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Abstract

This paper examines how policy governing the liner shipping sector affects maritime transport costs and seaborne trade flows. The paper uses a novel data set and finds that restrictions, particularly on foreign investment, increase maritime transport costs, strongly but unevenly. The cost-inflating effect ranges from 24 to 50 percent and trade on some routes may be inhibited altogether. Distance increases maritime transport costs, but also attenuates the cost impact of policy barriers. Overall, policy restrictions may lower trade flows on specific routes by up to 46 percent and therefore deserve greater attention in national reform programs and international trade negotiations.

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The Trade-Reducing Effects of Restrictions on Liner Shipping

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1. Introduction

Since most manufactured and semi-manufactured goods are transported in liner vessels, access to efficient and competitive liner shipping is crucial for a country's engagement in international trade. In fact, maritime transport costs (MTCs) today matter more than tariffs. *Ad valorem* MTCs of exports to the United States are on average more than three times higher than the average US tariff, and in New Zealand are more than twice as high.[1] The current perception is that the scope for lowering MTCs through policy reform is limited because the market for maritime liner shipping services is largely free of distortions. Governments now generally desist from both sins of commission, such as reserving cargo for national shipping lines, and sins of omission, such as exempting liner conferences from competition policy. However, a new services trade restrictions database reveals that protection persists. It now takes the form more often of restrictions on foreign investment in maritime transport services than of restrictions on cross-border trade or port services, which have been the focus of the existing literature.

This paper seeks to assess the impact on MTCs and seaborne trade flows of policy measures currently affecting trade in liner shipping services, with a focus on hitherto neglected restrictions on foreign investment or commercial presence – 'mode 3' in WTO parlance.' There are two principal reasons for this focus. First, the most significant barriers to cross-border trade (i.e. 'mode 1' in WTO terms) have indeed diminished in significance. Cargo reservations only affect a few specific goods and cover a tiny share of total seaborne trade, and many countries have narrowed the scope of exemptions from competition law for liner transport. Therefore, the total impact of mode 1 measures on MTCs is likely to be small. Second, even though cross-border trade is the key mode of supply for international shipping services, the ability to establish a commercial presence is crucial for an efficient provision of liner shipping services. Thus, provisions governing mode 3 are likely to affect maritime transport costs and trade flows.

The focus on policy barriers to foreign investment in the shipping sector addresses a blind spot in the existing literature on the determinants of maritime transport costs. One strand of the literature has studied aspects revolving around infrastructure and connectivity. In their

[1] The comparison is based on figures of average tariff rates, taken from WITS (2007), and maritime transport costs, taken from OECD (2007), respectively, both in ad valorem terms as of 2007.

seminal paper, Limao and Venables (2001) look at the quality of transport infrastructure as a whole. Other papers take up specific aspects of infrastructure such as port efficiency (Sanchez *et al.* 2003), different port characteristics (Wilmsmeier *et al.* 2006), or port infrastructure endowments (Wilmsmeier and Hoffmann 2008). The latter paper also addresses aspects of connectivity between ports,[2] as do Marquez-Ramos *et al.* (2006). In contrast, few papers investigate public policy. For instance, Wilmsmeier and Martinez-Zarzoso (2010) focus on the impact of being an open registry country whereas Clark *et al.* (2004) study the impact of anti-competitive practices in the liner shipping sector. Fink *et al.* (2002) quantify the effect of certain policies relative to other determinants of trade costs and find that both public policy—in the form of mandatory port services—as well as private anti-competitive practices have a substantial effect on transport costs.

This paper makes three principal contributions: first, we estimate the impact of restrictions on maritime transport costs and seaborne trade flows, highlighting in particular the role of investment barriers which have not been studied before. Second, we examine how distance affects maritime transport costs and, hence, seaborne trade flows. Third, we trace out how the impact of policy barriers on maritime transport costs itself varies with distance. To the best of our knowledge, this is the first paper to focus attention on the cost-inflating effect of a comprehensive set of measures, and to disentangle the various channels linking policy, distance, transport costs and trade flows.

We find that more restrictive liner shipping policies are associated with appreciably higher shipping costs, and investment restrictions matter most. Specifically, maritime transport costs are between 24 and 50 percent higher compared to ‘open’ routes, depending on the level of restrictiveness. Along the extensive margin, the probability of observing bilateral trade is between 17 and 25 percentage points lower on routes with policy barriers as compared to open routes. Thus, the cost-inflating effect is substantial in magnitude and, as we show below, varies with distance. In terms of the derived effect on seaborne trade, we estimate that policy barriers lower trade flows by 28 to 46 percent, primarily through raising transport costs.

[2] UNCTAD has pioneered the construction of composite indices summarizing the frequency, capacity and quality of services to and from countries, see UNCTAD’s ‘Liner Shipping Connectivity Index’ (LSCI).

Turning to the effect of distance, our estimates suggest that a 10 percent increase in distance leads on average to a 2.3 percent increase in maritime transport costs. Distance affects seaborne trade mainly through its impact on maritime trade costs.

Third, while for any given distance, restrictive liner shipping policies are associated with higher maritime transport costs, there is heterogeneity in this effect along the distance dimension. The cost-inflating effect is negatively related to distance. For example, intermediate levels of restrictiveness raise costs by as much as 47 percent on short routes but only by 28 percent on the longest routes. To the extent that distance attenuates the adverse impact of policy barriers, this effect works in the opposite direction of the direct effect of distance on maritime transport costs.

While multilateral trade negotiations have been successful in many areas, efforts to open up maritime services during the Uruguay Round negotiations under the auspices of the GATT/WTO were a notable failure, and hardly any progress has been made in recent Doha negotiations. This paper's findings suggest that the lack of progress in these negotiations leaves in place serious impediments to countries' integration into global markets. Breaking the stalemate in regional and multilateral negotiating fora could lead to potentially large gains from policy reform.

The paper is organized as follows: Section 2 describes policy barriers to trade and investment in the liner shipping sector. Section 3 presents the data and estimation methodology. In Section 4 we estimate the effect of policy measures in a maritime transport cost equation, and in Section 5 we use those results to estimate the impact of transport costs on trade flows in a gravity framework. Section 6 concludes and offers policy recommendations.

2. Policy Barriers to Trade in Maritime Shipping Services

We consider four types of potentially cost-increasing policy measures: cargo reservations and the operation of liner conferences, both of which affect cross-border shipping services; port and terminal usage fees on both ends of a route; and policy restrictions on establishing commercial presence. Taking a comprehensive view on policy measures allows us to gauge the relative importance of each type of measure, whereas previous papers have mostly studied some of these types of measures in isolation. While port usage costs are measured in dollar terms and are readily available from the World Bank's Doing Business database, the nature of other policy measures is less straightforward. This section therefore provides a brief background on such measures and how they interact.

