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Inmaculada Martínez-Zarzoso, Gordon Wilmsmeier

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Platz der Göttinger Sieben 3 · 37073 Goettingen · Germany · Phone: +49-(0)551-398172 · Fax: +49-(0)551-398173

e-mail: uwia@gwdg.de · http://www.iai.wiwi.uni-goettingen.de

FREIGHT RATES AND THE MARGINS OF INTRA-LATIN AMERICAN MARITIME TRADE

Inmaculada MARTÍNEZ ZARZOSO*

Universidad Jaume I, Spain and Georg-August Universitaet

Platz Der Goettinger Sieben 3, Goettingen, Germany

martinei@eco.uji.es

Gordon WILMSMEIER

Transport Research Institute

Edinburgh Napier University, Edinburgh, UK

G.Wilmsmeier@napier.ac.uk>

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ABSTRACT

This paper focuses on the analysis of the relationship between maritime trade and transport cost in Latin America. The data available are disaggregated (SITC 5 digit level) maritime trade flows on trade routes within Latin America over the period 1999-2004. The contribution to the literature is to disentangle the effects that transport costs have on the extensive margin (number of products imported) and the intensive margin (quantity imported of each product) of international trade in order to test some of the predictions of the trade theories that introduce firm heterogeneity in productivity, as well as fixed costs of exporting. Recent investigations show that spatial frictions (distance) reduce trade mainly by reducing the number of shipments and that most firms ship only to geographically proximate customers, instead of shipping to many destinations in quantities that decrease in distance. Our findings confirm this result for intra-LA trade and show that the opposite pattern is observed for ad-valorem freight rates that reduce aggregate trade values mainly by reducing the quantity imported (intensive margin).

KEYWORDS: Transport costs; Maritime trade; Latin America; Sectoral data; Competitiveness

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1. INTRODUCTION

How does trade cost affect countries' ability to participate in the global economy and what impact do changes in the cost of trade have on a country's trade and real income? This paper is devoted to partially answer these questions. While the gains from trade are widely accepted, less is known about the magnitude of the penalty faced by countries for which trade is costly. Reducing trade costs has direct and indirect benefits; it promotes trade and also leads to industrial restructuration in the economy; higher specialisation, and changes in factor prices and real income. How do these effects operate, and how large might they be?

The relationship between international trade and transport costs is usually estimated as part of a gravity model of trade, which relates bilateral trade flows to the income and population of trading partners and the geographical distance between them. Recent research has been concerned with the use of more accurate proxies for transport costs, like freight rates, infrastructure or customs procedures. In this line, Limao and Venables (2001) analyse empirically the dependency of trade and transport costs on geographical and infrastructural variables and estimate an elasticity of trade with respect to transport costs in the range 2-5. More recently, Martínez-Zarzoso and Suárez-Burguet (2005) and Martínez-Zarzoso et al. (2007) found similar results using disaggregated data.

The theoretical models used to generate the gravity equation usually assume homogeneous firms within a country and consumer love of variety. These two assumptions imply that all products are traded to all destinations. However, empirical observation indicates that few firms export and exporting firms commonly sell in a limited number of countries. This empirical fact has led to the development of the so-called new-new trade theories based on firm heterogeneity in productivity and fixed cost of exporting (Melitz, 2003). These new theories predict the existence of a productivity threshold for each country that firms have to exceed in order to become exporters. As a result two margins of trade emerge: The number of unique shipments (extensive margin) and the average value of shipments (intensive margin).

In marked contrast with previous studies for maritime trade, we decompose total trade into extensive margin and intensive margin in order to shed light on why trade costs matter for trade, isolating which component of trade they most affect. We find that the number of unique shipments between origin and destination pairs does co-vary with distance. It is also worth noting that once freight rates are added as an explanatory variable of each trade margin, distance still explains both of them. This result confirms that the distance variable captures other barriers to bilateral trade different from transport costs such as information costs, business networks and cultural barriers.

Some recent studies have found that distance is imperfectly correlated with transport costs. In light of these findings, a number of investigations have underlined the importance of obtaining better data on transport costs. Clark (2007) and Martinez-Zarzoso and Nowak-Lehmann (2007) find that distance is a poor proxy for transport costs. Distance may be a proxy for other types of trade costs and has the advantage of being truly exogenous of the volume of trade in goods.

Evidence that suggests that transport costs are only vaguely related to distance should not be confused with the finding that distance is correlated with trade flows. Hilberry and Hummels (2008) note that roughly a quarter of world trade takes place between countries sharing a common border and half of world trade occurs between partners less than 3000 kilometres apart. It is not clear however whether the effect of distance on trade volumes can be ascribed to transport costs or to other trade determinants such as historical ties, cultural proximity or business networks.

We use import values and volumes and freight rates from the International Transport Database (BTI) from UNECLAC[1]. Our dataset compiles information on import and export of countries[2] in Latin America and the Caribbean, representing a total of 277 maritime trade routes over a period of six years (1999-2004). Since the data represent individual shipments and contains precisely defined origin-destination detail for those shipments, we are able to decompose bilateral trade values into extensive and intensive margin and to investigate how well the variability of each margin is explained by freight rates. We can also observe the evolution over time of the number of commodities shipped and the number of origins from which the commodities are imported. Whereas the number of commodities shipped increase over time, the number of origins from which products are shipped is relatively stable over the years.

[1] United Nations Economic Commission for Latin America and the Caribbean.

[2] Importers: Argentina, Bolivia, Brazil, Chile, Colombia, Ecuador, Peru, Uruguay and Venezuela. Exporters: Anguila, Antigua and Barbuda, Argentina, Aruba, Bahamas, Barbados, Belize, Bermuda, Bolivia, Brazil, Chile, Colombia, Costa Rica, Cuba, Dominica, Dominican Republic, Ecuador, El Salvador, French Guiana, Grenada,Guatemala, Guyana, Honduras, Jamaica, Mexico, Nicaragua, Panama, Paraguay, Peru, Puerto Rico, Suriname, Trinidad and Tobago, Uruguay and Venezuela.

