.11
	(10.42)***	(10.00)***	(6.93)***	(9.38)***	(8.69)***
Observations	12	23	18	23	18
R-squared	0.95	0.93	0.95	0.88	0.88

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

Table 5: Determinants of Port Efficiency, 1998
Dependent var.: Port Efficiency (from the Global Competitiveness Report)

Variables	(1)	(2)	(3)
Infrastructure	0.27	0.26	0.26
	(3.04)***	(2.81)***	(2.86)***
Cargo Handling Restrictions	0.84	0.05	--
	(0.72)	(0.16)	--
Cargo Handling Restrictions (sqr.)	-0.85	--	--
	(0.70)	--	--
Mandatory Port Services	3.43	3.37	3.41
	(2.25)**	(2.19)**	(2.30)**
Mandatory Port Services (sqr.)	-5.20	-4.90	-4.91
	(2.42)**	(2.31)**	(2.34)**
Organized Crime	0.54	0.51	0.51
(Org. crime is not a problem)	(4.66)***	(5.72)***	(5.84)***
Constant	1.96	2.10	2.11
	(2.65)**	(3.37)***	(3.45)***
Nr. Observations	41	41	41
R sq.	0.77	0.77	0.77

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