The General Agreement on Trade in Services (GATS) defines trade as taking place through different modes of supply, two of which are most relevant to maritime trade. Cross-border trade (or mode 1) takes place when a maritime transport company from country A provides a service to a consumer resident in country B. Mode 1 is the key mode of supply for shipping services and has received greatest attention in previous research. The other relevant mode is the supply of a service through the establishment of commercial presence (or mode 3). A full commitment in mode 3 means that a country allows foreign firms to invest and establish local subsidiaries, branches or representative offices and imposes no restriction on their operation.[3]

Government barriers in mode 1: Cargo reservations

The main restrictions on cross-border trade (mode 1) take the form of cargo reservations or cargo preferences. These restrictions specify that some types of cargo can only be transported by some types of vessels, in general by vessels flying the country's flag or by vessels operated by national or domestic shipping lines. Over the past decades, most cargo reservations have disappeared (Fink *et al.* 2002) so that nowadays cargo reservations are likely to affect only a small part of world seaborne trade. For instance, in the US the volume of cargo transported under preference schemes represented around 1.5 percent of the total seaborne trade in 2005-07 (Bertho, 2011). In Brazil, 0.18 percent of total seaborne import tonnage was reserved for Brazilian flagged-vessels in 2009.

Private anti-competitive practices in mode 1

[3] Since today most international cargo can be transported irrespective of the vessel's flag, and since "deflagging" has spread, the establishment of a registered company for the purpose of operating a fleet under the national flag is less and less relevant (UNCTAD, 2011). This paper instead focuses on "the ability of international maritime transport service suppliers to undertake all activities which are necessary for the supply of a partially or fully integrated transport service, within which maritime transport constitutes a substantial element" (Draft Schedule on Maritime Transport Services mode 3b).

Historically, on many maritime routes liner shipping companies were allowed to cooperate on prices, capacities or schedules ("liner conferences"). Conferences thus are a particular form of institutionalized cartels and owe their existence to the fact that some countries exempt shipping lines from competition law. Since the 1990s, however, the influence of price-fixing agreements has decreased sharply: although 150 conferences operated in the world in 2001, less than 30 survived in 2010 (CI Online, 2010; OECD, 2002), mainly as a result of legislative changes such as the Ocean Shipping Reform Act (OSRA) in the US and the repeal of the block exemption for liner shipping conferences by European countries (Regulation 4056/86). Among the 118 routes in our sample, a carrier agreement is active on 37 routes (detailed list provided in Annex Table A.4).

Barriers to trade in mode 3: commercial presence

The impact of investment restrictions in the shipping sector has not been studied in the literature. Data unavailability may have been the main reason but it also seems the case that the complementarity between cross-border trade in shipping services and commercial presence has not been fully appreciated. In tramp shipping, tankers or dry bulk carriers are chartered by a single customer and so the transaction can easily be arranged by phone or via internet. In contrast, in the liner shipping segment a company needs hundreds or even thousands of customers to fill a container ship or general cargo vessel (Bertho, 2013). It is much more difficult to manage ten thousand boxes pertaining to ten thousand customers than ten thousand tonnes of crude oil pertaining to one customer. The development of a network of offices by establishing a commercial presence can greatly facilitate the administration and organization of vessels' calls as well as the management of cargo. Second, international transport increasingly takes the form of "door-to-door" or multimodal delivery. It is therefore important for maritime companies to establish a commercial presence abroad in order to have their own inland transport facilities or to develop partnerships with local transportation firms to facilitate the hinterland leg from the port to the final delivery point.

To obtain data on such mode 3 restrictions, we draw on the Services Trade Restrictions Database (Borchert, Gootiiz and Mattoo 2014) which provides detailed information on the incidence of policy measures in a number of services sectors, including maritime shipping. Table 1 provides an overview of individual policy measures applied to liner shipping. These measures either affect market entry, post-entry operations, or the regulatory environment.

The summary statistics indicate that (i) acquiring an equity position in a public incumbent firm is more heavily restricted than acquiring private sector firms, (ii) opening a branch, possibly as a less costly alternative to a subsidiary or an acquisition, is not permitted in a number of countries, and (iii) there appears to be a fair amount of regulatory discretion in the treatment of foreign suppliers, thereby giving rise to uncertainty.

Table 1: Policy measures in the maritime shipping sector affecting foreign investment

	Binary Variables			Continuous Variables			
	(1)	(2)		(3)	(4)	(5)	(6)
	Incidence	Percentage		Mean	Std.Dev.	Min	Max
Branch entry not allowed	26	0.40	Equity limit private sector	84.38	25.58	0	100
Subsidiary not allowed	2	0.03	Equity limit public sector	70.58	39.20	0	100
Licence required	40	0.89	Equity limit JVs	84.31	24.02	30	100
Licence criteria not publ avail	3	0.05	Equity limit subsidiaries	83.60	27.28	0	100
Licence not autom if crit fulfilled	12	0.18	Nationality employees	36.79	42.59	0	100
Regulator not independent	36	0.55	Nationality BoD	5.89	17.28	0	66
No right of appeal	13	0.20					
No prior notice of regul changes	38	0.58					
Repatriation of earnings restricted	5	0.08					

Source: Own calculations from Services Trade Restrictions Database, data refer to 2008-09. Col.(1) displays the incidence of the measures listed, i.e. a count measure of countries applying that restriction; Cols.(3)-(6) display standard descriptive statistics for continuous variables.

3. Data and Empirical Strategy

We first describe the construction of the Services Trade Restrictiveness Index (STRI) for liner shipping, and then our estimation strategy.

3.1 Liner Shipping STRI: Data and Methodology

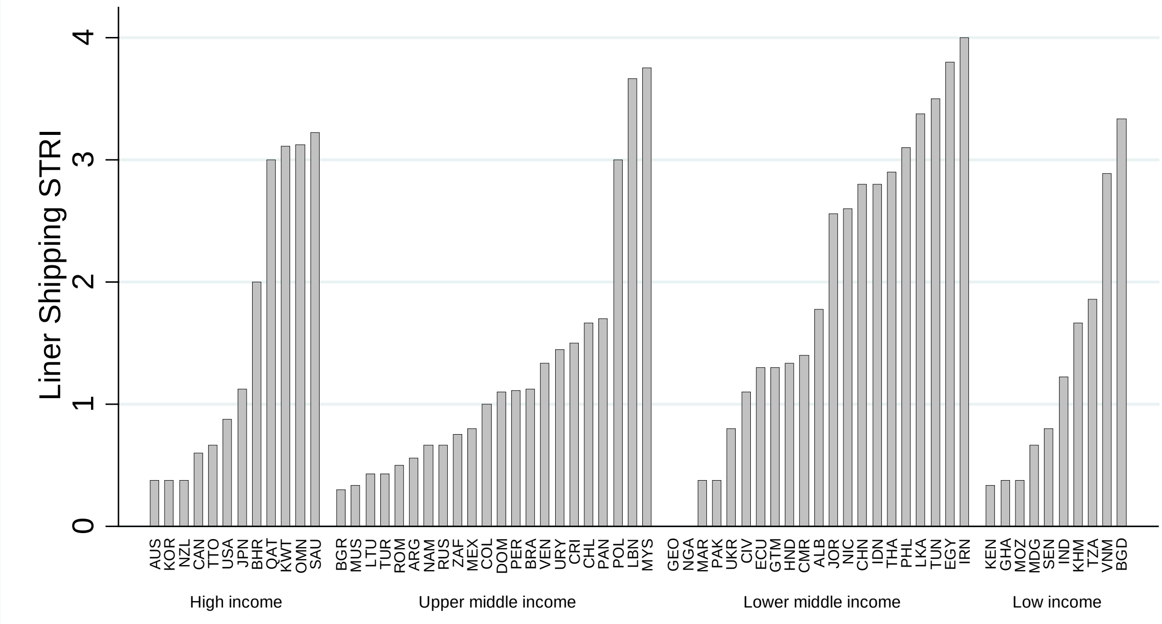
In order to incorporate multiple policy barriers to commercial presence as shown in Table 1, we construct a country-pair specific quantitative score (the liner shipping STRI) that reflects the restrictiveness of policy regimes applied at both ends of a given journey. The approach adopted in this paper builds on a relatively long tradition in the literature of quantifying policy barriers (Deardorff and Stern, 2008) of scoring the relative restrictiveness of specific policy measures and then constructing a weighted average of underlying scores. The scoring approach to quantification was first developed by the Australian Productivity Commission and used widely in work undertaken by the OECD[4]; recent applications to the maritime transport sector were developed by McGuire *et al.* (2000), Kimura *et al.* (2004), Achy *et al.*