This paper contributes to the existent literature in several respects. Unlike previous work, we decompose intra-Latin American maritime trade flows into multiple components in an effort to study what margins of trade freight rates act upon. Also, we are able to compare the effect of distance with the effect of freights and to show that spatial frictions are not as relevant in explaining maritime trade in comparison to total trade.

Section 2 presents the methodology to decompose shipments into several components and the main hypotheses to be tested. Section 3 describes the data and Section 4 shows the main results. Finally, Section 5 concludes.

2. DECOMPOSING MARITIME TRADE AND MAIN HYPOTESIS

In the related literature, the effect transport costs on trade has been commonly analysed using a gravity model of trade, with the dependent variable being the aggregate/ disaggregate value of trade between two countries. Some recent studies for aggregated trade are Sánchez, Hoffmann, Micco, Pizzolitto, Sgut and Wilmsmeier (2003), Martinez-Zarzoso and Suarez-Burguet (2005) and Limao and Venables (2001) and for disaggregated trade Martínez-Zarzoso, García-Menendez and Suárez-Burguet (2003) and Martinez-Zarzoso (2009). This approach relies on a model that assumes iceberg trade costs[3] and symmetric firms. In this setting, aggregated trade values react to trade cost in exactly the same way as firm-level quantities and consumers buy positive quantities of all varieties.

In this context we can express the quantity of a variety from origin country i to destination country j (q_{ij}) as

[3] Iceberg trade costs mean that for each good that is exported a certain fraction melts away during the trip as if an iceberg were shipped across the ocean.

$$q_{ij} = E_j \left(\frac{(p_i t_{ij})^{-\sigma}}{\widetilde{P}_j} \right) \qquad (1)$$

where E_j denotes country j's total expenditure on the differentiated product, $(p_i t_{ij})$ is the price of product i at destination j, this prices varies across destinations due to positive iceberg transport costs, t_{ij}. $\widetilde{P}_j = \sum_i (p_i t_{ij})^{(1-\sigma)}$ is a price index and σ is the elasticity of substitution, which is constant across varieties[4] (CES)[5].

Since the quantity traded of each variety is in most cases not observable, adding two assumptions: All varieties in the origin are symmetric and the destinations will consume all the varieties in equal quantity, will allow us to multiply quantity per variety (q_{ij}) by prices (p_i) and by the number of varieties (n_i) to obtain total trade values. The outcome is

$$T_{ij} = n_i p_i q_{ij} = E_j n_i \left(\frac{p_i (p_i t_{ij})^{-\sigma}}{\widetilde{P}_j} \right) \qquad (2)$$

In equation (2) quantity per variety is the only component of T_{ij} that has bilateral variation. As in Hillberry and Hummels (2008), with our dataset we are able to examine each of the components of total trade values in a more flexible way since not only quantities, but also prices and the number of varieties vary across origin and destinations. This could be the case when some of the assumptions above are relaxed. Prices may vary across destinations if the elasticity of substitution is not constant or if transport costs are not iceberg (Hummels and Skiba, 2004). Therefore for a given year t:

[4] Varieties refer to different products that are substitutes in consumption.
[5] The constant elasticity of substitution (CES) assumption is made in order to obtain a simple model that is easily derived and with testable implications.

$$T_{ij} = n_{ij} p_{ij} q_{ij} \qquad (3)$$

At least three reasons have been suggested in the literature to explain why the number of traded varieties might vary with trade cost. First, goods produced in different locations (origin and destination) could be homogeneous. In this case, if production costs in origin and destination are very similar or the trade costs are sufficiently large, these goods will not be traded. Also, the higher freight costs are, the more likely products are to be non-traded goods. Second, if goods are differentiated by country of origin, each country producing a different variety has to incur in a fixed cost to sell the product in each destination country. Therefore, not all the varieties will be shipped to each destination and the number of varieties traded will depend negatively on the size of this fixed trade costs. Finally, the reason could be that not all varieties are consumer goods. Intermediated inputs that are used in the production of final goods would only be exporter to destination j if country j produces the final good. Due to "just on time" production processes intermediates are usually traded along short distances.

The methodology we use to decompose aggregate value of trade into its various components is based on Hillberry and Hummels (2008). Unique shipments are indexed by s and the total value of shipments from country i to country j is given by

$$T_{ij} = \sum_{s=1}^{N_{ij}} P_{ij}^{s} Q_{ij}^{s} \qquad (4)$$

where N_{ij} is the number of unique shipments (extensive margin of trade) and $\overline{PQ}_{ij}$ is the average value per shipment (the intensive margin). Hence, total trade value is decomposed first into extensive and intensive margin

$$T_{ij} = N_{ij}\overline{PQ}_{ij} \tag{5}$$

where $\overline{PQ}_{ij} = \dfrac{\left(\sum_{s=1}^{N_{ij}} P_{ij}^{s} Q_{ij}^{s}\right)}{N_{ij}}$

Since there can be multiple unique shipments within an origin-destination country pair, the number of shipments can be further decomposed into the number of distinct SITC goods shipped, N_{ij}^{k}, and the number of average shipments between a country of origin and a destination country, N_{ij}^{F}. $N_{ij}^{F}>1$ means that we observe more than 1 unique shipment per commodity travelling from country i to country j.

$$N_{ij} = N_{ij}^{k} N_{ij}^{F} \tag{6}$$

The average value per shipment can also be further decomposed into average price and average quantity per shipment

$$\overline{PQ}_{ij} = \frac{\left(\sum_{s=1}^{N_{ij}} P_{ij}^{s} Q_{ij}^{s}\right)}{\sum_{s=1}^{N_{ij}} Q_{ij}} \frac{\left(\sum_{s=1}^{N_{ij}} Q_{ij}\right)}{N_{ij}} = \overline{P}_{ij}\overline{Q}_{ij} \tag{7}$$

By substituting equations (6) and (7) into (5) we can decompose total trade between two countries into four different components

$$T_{ij} = N_{ij}^{k} N_{ij}^{F} \overline{P}_{ij}\overline{Q}_{ij} \tag{8}$$

The units to measure quantities are tons for all commodities. Using a common unit allow us to aggregate over different products and compare prices (import unit values) across all commodities.