[4] See Conway *et al.* (2005), Conway and Nicoletti (2006) and OECD (2008, 2009).

(2005) and Li and Cheng (2007). We combine the established methodology with the latest and most comprehensive information on applied service trade policies in the maritime shipping sector.

The construction of a liner shipping STRI proceeds in two principal steps: first individual policy measures relevant to the maritime shipping sector are selected, scored and aggregated for each country. Further details are provided in Annex 5. Figure 1 displays the liner shipping STRI by country and income group. As suggested in the literature, the liner shipping sector is relatively open to foreign trade in comparison to other services sectors (Borchert *et al.*, 2011; Kumar and Hoffmann, 2002), yet there is considerable variation across countries, which bodes well for identifying the impact of regulatory regimes. At the same time the index exhibits plausible correlations with some geographical characteristics; for instance, island countries for which international shipping is crucial tend to exhibit a low STRI (Australia, New Zealand, Mauritius and Trinidad and Tobago, one of the Caribbean's main maritime transport hubs).

Figure 1: Liner Shipping STRI, Mode 3, across per-capita income group



Sources: Author's calculation. Note: Level of development according to World Bank classification.

Second, country scores are combined—or 'bilateralized'—so as to obtain an indicator of restrictiveness that varies at the route level. Recall that activities specifically tied to having a commercial presence are administration and organization of vessels' calls, management of cargoes in ports of origin and destination, and administration and organization of hinterland transportation, all of which needs to work efficiently at both ends of a journey. Considering that potential policy barriers in ports of origin and destination add to each other, we obtain the bilateral STRI as the sum of origin and destination countries' indexes.[5]

3.2 Estimation Strategy and Related Data

Our approach is first to estimate the impact of liner shipping policies on bilateral MTCs, controlling for other determinants. In the second stage, we estimate the impact of transport costs on seaborne trade flows, again including relevant covariates.

In the first stage, we follow the model of liner shipping prices developed by Fink *et al.* (2002) and used in a number of subsequent papers.[6] In this model, the MTC for a product *k* on a maritime route between an origin country *o* and a destination *d* are assumed to be equal to the marginal cost of the service multiplied by a mark-up term.[7] The principal determinants of marginal costs and mark-ups in maritime shipping are distance, scale economies and policy barriers. Distance between the origin and destination has a straightforward effect on the marginal costs of transport through fuel, labor and other costs. At the same time, many maritime journeys between two countries are not direct and involve the "hub and spoke model" – i.e. long journeys between main ports performed by large vessels and cargo distribution within regions delegated to feeders after transhipment. We account for this feature of maritime shipping by including a transhipment variable in the MTC equation. The empirical relevance of doing so is illustrated by the fact that in our sample a direct service exists on 51 routes while transhipment is needed on 67 routes. Since maritime shipping is also understood to operate under increasing economies of scale, overall trade volume on a given route may affect transport costs. We address this issue by accounting for the aggregate bilateral country-pair volume of trade as well as for route-specific trade imbalances.[8]

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[5] An alternative approach, constructing the bilateral STRI as the product of origin and destination country indices, did not yield substantially different results.

[6] See Micco and Pérez (2002), Clark *et al.* (2004) and Wilmsmeier and Martinez-Zarzoso (2010).

[7] The term 'MTC' is used in the literature even if it corresponds to the price paid by consumer of the service. Here we follow this convention.

[8] Maritime transport costs are directional and we wish to allow for the fact that a low 'backhaul' is cross-subsidised by charging a higher price on one leg of the journey.

We assume that distance, scale economies and policy barriers jointly determine costs for shipping good *k* between country-pair *o* and *d* by affecting marginal costs or mark-ups. This gives rise to the following reduced form equation, which incorporates all principal determinants previously discussed:

$$\begin{aligned}\ln(\text{mtc}_{\text{odk}}) = {} & \beta_1 \ln(\text{distance}_{od}) + \beta_2 \text{tranship}_{od} + \beta_3 \ln(\text{tv}_{od}) + \beta_4 \ln(\text{tra\_imb}_{od}) \\ & + \sum_{q=2}^{4} \beta_{5,q} \text{STRI}_{od,q} + \beta_6 \text{CR}_{od} + \beta_7 \text{LC}_{od} + \beta_2 \text{TermCosts}_{od} \\ & + \theta_o + \lambda_d + \delta_k + \varepsilon_{odk}\end{aligned} \tag{1}$$

The dependent variable mtc_{odk} represents the per-unit cost (in dollars per tonne) paid by the service's consumers, including the price of the transport, insurance costs and cargo handling but excluding customs charges. The product index *k* corresponds to containerizable goods disaggregated at the 2-digit level of the Harmonized System (HS) classification.[9] In order to obtain the most precise price data, we restrict the sample to two importing countries (and all their trade partners) which report import values in CIF *as well as* "value for duty," thereby allowing us to compute 'true' MTCs and sidestepping the problems afflicting CIF-FOB ratios (Hummels and Lugovskyy, 2006).[10] We use the data computed by Korinek (2011) who uses Hummels' (1999) methodology to compute transport costs. The $distance_{od}$ variable measures maritime distance between the two main container ports of trading partners, corresponding to the shortest way by capes, straits or canals expressed in nautical miles (AXS Marine, 2010).

Our main interest lies in the policy measure $STRI_{od,q}$ which represent dummy variables corresponding to quartiles of the bilateral liner shipping STRI score. In addition, we control for the presence of cargo reservations (CR_{od}) and liner conferences (LC_{od}) on a particular route as well as the terminal fees ($TermCosts_{od}$) at origin and destination ports, respectively.