We now have two decomposition levels, the first given by equation (5) decomposes total trade value into number of products traded and average value per product and the second, given by equation (8) decompose further these two components into another two each: the number of distinct SITC goods shipped, the number of average shipments between a country of origin and a destination country, average price and average quantity. Taking logs for the first and second level decompositions and adding the time dimension, t:

$$\ln T_{ijt} = \ln N_{ijt} + \ln \overline{PQ}_{ijt} \tag{9}$$

$$\ln T_{ijt} = \ln N^{k}_{ijt} + \ln N^{F}_{ijt} + \ln \overline{P}_{ijt} + \ln \overline{Q}_{ijt} \tag{10}$$

Next we began to analyze how each of the components of equation (10) co-varies with distance and with other trade-related costs. Before we specify the empirical model, we state a number of hypotheses that are based on recent theories of international trade under imperfect competition and heterogeneous firms. One of the starting points of these theories was Melitz (2003) who introduced firm heterogeneity and fixed costs in a general equilibrium model of international trade. Chaney (2008) extended Melitz's model to multiple countries with asymmetric trade barriers and derives three predictions for aggregated trade:

First, for aggregated bilateral trade flows the model predicts that the elasticity of exports with respect to trade barriers is larger than in the absence of firm heterogeneity and larger than the elasticity for each individual firm. A reduction on variable cost has two effects: it increases the size of exports of each exporter and it also allows some new firms to enter the market. Therefore, the extensive margin amplifies the impact of variable costs.

Second, in more homogeneous sectors aggregated exports are very sensitive to changes in transportation costs because many firms enter and exit when variable costs changes.

Third, the elasticity of exports with respect to variable costs does not depend on the elasticity of substitution between goods, whereas the elasticity of exports with respect to fixed costs is negatively related to the elasticity of substitution, in contrast with models with representative firms, according to which the elasticity of exports with respect to transport costs equals the elasticity of substitution minus one.

Finally, with respect to the two margins of trade, Chaney (2008) shows that in the presence of firm heterogeneity, the extensive margin and the intensive margin are affected in different directions by the elasticity of substitution. The impact of trade barriers is strong in the intensive margin for high elasticities of substitution, whereas the impact is mild on the extensive margin. The author proves that the dampening effect of the extensive margin dominates the magnifying effect of the intensive margin.

We are interested to know if these predictions hold for maritime trade flows in Latin America. In order to test some of the abovementioned predictions, the estimating equation takes the following form:

$$\ln M_{ijkt} = \alpha_i + \beta_j + \alpha_1 \ln GDP_{it} + \alpha_2 \ln GPD_{jt} + \alpha_3 \ln POP_{it} + \alpha_4 \ln POP_{jt} + \alpha_5 \ln D_{ij} + \gamma_k + \lambda_t + \varepsilon_{ijkt} \quad (11)$$

were γ_k and λ_t are industry and year fixed effects and α_i and β_j are importer and exporter fixed effects. ε_{ijkt} is an error term and $\ln(M_{ijkt})$ is in turn the log of total imports and each of its components: the log of average value per shipment (intensive margin), and the log of the number of shipments (extensive margin), as described in equation (9). Since

OLS is linear, the coefficient on total imports will be equal to the sum of the coefficients on the two margins. A further decomposition can be done, using as dependent variable in equation (11) each of the components of equation (10). Some summary statistics of our data are presented in Table 1.

3. DATA DESCRIPTION

The main data source we use is the raw data files from the BTI (International Transport Database) dataset from UNECLAC that gives information on the actual freight rates per ton paid for the export of a certain good between countries *i* and *j* excluding loading costs.

The international transport database covers annual trade and transport statistics of eleven Latin American countries - Argentina, Bolivia, Brazil, Chile, Colombia, Ecuador, Mexico, Paraguay, Peru, Uruguay, and Venezuela. The BTI is maintained by ECLAC's Transport Unit. It covers annual trade and transport statistics of each country and contains detailed information about the value and volume of imports and exports. It also includes information about the use of different transport modes, the costs of international freight and insurance, and the traded commodities. Data is for the years 1999-2004, and grouped by the Standard International Trade Classification (SITC) codes. Country data are processed by national customs services and due to the large quantity of data, it is possible to formulate detailed queries, combining the different fields of information covered by the database. Income and population data are from the World Development Indicators Database 2008 and distance is from CEPII[6].

Table 1 in the Appendix shows the split between pure freight rates and insurance costs by importer. Insurance cost in ad-valorem terms is the highest for Argentina, it

[6] http://www.cepii.fr/anglaisgraph/bdd/distances.htm.

represents a 13 percent of total cif-fob costs (freight + insurance) and Venezuela (8.6 percent) and it is the lowest for Brazil (0.55 percent).

4. MAIN RESULTS

First we present some results for the decomposition of trade flows in Table 2. Argentina, followed by Brazil, shows the highest total import value. We observe the highest average number of shipments for Colombia and the lowest for Bolivia, whereas in terms of average value shipped Mexico shows the highest value and Bolivia, once more, the lowest.

Table 3 presents the results of testing model (1) using distance as a proxy for transport costs and Table 4 adds freight rates as an additional explanatory variable.

The dependent variable in the first column in Table 3 is total imported value, whereas in the following columns each of the components of equation (10) is used as dependent variable. The coefficients of the gravity equation have the expected sign. GDP has a significant positive effect on both, the volume exported by firms and the number of exporters. Distance has a negative estimate for most of the components. Only the average price shows a positive distance coefficient. Increases in shipment distance correspond to increases in average price per ton. A similar result was obtained by Hillberry and Hummels (2008).

The decomposition of the influence of distance on trade shows a greater effect on the extensive margin (column 2 of Table 3), for all products and for our sample. About 71% of the distance effect on trade works through the extensive margin (i.e. 0.399/(0.399+0.163)); 29% of the increase in aggregate trade flows comes from larger average shipments. Previous research finds similar results, with the extensive margin being more important than the intensive margin (Hillberry and Hummels, 2008; Mayer and Ottaviano, 2008). Our results are closer to Mayer and Ottaviano (2008), who analyze

French and Belgian individual export flows and show that 75% of the distance effect on trade comes from the extensive margin.

Turning to the second level decomposition of equation (11), on the one hand we see that the decline in number of shipments over space come entirely from the second component (N_{ijf}), proximate geographic countries see a larger number of unique shipments per commodity, whereas the number of commodities shipped between countries (N_{ijk} in column 4 of Table 3) does not seem to vary with distance. On the other hand, the components of average value per shipment (columns 6 and 7 in Table 3) change with distance in opposite direction. Increases in shipment distance correspond to increases in average prices per ton and decreases in average quantities shipped. The more plausible explanation is related to trade composition: goods with low value to weight are imported from closer locations than goods with high value to weight ratios.

Table 4 shows the decomposition of the influence of ad-valorem transport costs on maritime trade. The effect is lower on the extensive margin (column 2), for all products and for our sample. Around 29% of the trade cost effect on trade works through the extensive margin, whereas 71% of the variation in aggregate trade works through the intensive margin (column 3). Hence, shipping costs seems to affect to a higher extent the intensive margin, which is in accordance with the theoretical prediction that states that changes in variable costs mainly affect the intensive margin of trade (Chaney, 2008). It is widely recognized that shipping costs decrease with higher values traded and hence can be considered as variable costs of trade.

To our knowledge, this is the first paper that evaluates the effect of maritime transport costs on the two margins of trade. Previous research finds similar results for the effect on total import values. Our results are close to those found in a recent study done by Korinek (2009). The results in her study indicate that, for a broad sample of countries, a 10% increase in shipping costs is associated with a 3% drop in trade. In our sample a 10% increase in shipping costs is associated with a 2.4% drop in trade.

Turning to the second level decomposition of equation (11), on the one hand we see that the decline in number of unique shipments due to higher shipping costs come entirely from the first component (N_{ijk}). Model 4 (Table 3) shows that the number of commodities shipped between countries decreases when shipping costs are higher, whereas the number of unique shipments per commodity (N_{ijf}) plays no role (Column 5). On the other hand, results in Models 6 and 7 show that the components of average value per shipment change with shipping costs in the same direction. Increases in shipment costs are associated to decreases in average quantities shipped and in average prices per ton. 87% of the variation in average imported value works trough changes in average prices per ton, whereas only 13% works trough changes in average quantities shipped.

With respect to the previous results found in Table 3 for spatial frictions, the main pattern remains unchanged, the only difference is that adding shipping costs slightly reduces the estimated coefficient for distance and that the percentage of variation in distance explained through the extensive margin of maritime trade increases from 71 percent to 77 percent.

Shipping costs can also be decomposed into insurance and pure freight and we use this decomposition to test some of the predictions outlined before with respect to fix and variable trade costs. The results are presented in Table 5. In this case we are using transport cost per tonne and insurance paid per tonne shipped. In this specification the effect of transport costs on the two margins of trade is more evenly distributed (50% of the variation of total imports is explained through the extensive margin and 50% through the intensive margin) and the effect of distance works completely through the extensive margin and does not affect the intensive margin. With respect to insurance, the effect on each margin goes in opposite direction: a higher insurance per tonne increases the number of unique shipments and slightly reduces the average value of the shipments.

Turning to the second level decomposition of equation (11), on the one hand we see that the increase in number of shipments due to a higher insurance cost come entirely from the second component (N_{ijf}), higher insurance costs is associated to a larger number of unique shipments per commodity, whereas the number of commodities shipped between countries does not seem to vary with insurance cost. On the other hand, the components of average value per shipment change with shipping costs in opposite directions and they almost compensate each other. Increases in insurance cost are associated to decreases in average quantities shipped and to increases in average prices per ton. 50% of the absolute variation in average imported value works trough each channel. The explanation could be related, once again, to trade composition: goods with low value to weight pay a lower insurance than goods with high value to weight ratios.

Finally, Table 6 present separated results by three product categories: Agriculture, raw materials and manufactures. Whereas the results for manufactures are very similar to those found for all products (Table and 4), interesting differences are found for agriculture and raw materials.

First, when the sample is restricted to agriculture and raw materials the total value of imports does not depend on distance, whereas shipping cost presents a higher estimated coefficient that for raw materials is almost double than the one found for manufactures.

Turning to the second level decomposition of equation (11), on the one hand we see that the decline in number of shipments over space come entirely from the second component (N_{ijf}) only for manufactures, proximate geographic countries see a larger number of unique shipments per commodity, whereas for agricultural products and raw materials the number of commodities shipped between countries does seem to increase with distance. On the other hand, the components of average value per shipment change with distance in opposite direction only for manufactures. Increases in shipment distance correspond to increases in average prices per ton and decreases in average quantities shipped. However, for raw materials and agriculture only the average price increases with distance, whereas the average quantity does not co-vary with spatial frictions.

With respect to shipping costs, we also observe a different pattern for agriculture and raw materials as compared with manufactures. The effect of a reduction in shipping costs on trade comes through both margins for the former, whereas for the latter it mainly works through the intensive margin.