We include full sets of origin, destination, and commodity fixed effects (θ_o, λ_d and δ_k). It is important to emphasize that the coefficients of interest in equation (1) are identified off

[9] Following the OECD Maritime Transport Costs Database, we assume that containerisable cargo corresponds to all lines except 10, 12, 15, 25-29, 31, 72, and 99 in the Harmonized System (HS) disaggregated at 2-digits.

[10] "Value for duty" is defined by Statistics New Zealand as the value of imports before the addition of insurance and freight costs. The equivalent statistical concept in the United States is "Customs value" which is defined as the price actually paid or payable for merchandise when sold for exportation to the United States, excluding U.S. import duties, freight, insurance, and other charges incurred in bringing the merchandise to the United States. In contrast, the CIF value of imports is the actual cost paid by importers, so that the difference of both valuations yields a measure of 'true' maritime transport costs.

country-pair variation, while the exporter and importer fixed effects absorb any unobserved country heterogeneity such as port infrastructure or the quality of institutions.[11] One may also expect unobserved product heterogeneity to affect maritime transport costs. For instance, there is evidence that in the presence of market power, shipping prices depend on the (demand) characteristics of the products to be shipped (Calvo Pardo and Lazarou 2013; Hummels, Lugovskyy and Skiba 2009). Likewise perishable goods may command a premium for timely delivery. All these effects are absorbed by the full set of commodity fixed effects.

The sample includes two importers (New Zealand and the United States, destination countries) and 65 exporters (origin countries) representing a total of 9,984 observations.[12] Among exporters, 12 are high income countries, 43 are middle income and 10 are low income countries. The sample accounts for 69 percent of US total seaborne imports and 52 percent of New Zealand's total seaborne imports, respectively. We estimate equation (1) on a cross-section of product-country-pairs for the year 2006, for which transhipment data are available from UNCTAD.

Before proceeding to the results for the transport costs equation, the censored nature of the dependent variable mtc_{odk} needs to be emphasized as it is derived from trade flows and thus is missing for zero trade flow observations. Essentially transport costs do exist but are prohibitively high so that no trade is observed (Limao and Venables, 2001). Censoring affects around 50 percent of the sample. We address this issue by estimating a top-coded tobit model. Censored observations' missing MTC values are replaced by the highest value of transport costs observed in the dataset (Carson and Sun, 2007).

[11] One such institution is a country's stance on exempting liner conference from domestic competition law. In our particular sample the incidence of this institution is collinear with the country fixed effects and thus cannot be identified separately.

[12] The number of origin countries is in the first instance constrained by the total number of countries in the Services Trade Restrictions Database (103), of which 22 are landlocked and thus drop out. In addition, for 13 EU member states, for which policy information is in principle available, trade flows cannot be tracked back to the port of entry through which they entered EU territory (typically Rotterdam), so they drop out as well. We end up with 65 exporters; the country sample is detailed in Annex 2.

4. First Stage: Estimating Maritime Transport Costs

4.1 Estimation Results

Results from estimating equation (1), i.e. the determinants of maritime transport costs, are presented in Table 2. Model 1 includes control variables only. Distance, transhipment and total seaborne import volume variables are all highly significant. The trade imbalance variable is always insignificant, which could be due to the difficulty of identifying the relevant regional trade routes for a given country-pair.[13] The coefficients of natural trade barriers are all correctly signed and indicate, as we would expect, that increasing distance as well as the need for transhipment are cost-inflating whereas a higher total trade volume allows scale economies to be exploited, thereby lowering shipping costs.

In models 2-5, we consider the four principal types of potentially cost-increasing measures that have been observed: cargo reservations on cross-border shipping services (col.2), liner conferences on particular routes (col.3), fees and other terminal costs in the ports at both ends of the journey (col.4), and policy restrictions on establishing commercial presence in the countries involved (col.5). We find some evidence that cargo reservations and port costs are cost-inflating but investment restrictions exert a much stronger influence.

Our main results for the first stage of the inquiry are contained in column 6 where all potential determinants of maritime transport costs are jointly considered. We include indicator variables for quartiles of the STRI distribution and so do not restrict the effect of investment restrictions to be linear in our measure of restrictiveness. The coefficients associated with cargo reservations, liner conferences and port terminal costs are now insignificant but those associated with the liner shipping STRI are positive and significant at the 1 or 5 percent level. The latter coefficients increase monotonically but the cost-inflating effect of policy barriers is not linear. The marginal effects of policy implied by the STRI coefficients in column 6 range from 24.1 to 49.7 percent at the median distance and thus are economically quite significant. We provide a comprehensive discussion of the marginal effects of policy further below.

[13] The pronounced ‘hub-and-spoke’ network structure of maritime trade would imply that the inter-regional seaborne trade volume (e.g. between ‘Australasia’ and the Far East) is more relevant for shipping costs between Auckland and Shenzhen than the inter-country trade volume New Zealand and China.

Table 2: Estimation results -- the MTC equation

	(1)	(2)	(3)	(4)	(5)	(6)
Distance	1.3046***	1.2811***	1.2765***	0.9912***	1.4514***	1.1193***
Transhipment	0.6164**	0.5922**	0.5783**	0.8615**	0.9128***	1.0566***
Total Import Vol	-0.5715***	-0.5312***	-0.5823***	-0.6908***	-0.5813***	-0.6651***
Abs Import Imbalance	-0.0899	-0.1175	-0.0757	-0.0052	-0.0687	0.0306
Cargo Reservations		0.6473*				-0.0159
Liner Conference			-0.262			-0.3168
Port Terminal Costs				0.0143**		0.0105
STRI 2nd quartile					1.3093***	1.1532***
STRI 3rd quartile					2.0545***	1.5336**
STRI 4th quartile					2.5594***	2.3215**
Observations	9984	9984	9984	8790	9984	8790
Right-censored obs	5199	5199	5199	4512	5199	4512
Uncensored obs	4785	4785	4785	4278	4785	4278
Pseudo R2	0.2053	0.2055	0.2054	0.2032	0.2059	0.2038

Source: Authors' calculation. Notes: significance levels: * 10% level, ** 5% level, *** 1% level. The dependant variable is the log of per-unit maritime transport cost expressed in dollars per kilogram. The variables *Distance*, *Total import volume* and *Absolute Import Imbalance* are in logarithms. Tobit coefficients reported for all models, marginal effects discussed in the text. The R-squared is McFadden's pseudo R-squared. Estimations use White heteroskedasticity-consistent standard errors which are clustered at the country-pair level. The number of observations is lower in Models (4) and (6) due to unavailability of information on port terminal costs in Bahrain, Egypt, India, Korea, Lebanon, Madagascar, Qatar, Saudi Arabia and Turkey. Origin, destination and commodity fixed-effects as well as intercepts are included in all models but not reported.

We subject the results from the main specification to three further robustness checks. First, we check whether our results are affected by the potential endogeneity of MTC with respect to bilateral total trade volume. Using applied most-favored-nation (MFN) tariffs and non-seaborne imports as instruments for seaborne import volumes leads only to minor changes in the coefficients (see Annex Table A.6); more importantly, the impact of the STRI liner shipping index remains significant and virtually unchanged in terms of magnitude. Hence, as the degree of endogeneity appears to be small while IV estimation is associated with efficiency losses, we conclude that model 6 is our preferred specification for estimating the MTC equation.