As a robustness check, and in line with some previous findings (Martínez-Zarzoso and Nowak-Lehman, 2007), we consider a non-linear relationship between distance and the trade margins. The results are presented in Appendix 2. While for total value exported the coefficient of squared distance is not statistically significant from zero, we find an inverted U-shaped relationship between distance and the number of shipments, between distance and the average value shipped and between distance and the average quantity shipped. Therefore, the number of goods shipped increase with distance for shorter distances and then decreases. The turning point corresponds to a distance of 563 kilometres (the minimum distance in our sample is between Argentina and Uruguay, 215 km and the maximum 2854 km). The average quantity shipped increase only for distances lower than 702 km, whereas the average value imported increases with distances lower than 1252 km and then decreases. Further research is needed to explain these findings, a possible explanation can be found by considering the type of products shipped.

5. CONCLUSIONS

This paper focuses on the analysis of the relationship between maritime trade and transport costs in Latin America. According to new theories of international trade with imperfect competition and heterogeneous firms, lower trade costs increases bilateral trade through an increase of both margins of trade: The number of exporting firms (extensive margin) and the average value of imports (intensive margin). We use highly disaggregated trade data to decompose intra-LA imports into these two components to shed some light on why trade costs matter for trade. Several new findings are derived. First, about 77 percent of the distance effect on trade works through the extensive margin, indicating that the number of shipments sharply decreases with distance. Spatial frictions are less relevant for the intensive margin, with only 23 percent of the distance effect working through this margin. Second, the opposite pattern is observed for ad-valorem freight rates: only 29 percent of its effect on trade works through the extensive margin, whereas 71 percent is attributable to the intensive margin.

Finally, the main results hold for manufactures, but change for agriculture and raw materials, especially with respect to spatial frictions, that are much less relevant for these categories of goods.

Table 1. Summary statistics

VARIABLE	Obs	Mean	Std. Dev.	Min	Max
LTCIF	897652	13.735	2.230	0.000	19.328
LNIJ	897652	4.004	1.509	0.000	7.301
LNIJF	897652	4.367	1.156	0.000	6.309
LNIJK	897652	-0.363	0.980	-6.309	1.453
LAVCIF	897652	9.731	1.737	0.000	17.488
LAVP	897652	7.957	1.076	-1.955	19.058
LAVQ	897652	1.774	2.058	-6.908	11.541
LCIFOB	689121	-2.911	1.062	-14.202	9.079
LD	896980	7.700	0.769	5.371	8.971
LIGDP	897652	8.115	0.327	6.918	8.897
LEGDP	860986	8.389	0.330	6.109	9.521
LIPOPU	897652	17.381	0.888	15.058	19.043
LEPOPU	860986	16.861	1.664	11.184	19.043

Note: where L denote natural logs, TCIF denote the value of bilateral imports ($), NIJ; NIJF AND NIJK denote respectively the number of shipments, the number of distinct SITC goods shipped and the number of average shipments between a country of origin and a destination country, AVCIF, AVP, AVQ denote respectively average value of imports, average price of imports and average quantity imported. CIFOB refers to the ad-valorem transport cost, IGDP and EGDP are GDP of the importer and the exporter country respectively and IPOPU and EPOPU refer to populations in origin and destination.

Table 2. The extensive and the intensive margins of Latin American maritime trade flows

Var. Means	Value	Nij	Average Value
Argentina	9705055	106.701	117584.3
Bolivia	41808.58	10.307	6510.563
Brazil	6152345	104.636	102297.9
Chile	2186648	35.161	86494.24
Colombia	3625897	255.318	41095.26
Ecuador	3685330	126.920	35877.6
Mexico	5241092	18.884	278440.5
Peru	2447187	35.246	102030.2
Uruguay	206142.1	13.263	29462.56
Venezuela	3993809	146.725	51066.9

Table 3. Explaining the extensive and the intensive margins with distance

	M1	M2	M3	M4	M5	M6	M7
Margins	**Total**	**Extensive**	**Intensive**	**Extensive components**		**Intensive components**	
	Value	**Nij**	**Av(P*Q)**	**Nijf**	**Nijk**	**avPrice**	**AvQ**
LD	-0.562**	-0.399***	-0.163***	-0.410***	0.011	0.175***	-0.338***
	-4.128	-16.746	-4.978	-26.845	0.451	8.54	-7.937
IGDPLN	2.294***	0.532***	1.762***	0.594***	-0.063	0.637***	1.125***
	34.059	10.457	27.081	24.923	-1.498	14.075	13.539
EGDPLN	0.485***	0.348***	0.137*	0.388***	-0.04	0.033	0.105
	5.582	6.915	2.442	9.184	-0.972	1.086	1.552
IPOPULN	1.336***	0.792***	0.545***	0.787***	0.004	-0.066***	0.611***
	14.167	26.717	15.334	42.343	0.199	-3.504	14.94
EPOPULN	0.424**	0.015	0.408***	-0.028	0.043	0.052**	0.357***
	4.68	0.448	15.117	-1.962	1.78	2.945	11.709
Y2000	0.297*	0.268***	0.029	0.256***	0.012	-0.132***	0.160***
	2.346	14.801	1.393	28.763	0.809	-8.864	6.486
Y2001	0.302*	0.151***	0.151***	0.142***	0.009	-0.110***	0.261***
	3.008	9.612	5.594	20.105	0.672	-6.186	7.557
Y2002	0.173	0.135***	0.038	0.128***	0.006	-0.167***	0.205***
	0.995	7.217	1.465	17.636	0.386	-8.458	6.095
Y2003	0.134	0.306***	-0.172***	0.312***	-0.006	-0.233***	0.061
	0.665	12.958	-5.737	34.024	-0.336	-10.109	1.794
Y2004	0.302	0.375***	-0.073*	0.383***	-0.008	-0.136***	0.063
	1.526	13.668	-2.264	40.718	-0.36	-6.011	1.606
CONSTANT	-38.44***	-17.70***	-20.74***	-15.04***	-2.659**	1.971**	-22.71***
	-23.661	-18.29	-22.415	-31.095	-3.301	3.01	-18.474
R-SQUARED	0.33	0.485	0.518	0.476	0.401	0.571	0.563
N	860986	860986	860986	860986	860986	860986	860986
LL	-1721049	-1283085	-1376281	-1061089	-973961	-892378	-1474909
RMSE	1.786261	1.074062	1.196847	0.829949	0.750071	0.682261	1.34211
AIC	3442116	2566204	2752595	2122212	1947957	1784791	2949851
BIC	3442221	2566402	2752794	2122411	1948155	1784989	2950050

Notes: t-statistics are given below each estimate. The dependent variables are listed in the second row. Value denotes imports in current $ of good k from the exporting country i to the importing country j in natural logarithms, N_{ij}; N_{ijf} and N_{ijk} denote respectively the number of shipments, the number of distinct SITC goods shipped and the number of average shipments between a country of origin and a destination country, AV(P*Q), avPrice, avQ denote respectively average value of imports, average price of imports and average quantity imported. All dependent and independent variables, excluding time dummies, are also in natural logarithms. LD denotes the log of distance, EGDPLN and IGDPLN denote Gross Domestic Product of the exporter and the importer country respectively and EPOPULN and IPOPULN denote the respective populations. All the estimations use country and product fixed effects and White's heteroscedasticity-consistent standard errors. Panel data are for the year 1999-2004.

Table 4. Explaining the extensive and the intensive margins with freight rates

	M1	M2	M3	M4	M5	M6	M7
Margins	**Total**	**Extensive**	**Intensive**	**Extensive components**		**Intensive components**	
	Value	**Nij**	**Av(P*Q)**	**Nijk**	**Nijf**	**avPrice**	**AvQ**
LCIFOB	-0.240*	-0.050***	-0.190***	-0.049***	-0.001	-0.166***	-0.024
	-3.041	-4.37	-14.06	-5.858	-0.116	-14.23	-1.685
LD	-0.538**	-0.414***	-0.123***	0.02	-0.434***	0.236***	-0.359***
	-3.906	-16.143	-3.808	0.865	-27.589	10.772	-8.063
IGDPLN	2.187***	0.510***	1.677***	-0.092*	0.602***	0.582***	1.095***
	28.376	10.283	25.222	-2.165	25.448	12.84	13.49
EGDPLN	0.382**	0.346***	0.037	-0.053	0.399***	-0.017	0.053
	3.661	6.35	0.613	-1.246	9.904	-0.554	0.721
IPOPULN	1.239***	0.746***	0.493***	-0.015	0.761***	-0.081***	0.575***
	12.88	25.105	13.639	-0.71	38.694	-4.458	13.677
EPOPULN	0.435**	0.037	0.398***	0.042	-0.005	0.031	0.366***
	4.172	1.093	15.36	1.697	-0.341	1.907	12.529
Y2000	0.277	0.213***	0.065**	0.035	0.178***	-0.087***	0.151***
	1.801	9.848	2.619	1.748	21.213	-5.074	4.756
Y2001	0.378*	0.292***	0.086**	0.01	0.282***	-0.060***	0.146***
	3.064	15.064	2.711	0.552	36.057	-3.566	3.757
Y2002	0.304	0.252***	0.052	0.008	0.244***	-0.126***	0.178***
	1.688	10.415	1.544	0.395	26.241	-6.458	4.143
Y2003	0.316	0.451***	-0.135***	0.004	0.447***	-0.193***	0.058
	2.055	14.505	-4.009	0.156	38.985	-9.369	1.398
Y2004	0.468*	0.545***	-0.077*	0.005	0.539***	-0.110***	0.034
	2.76	15.361	-2.155	0.181	45.431	-5.513	0.76
CONS	-35.954***	-17.013***	- 18.942***	-1.959*	-15.054***	2.623***	-21.565***
	-47.244	-17.393	-20.001	-2.391	-31.89	4.144	-17.343
R-SQUARED	0.386	0.512	0.557	0.399	0.532	0.614	0.585
N	665383	665383	665383	665383	665383	665383	665383
LL	-1294469	-967913	-1041602	-752022	-775480	-670847	-1135914
RMSE	1.693311	1.036559	1.157952	0.749345	0.776235	0.663284	1.334282
AIC	2588955	1935860	2083238	1504077	1550994	1341729	2271861
BIC	2589046	1936054	2083432	1504271	1551188	1341923	2272055

Notes: t-statistics are given below each estimate. The dependent variables are listed in the second row. Value denotes imports in current $ of good k from the exporting country i to the importing country j in natural logarithms, N_{ij}; N_{ijf} and N_{ijk} denote respectively the number of shipments, the number of distinct SITC goods shipped and the number of average shipments between a country of origin and a destination country, AV(P*Q), avPrice, avQ denote respectively average value of imports, average price of imports and average quantity imported. All dependent and independent variables, excluding time dummies, are also in natural logarithms. LCIFOB denotes ad-valorem shipping costs, including freight and insurance, LD denotes the log of distance, EGDPLN and IGDPLN denote Gross Domestic Product of the exporter and the importer country respectively and EPOPULN and IPOPULN denote the respective populations. All the estimations use country and product fixed effects and White's heteroscedasticity-consistent standard errors. Panel data are for the year 1999-2004.