Second, in our sample we observe a number of minuscule trade flows that arise from the shipment of tiny physical quantities. The concern is that the distribution of per-unit transport costs is artificially inflated by these observations (Baldwin and Harrigan, 2007; Harrigan 2010). Thus, we re-estimate model 6 after dropping all observations for which the physical weight reported is less than one metric tonne.[14] The results remain qualitatively unchanged; whilst the distance elasticity remains virtually identical,[15] the impact of policy barriers declines slightly but still ranges from 12 to 31.5 percent on average. A full tabulation of marginal effects for the restricted sample is available upon request.

Third, while the commodity fixed effects control, in principle, for alternative modes of transportation at the product level, especially by air, it is important to check for road transport because trade between neighboring countries in particular is more likely to be carried by road (Hummels, 2007). We therefore check for competition from surface transport by dropping observations involving contiguous countries; this is the case of US-Mexican trade representing 85 observations. The results remain virtually unchanged.

4.2 Policy Impact

We now discuss in detail the implied marginal effects of policy, first holding distance fixed and then exploring how the effects vary across distance (Table 3). Conditional on distance, more restrictive policies are associated with appreciably higher costs. At the median distance, the expected value of maritime transport costs is on average 24.1 percent higher on routes in the second quartile of the liner shipping STRI as compared to 'open' routes (the first quartile serves as reference category). MTCs are 32.9 percent and 49.7 percent higher on the routes classified in the third and the fourth quartile, respectively, compared to open routes (Panel A, column 3).

The marginal effects in panel A refer to the expected value of transport costs,[16] which comprise of the effect on actual non-censored transport costs (panel B) and the effect on the censoring probability (panel C), for higher policy barriers increase the likelihood of choking bilateral trade flows. In the standard tobit model (left-censoring at zero), the 'McDonald-Moffitt decomposition' provides an elegant way of partitioning the marginal effect on the censored expectation into the constituent effects of covariate changes on the probability of

[14] This affects 524 observations, or less than 6 percent of the sample. Observed average trade costs in this (potentially abnormal) subsample exceed the average in the rest of the sample by a factor of five.
[15] The effect of the lower tobit coefficient is counter-balanced by the expected value of MTCs being considerably lower in the restricted sample.
[16] Notice that the object of interest is the effect on the expected value of trade costs, $E(MTC|x)$, whereas the econometric specification of the tobit model employs logged values of MTCs rather than levels. Since $E(\ln x)$ is not equal to $\ln(E(x))$, the quantities of interest are not straightforward to obtain. Details on the computation of marginal effects are available upon request.

censoring and the truncated expected value, respectively. The non-standard form of our setup (right-censoring at a non-zero value with a dependent variable in logarithm) renders the McDonald-Moffitt decomposition not applicable. We therefore discuss the relevant margins separately.

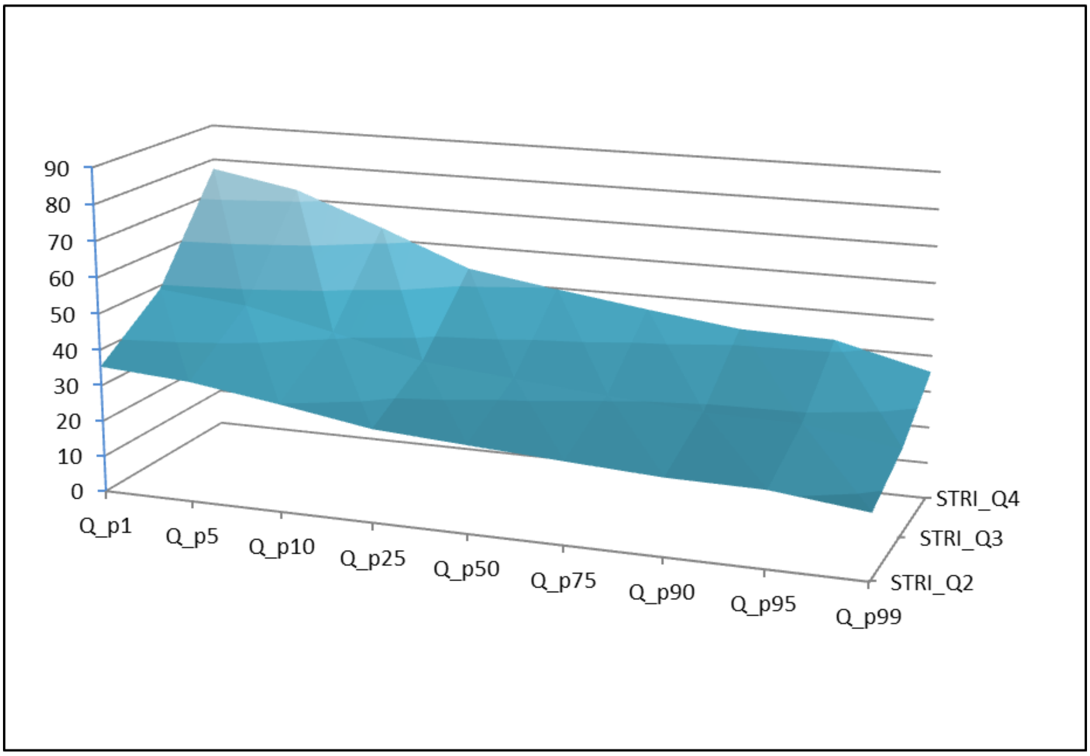
Table 3: Marginal effects of policy restrictiveness, over distance

	(1)	(2)	(3)	(4)	(5)
A. Change in expected MTC (percent)					
Distance percentile:	5th	25th	50th	75th	95th
STRI 2nd quartile	33.60	25.80	24.15	22.60	20.84
STRI 3rd quartile	46.51	35.30	32.96	30.77	28.30
STRI 4th quartile	72.72	53.59	49.70	46.11	42.09
B. Change in expected uncensored MTC (percent)					
Distance percentile:	5th	25th	50th	75th	95th
STRI 2nd quartile	26.35	21.59	20.63	19.74	18.74
STRI 3rd quartile	36.21	29.47	28.12	26.88	25.49
STRI 4th quartile	56.46	45.42	43.24	41.24	39.01
C. Change in censoring probability (percentage points)					
Distance percentile:	5th	25th	50th	75th	95th
STRI 2nd quartile	-11.24	-12.49	-12.62	-12.68	-12.67
STRI 3rd quartile	-15.00	-16.59	-16.74	-16.81	-16.78
STRI 4th quartile	-23.35	-25.13	-25.21	-25.16	-24.95

Like the expected value of transport costs, the impact along the censoring margin is also increasing in restrictiveness; for instance, at the median distance, the probability of observing bilateral trade is 12.6 percentage points lower on routes with policy barriers in the second quartile of the STRI distribution. On routes in the third and fourth quartiles, respectively, the probability is lower by 16.7 and 25.2 percentage points as compared to open routes. The 'choking' effect of policy barriers is thus a significant driver of the overall effect on maritime transport costs.