Table 5. Explaining the extensive and the intensive margins with freight rates and insurance

	M1	M2	M3	M4	M5	M6	M7
Margins	**Total**	**Extensive**	**Intensive**	**Extensive components**		**Intensive components**	
	Total Value	**Nij**	**Av(P*Q)**	**Nijk**	**Nijf**	**avPrice**	**AvQ**
LCTON	-0.318*	-0.158***	-0.160***	-0.079***	-0.079***	0.107***	-0.267***
	-3.207	-8.743	-8.174	-6.112	-7.841	15.018	-13.547
LINSTON	0.027	0.030**	-0.003	0.003	0.027***	0.108***	-0.111***
	0.576	3.147	-0.253	0.433	4.518	14.438	-8.093
LD	-0.397*	-0.422***	0.025	0.033	-0.455***	0.135***	-0.110**
	-2.453	-15.186	0.875	1.242	-22.823	5.793	-2.659
Y2000	0.213	0.163***	0.05	-0.003	0.166***	-0.042*	0.092**
	1.114	6.354	1.834	-0.14	10.898	-2.361	3.007
Y2001	0.288*	0.283***	0.004	-0.023	0.307***	-0.022	0.027
	2.431	10.618	0.131	-1.017	20.393	-1.163	0.745
Y2002	0.197	0.240***	-0.043	-0.03	0.270***	-0.055**	0.012
	0.984	8.114	-1.201	-1.243	17.257	-2.738	0.303
Y2003	0.347	0.417***	-0.069	-0.042	0.459***	-0.059**	-0.011
	1.92	12.817	-1.962	-1.703	23.086	-2.923	-0.282
Y2004	0.519	0.537***	-0.017	-0.055*	0.592***	0.005	-0.022
	2.135	14.694	-0.485	-2.01	28.416	0.249	-0.583
CONS	-14.74***	-12.08***	-2.66**	-1.67*	-10.40***	7.29***	-9.95***
	-15.895	-12.274	-3.192	-2.448	-18.516	16.912	-9.64
R-SQUARED	0.404	0.524	0.556	0.418	0.531	0.656	0.636
N	436639	436639	436639	436639	436639	436639	436639

Notes: t-statistics are given below each estimate. The dependent variables are listed in the second row. Value denotes imports in current \$ of good k from the exporting country i to the importing country j in natural logarithms, N_{ij}; N_{ijf} and N_{ijk} denote respectively the number of shipments, the number of distinct SITC goods shipped and the number of average shipments between a country of origin and a destination country, AV(P*Q), avPrice, avQ denote respectively average value of imports, average price of imports and average quantity imported. All dependent and independent variables, excluding time dummies, are also in natural logarithms. All explanatory variables, excluding time dummies, are also in natural logarithms. LCTON denotes the log of shipping cost per tonne including insurance, LINSTON is the log of the insurance per tonne and LD denotes the log of distance. All the estimations use country and product fixed effects and White's heteroscedasticity-consistent standard errors. Panel data are for the year 1999-2004.

Table 6. Results by product category

	M1	M2	M3	M4	M5	M6	M7
Margins	**Total**	**Extensive**	**Intensive**	**Extensive components**		**Intensive components**	
MANUFACTURES							
	VALUE	**Nij**	**Av(P*Q)**	**Nijk**	**Nijf**	**avPrice**	**AvQ**
LCIFOB	-0.231*	-0.045***	-0.186***	-0.042***	-0.003	-0.164***	-0.022
	-2.892	-3.799	-13.42	-5.02	-0.299	-13.592	-1.503
LD	-0.595**	-0.432***	-0.163***	-0.012	-0.420***	0.235***	-0.399***
	-3.843	-16.252	-5.114	-0.523	-25.139	10.388	-8.801
R-SQUARED	0.391	0.494	0.553	0.401	0.53	0.607	0.565
N	621981	621981	621981	621981	621981	621981	621981
AGRICULTURAL PRODUCTS							
	VALUE	**Nij**	**Av(P*Q)**	**Nijk**	**Nijf**	**avPrice**	**AvQ**
LCIFOB	-0.328*	-0.144**	-0.185*	-0.134***	-0.009	-0.146***	-0.038
	-3.322	-3.62	-2.089	-3.974	-0.562	-6.55	-0.384
LD	0.322	0.135	0.187	0.459***	-0.324***	0.088	0.099
	1.207	1.75	1.132	4.54	-5.729	1.93	0.509
R-SQUARED	0.403	0.484	0.335	0.383	0.444	0.461	0.333
N	29646	29646	29646	29646	29646	29646	29646
RAW MATERIALS							
	VALUE	**Nij**	**Av(P*Q)**	**Nijk**	**Nijf**	**avPrice**	**AvQ**
LCIFOB	-0.444***	-0.152**	-0.293**	-0.096	-0.056	-0.283***	-0.01
	-6.143	-3.517	-3.767	-1.475	-1.219	-5.507	-0.141
LD	0.229	0.028	0.202	0.495***	-0.467***	0.148**	0.054
	0.54	0.36	1.796	4.736	-6.313	3.788	0.455
R-SQUARED	0.349	0.432	0.42	0.364	0.531	0.537	0.453
N	9348	9348	9348	9348	9348	9348	9348

Notes: t-statistics are given below each estimate. The dependent variables are listed in the second row. Value denotes imports in current $ of good k from the exporting country i to the importing country j in natural logarithms, N_{ij}; N_{ijf} and N_{ijk} denote respectively the number of shipments, the number of distinct SITC goods shipped and the number of average shipments between a country of origin and a destination country, AV(P*Q), avPrice, avQ denote respectively average value of imports, average price of imports and average quantity imported. All dependent and independent variables, excluding time dummies, are also in natural logarithms. LCIFOB denotes ad-valorem shipping costs, including freight and insurance and LD denotes the log of distance. All the estimations use country and product fixed effects and White's heteroscedasticity-consistent standard errors. Panel data are for the year 1999-2004.