As we would expect, the impact on the censoring probability amplifies the effect of policy on the truncated mean (panel B); for instance, conditional on observing trade, expected transport costs are 43.2 percent higher on restrictive routes but overall expected transport costs, including zero trade flows, are higher (49.7 percent) on a comparable route (column 3). This amplification effect holds for every combination of distance and policy restrictiveness, though the relative contribution of each margin may differ.

Figure 2: Marginal effects of policy restrictiveness, over distance, in percent



Source: Authors' calculation. Notes: The graph shows the percentage increase in the expected value of maritime trade cost at selected quantiles of the bilateral distance distribution. Since increasing levels of restrictiveness are captured by dummy variables, the marginal effects at each point are calculated as the discrete change in E[MTC | x] with and without the respective dummy variable.

The results across panels A-C show that, for any given distance, costs are increasing in restrictiveness along all three margins, and that effects on the uncensored and censored observations reinforce each other. At the same time there is substantial heterogeneity in these effects along the distance dimension. In particular, the cost-inflating effect is considerably stronger for proximate country pairs and attenuates for faraway destinations.[17] For instance, between nearby countries such as the United States and Venezuela (5th percentile = 1,850km distance) the existence of significant policy barriers (3rd quartile of STRI) raises maritime transport costs by 46.5 percent whereas the same measures applied between countries at the 95th percentile (10,500km, for instance New Zealand and Bulgaria) raises transport costs by only 28.3 percent (panel A, cols. 1 and 5). The most stringent barriers can raise costs by up to

[17] Table 3 displays what is sometimes referred to in the literature as Marginal Effects at Representative Values (MERs); Figure 2 provides a visualization over a range of MERs.

77 percent on short distances (Figure 2). Notice that the incremental effect of highly restrictive policies relative to intermediate policies, i.e. the slope of the hyper plane along the STRI dimension, is also slightly decreasing with distance.

Why might distance attenuate the impact of policy restrictions on MTCs? To see one simple rationale for this finding, recall that MTCs are a product of marginal cost and mark-up, and policy restrictions could in principle affect either. The results above are consistent with the case in which restrictions increase the (quality-adjusted) marginal cost of liner services. For example, policy constraints on establishing commercial presence could plausibly inhibit operational efficiency, reducing the quality, or increasing the marginal cost of the service. Longer distances also imply *ceteris paribus* higher marginal costs and hence higher MTCs. In many demand systems, however, the preferences of consumers of liner services are likely to be more elastic at higher MTCs. The fact that carriers will find it optimal to charge lower mark-ups when demand is more elastic implies that the cost-inflating effect of policy barriers is falling with distance. Atkin and Donaldson (2014) find a similar pattern of mark-ups declining with distance in intranational trade and provide a similar rationale.

Notice that along the extensive margin, the likelihood of observing a positive trade flow falls with distance for any given level of restrictiveness (panel C). This is exactly what we would expect, even though the distance heterogeneity is not very pronounced. For instance, the 16.8 percentage points decrease in censoring probability for country pairs at the 95th distance percentile is about 12 percent higher than the 15 percentage points decrease for nearby countries (5th percentile, panel C row 2).

4.3 Distance and Other Covariates

In addition to influencing maritime transport costs through the effect of policy, distance also has a direct effect on costs. In the main specification, per-unit trade cost increase by 2.3 percent if bilateral distance between country pairs increases by 10 percent. In other words, everything else equal, MTCs on the New Zealand—Panama route are approximately 2$/tonne higher than on the New Zealand—Peru route, which is some 676km shorter. Regarding the marginal effects of other covariates, the need for transhipment in order to connect two countries raises per-unit MTCs by around 28.3 percent, which constitutes a substantial premium. Concerning economies of scale, a 10 percent increase in the total volume of seaborne imports reduces per-unit MTCs by 1.4 percent.

5. Second Stage: Estimating Seaborne Trade Flows

In the second stage of our analysis, we use a standard gravity framework to assess the impact of maritime transport costs on seaborne trade flows. Compared to earlier studies that have looked at the effect of MTCs on seaborne trade flows[18], the two-step approach allows us to obtain more accurate impact effects not only with respect to policy barriers but also with regard to conventional gravity variables such as distance. Following the approach in Limao and Venables (2001), we address the endogeneity of transport costs by using predicted values of MTCs from the first stage, which are not afflicted by reverse causality.[19]

5.1 Data and Estimation

We base our estimation on the structural gravity model as developed by Anderson and van Wincoop (2003) in which imports are a function of sectoral output, expenditure, and a trade cost function that comprises of bilateral trade barriers as well as inward and outward multilateral resistance terms. A key property of this framework is trade separability, which defines this structural relationship for each product category *k*.

$$M_{od}^{k} = \frac{Y_d^k E_o^k}{Y}\left(\frac{\tau_{od}^{k}}{\Pi_d^k \mathrm{P}_o^k}\right)^{1-\sigma^k} \tag{2}$$

We specify the trade cost function $\tau(\cdot)$ to include distance, contiguity, membership in a preferential trade agreement (PTA), tariff rates, and maritime transport costs.[20] As is standard in the literature, we add an error term multiplicatively and estimate equation (2) with Poisson

[18] See Radelet and Sachs (1998), Limao and Venables (2001), Martinez-Zarzoso and Suarez-Burguet (2005), Marquez-Ramos *et al.* (2006), Martinez-Zarzoso and Nowak-Lehmann (2007), Martinez-Zarzoso *et al.* (2008), Korinek and Sourdin (2009).

[19] Few studies acknowledge the endogeneity of MTCs, and those that apply IV techniques use the unit value of goods as an instrument for MTCs, see Martinez-Zarzoso and Suarez-Burguet (2005), Marquez-Ramos *et al.* (2006), and Korinek and Sourdin (2009). This approach raises doubts about the exclusion restriction because the value of trade (price times quantity) is likely to be correlated with the unit value of goods. Martinez-Zarzoso and Nowak-Lehmann (2007) estimate transport costs and trade simultaneously but this approach, too, is problematic since it is not the amount of individual products (or HS-2/4 lines) that creates economies of scale in liner shipping but rather the total amount of bilateral trade.

[20] Other standard gravity variables such as common language or common religion exhibit little variation and are partly collinear with other variables in our specific sample, as both importing countries (United States, New Zealand) are English-speaking and party to several PTAs.

Pseudo Maximum Likelihood (PPML), assuming the conditional mean of imports can be modelled as described:

$$E\left[M_{odk}\right]=\exp\left\{\begin{array}{c}\gamma_1\ln(\text{mtc}_{odk})+\gamma_2\ln(\text{distance}_{od})+\gamma_3\text{contiguity}_{od}+\gamma_4\text{PTA}_{od}+\gamma_5\text{tariffs}_{odk}\\ +\sum_{q=2}^{4}\gamma_{6,q}\text{STRI}_{od,q}+\gamma_7 CR_{od}+\gamma_8 LC_{od}+\theta_o+\lambda_d+\delta_k\end{array}\right\} \quad (3)$$

The gravity-type variables are self-explanatory but further details including data sources can again be found in Annex 3. We use the average applied tariff between country-pairs for product *k*. *PTA* is a dummy variable indicating whether a bilateral route is covered by any of the main preferential agreements to which the US and New Zealand are party, namely NAFTA, CAFTA, and other 'closer economic relations' (CER) agreements.[21]

5.2 Results

We obtain a rich set of results that illustrate how natural and policy barriers affect seaborne trade flows. By linking the first-stage tobit estimates with second-stage PPML estimates, we are able to disentangle direct and indirect effects (through transport costs) and trace out how these change across different samples.

As a point of reference, we start by estimating equation (3) using actual MTC data, as if maritime transport costs were exogenous to trade flows (Table 4, col. 1-3). All variables exhibit the correct sign and most of them are significant at the 1 percent level. Notice that the coefficient on contiguity is also correctly signed for the specific sample of exclusively seaborne imports, since surface transport (road trucking) is arguably the most efficient transport mode for countries sharing a border. This result confirms a pattern often stated in the literature, namely that the importance of maritime transport decreases significantly when two trading partners share a common border (Hummels, 2007).

However, the partial effect of maritime transport costs may be biased because of the reverse causality arising from the fact that larger volumes shipped are associated with lower average costs. In order to obtain an unbiased estimate in the trade gravity equation, we use predicted values of MTCs from the first stage (col. 4-6). From the specifications with predicted

[21] New Zealand has a CER agreement with Thailand; the United States has CERs with Australia, Chile, Jordan and Morocco, respectively.

transport costs, we obtain three main results: first, the marginal effect of transport costs on trade flows differs across the sub-samples; in particular, in the full sample the coefficient is lower compared to the one using actual MTCs but the value of trade is much more sensitive to transport costs in the positive trade flow sample. Second, the impact of conventional gravity variables such as geography and trade policy is substantially altered once transport costs are properly controlled for. Third, the two-stage approach allows us to quantify correctly the overall impact on trade flows of key determinants such as distance and investment restrictions. We discuss each result in turn.

Table 4: Estimation results -- The gravity equation

	Actual Transport Cost			Estimated Transport Cost		
	(1)	(2)	(3)	(4)	(5)	(6)
	Full	Full	Positive	Full	Full	Positive
Per-unit MTC (actual)	-0.8495***	-0.8473***	-0.8444***			
Per-unit MTC (predicted)				-0.5613**	-0.5118*	-1.2721***
Distance	-2.8519***	-2.2853***	-2.2134***	-1.4673**	-1.0001	0.8561
Contiguity	-5.9695***	-4.9197***	-4.8052***	-3.3675***	-2.6467**	-0.4290
PTA	0.3631***	1.0717***	1.0779***	0.2702**	0.9138***	0.6125**
Avg applied tariff	-0.0041	-0.0042	-0.0041	-0.0027	-0.0027	-0.0014
STRI 2nd quartile		-0.9942*	-0.9203**		-0.5536	-0.5086**
STRI 3rd quartile		-1.0699	-0.8105*		-0.5202	-2.0817***
STRI 4th quartile		-0.6411	-0.3203		-0.0473	-1.8456***
Cargo Reservations		-0.0917	-0.1238		-0.1681	-0.3256
Liner Conference		0.5265***	0.5490***		0.5266***	0.5261
Observations	9966	9966	4786	8774	8774	4280
Log L	-2.850e+11	-2.846e+11	-2.844e+11	-2.856e+11	-2.853e+11	-2.773e+11
R2	0.6016	0.6003	0.5991	0.6101	0.6091	0.6079

Source: Authors' calculation. Notes: significance levels: * 10% level, ** 5 % level and *** 1 % level. The dependant variable is the log of seaborne imports, expressed in dollars. The variables *MTC* and *Distance* are in logarithms. All models estimated by Poisson Pseudo Maximum Likelihood (PPML) with robust standard errors clustered at the country-pair level. Full sets of origin, destination and commodity fixed-effects included in all specifications but not reported.

First, in the full sample including zero trade observations, the effect of transport costs on the value of imports is lower when predicted values of MTCs are employed (columns 4 and 5) as the effect of reverse causality is purged or at least substantially reduced. In the PPML specifications, coefficients on continuous variables can be interpreted as elasticities, i.e. a 1 percent increase in maritime transport costs would reduce imports by 0.51 percent (col.5). This cost effect strengthens substantially once zero trade observations are excluded. Hence, while maritime transport costs do play a role in affecting the extensive margin, they are quantitatively even more important as drivers of the intensive margin (column 6).

Second, the predicted values of MTCs used in models 4-6 properly include the effect of variables such as distance or contiguity whose impact on the value of trade should mainly work through raising transport costs. This is exactly what we find. Compared to their coefficients in columns 1-3, the direct effect of distance and contiguity either vanishes or is substantially reduced. The significant distance coefficient in column 4 may reflect a selection effect[22] but distance is insignificant in columns 5 and 6. Contiguity has a direct effect only in the full sample including zero trade flows but no effect once only positive seaborne trade flows are considered, which is precisely what we would expect. In contrast, the presence of a PTA directly affects trade flows without raising transport costs, and this prediction is borne out by the fact that the PTA coefficient is significant and of roughly equal size across all 6 columns. These results demonstrate the usefulness of the two-step approach for correctly quantifying the impact on trade flows of policy measures and other gravity variables. For instance, if one simply estimated the effect of distance on trade flows, conditional on contiguity, PTAs and tariffs, but not otherwise accounting for maritime transport costs, one would obtain a distance elasticity of trade of –3.1. In contrast, the distance elasticity implied by model 4 in Table 4, which incorporates both the main effect through MTCs as well as a potential direct effect, would amount to –1.6 only.[23] Thus without taking proper account of MTCs, estimates of distance elasticities may be severely biased.[24]

Of particular interest is a quantification of the effect of investment restrictions on seaborne trade as these kinds of frictions have not been studied before. Table 5 shows that the trade depressing effects, in percentage terms, of policy barriers through raising transport costs is sizable.[25] Across all three columns, the effect of policy restrictiveness is nonlinear but

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[22] In addition to the first-order effect of distance on marginal costs, which is rolled into predicted MTCs, distance may exert a direct effect through specialisation. Harrigan (2010) has shown that in the presence of alternative transport modes which differ in their cost/speed trade-off, and consumers valuing timeliness of delivery, distance will play a role in determining comparative advantage. Using US import data, Harrigan shows that faraway exporters have a relatively high market share in goods which are transported by air (as opposed to surface), implying that in a sample restricted to seaborne trade flows and controlling for contiguity, distance exerts a negative effect via comparative advantage specialization.