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Appendix 1. Split between pure freight rates and insurance costs by importer

Importer	Fleadv	Segadv	Cifob	Flekg	Segkg	Cifobkg
Argentina	0.0490459	0.0073304	0.0563763	0.3271372	0.6548943	0.9820315
Bolivia	0.4041397	0	0.4041397	0.6919587	0	0.6919587
Brazil	0.3278932	0.0018188	0.329712	0.4661918	0.1758087	0.6420005
Chile	0.1790524	0.0092822	0.1883346	4.010412	0.3088272	4.3192392
Colombia	0.1197173	0.001803	0.1215203	0.25325	0.0422111	0.2954611
Ecuador	1.495182	0.0333283	1.5285103	0.2729071	0.1759368	0.4488439
Mexico	0	0	0	0	0	0
Peru	0.1834594	0.0117477	0.1952071	0.3292462	0.4173018	0.746548
Uruguay	0.0855957	0.0062402	0.0918359	0.5498556	0.1598914	0.709747
Venezuela	0.0007182	0.0000677	0.0007859	0.0017304	0.0032216	0.004952
Total	0.3798533	0.0089007	0.388754	0.4404921	0.1779462	0.6184383
In percent:						
Importer	**Fleadv**	**Segadv**	**Cifob**	**Flekg**	**Segkg**	**Cifobkg**
Argentina	87.00%	13.00%	100%	33.31%	66.69%	100%
Bolivia	100.00%	0.00%	100%	100.00%	0.00%	100%
Brazil	99.45%	0.55%	100%	72.62%	27.38%	100%
Chile	95.07%	4.93%	100%	92.85%	7.15%	100%
Colombia	98.52%	1.48%	100%	85.71%	14.29%	100%
Ecuador	97.82%	2.18%	100%	60.80%	39.20%	100%
Mexico						
Peru	93.98%	6.02%	100%	44.10%	55.90%	100%
Uruguay	93.21%	6.79%	100%	77.47%	22.53%	100%
Venezuela	91.39%	8.61%	100%	34.94%	65.06%	100%
Total	97.71%	2.29%	100%	71.23%	28.77%	100%

Note: Fleadv denote ad-valorem pure freight rates (as a % of fob values), Segadv denote ad-valorem insurance, Cifob denotes the sum of Fletacv and Segadv , Flekg denotes pure freight in $ per kilogram, Segkg denote insurance in $ per kilogram and Cifobkg denotes the sum of Flekg and Segkg. For Mexico there are no data for pure freights and insurance costs and for Bolivia there are no data available for insurance cost.

Appendix 2. Non linear relationship between distance and trade margins

	M1	M2	M3	M4	M5	M6	M7
Margins	**Total**	**Extensive**	**Intensive**	**Extensive components**		**Intensive components**	
	Value	**Nij**	**Av(P*Q)**	**Nijk**	**Nijf**	**avPrice**	**AvQ**
LD	4.842	1.989***	2.853***	0.425	1.564***	0.677*	2.176***
	1.349	5.957	6.56	1.261	6.793	2.022	3.862
LD2	-0.356	-0.157***	-0.199***	-0.027	-0.130***	-0.033	-0.166***
	-1.48	-7.023	-6.82	-1.215	-8.751	-1.528	-4.43
IGDPLN	2.524***	0.634***	1.891***	-0.045	0.679***	0.659***	1.232***
	12.656	11.943	27.051	-1.024	27.78	14.312	14.013
EGDPLN	0.592**	0.395***	0.197***	-0.032	0.427***	0.043	0.155*
	4.773	7.704	3.388	-0.773	10.021	1.353	2.171
IPOPULN	1.232***	0.746***	0.487***	-0.004	0.749***	-0.076***	0.563***
	9.378	27.229	13.381	-0.181	40.89	-3.468	12.898
EPOPULN	0.417***	0.012	0.405***	0.042	-0.030*	0.051**	0.354***
	5.729	0.363	14.864	1.76	-2.122	2.934	11.515
Y2000	0.317*	0.277***	0.04	0.014	0.263***	-0.130***	0.170***
	2.323	15.137	1.915	0.913	29.06	-8.77	6.802
Y2001	0.310*	0.154***	0.156***	0.01	0.145***	-0.109***	0.264***
	3.056	9.766	5.722	0.714	20.421	-6.161	7.636
Y2002	0.178	0.137***	0.041	0.007	0.130***	-0.166***	0.207***
	1.016	7.245	1.561	0.407	17.484	-8.455	6.128
Y2003	0.143	0.310***	-0.167***	-0.006	0.316***	-0.232***	0.066
	0.711	13.038	-5.509	-0.297	33.59	-10.109	1.898
Y2004	0.309	0.378***	-0.069*	-0.008	0.386***	-0.136***	0.066
	1.602	13.623	-2.108	-0.336	39.302	-6.003	1.667
CONS	-59.500**	-27.006***	-32.494***	-4.273**	-22.733***	0.016	-32.510***
	-3.933	-17.759	-17.428	-2.779	-26.247	0.011	-13.195
TURNING POINT	-	563.628	1252.003	-	409.683	28497.620	702.199
R-SQUARED	0.337	0.488	0.521	0.401	0.48	0.572	0.564
N	860986	860986	860986	860986	860986	860986	860986
LL	-1716142	-1280442	-1372883	-973799	-1058063	-892090	-1473034
RMSE	1.776111	1.07077	1.192133	0.74993	0.827038	0.682033	1.339192
AIC	3432305	2560919	2745801	1947633	2116163	1784216	2946104
BIC	3432421	2561129		1947843	2116373	1784426	2946314

Notes: t-statistics are given below each estimate. The dependent variables are listed in the second row. Value denotes imports in current $ of good k from the exporting country i to the importing country j in natural logarithms, N_{ij}; N_{ijf} and N_{ijk} denote respectively the number of shipments, the number of distinct SITC goods shipped and the number of average shipments between a country of origin and a destination country, AV(P*Q), avPrice, avQ denote respectively average value of imports, average price of imports and average quantity imported. All dependent and independent variables, excluding time dummies, are also in natural logarithms. LCIFOB denotes ad-valorem shipping costs, including freight and insurance, LD denotes the log of distance, LD2 denotes the log of distance squared, EGDPLN and IGDPLN denote Gross Domestic Product of the exporter and the importer country respectively and EPOPULN and IPOPULN denote the respective populations. All the estimations use country and product fixed effects and White's heteroscedasticity-consistent standard errors. Panel data are for the year 1999-2004.