[23] We compute this quantity by calculating the marginal effect on the censored mean with respect to distance in elasticity terms from the first stage (unrestricted and restricted sample) and then multiply the results with the cost elasticity of trade from the second stage as shown in columns 4 and 5, respectively. In so doing we take care of the retransformation problem on both sides of the first-stage equation, for what is needed is the elasticity of *MTCs* with respect to *distance* while the estimable equation is framed in terms of *log(MTC)* on *log(distance)*.

[24] Egger (2008) has shown in a general gravity framework (not specific to seaborne trade) that the marginal effect of distance may differ across country pairs. Here we argue that, heterogeneous effects notwithstanding, even the average effect may be biased if distance were solely and directly used as a transport cost proxy.

[25] For columns 1 and 2, we compute this quantity by first calculating, for each STRI quartile, the marginal effect on the censored expected value of trade costs in the first stage, and then evaluate the predictive margins for the value of imports in the second stage at each of these values for predicted MTC. We then express the change in

monotonically increasing, as we would expect. In the main specification based on the full sample and estimated transport costs (Table 4 col. 5), the value of imports may be lower by up to 46 percent on highly restrictive routes (Table 5 col.2) solely based on the indirect effect through MTC.

Table 5: Marginal effects of policy restrictiveness through MTC, percent

	Sample		
	Full	Full	Positive
	(1)	(2)	(3)
STRI 2nd quartile	-30.09	-27.85	-43.91
STRI 3rd quartile	-37.59	-34.94	-53.40
STRI 4th quartile	-48.88	-45.76	-66.83

Source: Authors' calculations. Notes: the figures in each column are computed based on differential values of the "predicted per-unit MTC" variable in models (4)-(6) of Table 4, respectively. See footnote 37 for computational details.

6. Conclusion and Recommendations

Contrary to popular belief, international trade in liner shipping services is still restricted by policy. In particular, the impact of widespread investment restrictions in the shipping sector has not been studied in the literature. This paper demonstrates that such policy measures have a significant effect in terms of raising maritime transport costs and, hence, lowering seaborne trade flows. Since the bulk of global merchandise goods trade is seaborne, the magnitude of frictions identified in this paper and their spatial distribution have important ramifications for connectivity and market integration.

Trade policy restrictions in mode 3 raise maritime transport costs by up to 50 percent, with pronounced heterogeneity of this effect along the distance dimension. A substantial part of the detrimental effect of policy barriers emanates from increasing the probability that an observation is being censored; in other words, regulatory measures inhibit seaborne trade

these predictive margins in the second stage in percentage terms. For column 3, we follow in principle the same procedure but the correct quantities with respect to this sample are now the marginal effect on the truncated expectation as obtained from the restricted sample of the first stage. On retransformation to the correct quantities see Note 26 above.

altogether on a particular bilateral route. We also find transhipment requirements and total import volume to be significant determinants of maritime transport costs but the magnitude of these effects is secondary compared to the effects of policy barriers and distance.

In a second step, we examine the effect of maritime transport costs on seaborne imports. Using predicted values from the previous transport cost equation to address the reverse causality induced by scale economies in liner shipping, we estimate that policy restrictiveness lowers trade flows by up to 46 percent. The two-step approach turns out to be crucial for obtaining correct impact effects not only with respect to policy barriers but also with regard to conventional gravity variables such as distance.

Our finding that protection persists and matters in maritime transport is relevant for both national policy and international trade negotiations. In a wide range of both developing and industrial countries, from China to Germany, restrictions on foreign ownership in shipping are unquestioningly accepted. In the Uruguay Round negotiations at the World Trade Organization, efforts to open up maritime services were a notable failure, and hardly any progress has been made in the more recent Doha negotiations. Even regional trade negotiations in services have tended to exclude maritime transport because of the unwillingness of major countries to accept international disciplines. Perhaps a greater awareness of the high cost of protection may bolster efforts to challenge the political status quo.

References

Achy, Lahcen, Mongi Boughzala, Hanaa Kheir-El-Din and Sübidey Togan. 2005. "*Impact of Liberalization of Trade in Services: Banking, Telecommunications and Maritime Transport in Egypt, Morocco, Tunisia and Turkey*", Femise project, FEM22-02.

Anderson, James E. and Eric Van Wincoop. 2003. "Gravity with Gravitas: A Solution to the Border Puzzle." *American Economic Review*, 93(1): 170-192.

Atkin, David and Dave Donaldson. 2014. "*Who's Getting Globalized? The Size and Implications of Intranational Trade Costs*, mimeo.

AXS Marine. 2010. "AXS Marine Distance Table" AXS Marine website. http://www.axsmarine.com/distance/.

Baldwin, Richard and James Harrigan. 2007. "*Zeros, Quality and Space: Trade Theory and Trade Evidence*" National Bureau of Economic Research Working Paper 13214.

Bertho, Fabien. 2013. "*The Impact of Liner Shipping Trade and Competition Regulations on the Market Structure, Maritime Transport Costs and Seaborne Trade Flows*". Doctoral dissertation, Sciences Po Paris, Paris, France.

Bertho, Fabien. 2011. "*Maritime Transport in Australia and in the United States*" in: The Impacts and Benefits of Structural Reforms in the Transport, Energy and Telecommunications Sectors in APEC Economies, APEC Policy Support Unit Report, Singapore: Asia-Pacific Economic Cooperation Secretariat, pp. 290-333.

Borchert, Ingo, Batshur Gootiiz and Aaditya Mattoo. 2014. "Policy Barriers To International Trade In Services: Evidence from a New Database", *World Bank Economic Review* 28 (1), pp. 162-188.

Borchert, Ingo, Batshur Gootiiz and Aaditya Mattoo. 2011. “Services in Doha: What’s on the Table?”, Chap. 5 in: Will Martin and Aaditya Mattoo (eds.), “*Unfinished Business? The WTO's Doha Agenda*”, London: CEPR and World Bank, pp. 115-143.

Calvo Pardo, Hector F. and Nicholas-Joseph Lazarou. 2013. “Firm heterogeneity and asymmetric trade with a transport sector - Implications of trade liberalisation”, University of Southampton, mimeo.

Carson, Richard T. and Yixiao Sun. 2007. “The Tobit model with a non-zero threshold” *Econometrics Journal* 10, pp. 488–502.

Clark, Ximena, David Dollar and Alejandro Micco. 2004. “Port Efficiency, Maritime Transport Costs and Bilateral Trade.” *Journal of Development Economics*, 75: 417-450.

Containerization International Online. 2010. “Fleet Deployment Statistics” http://www.ci-online.co.uk/

Conway, Paul, Véronique Janod and Giuseppe Nicoletti. 2005. “*Product Market Regulation in OECD Countries: 1998 to 2003*” OECD Economics Department Working Papers 419.

Conway, Paul and Giuseppe Nicoletti. 2006. “*Product Market Regulation in the Non-Manufacturing Sectors of OECD Countries: Measurement and Highlights*” Organization for Economic Cooperation and Development Economics Department Working 530.

Deardorff, Alan V. and Robert M. Stern. 2008. “Empirical Analysis of Barriers to International Services Transactions and the Consequences of Liberalization,” in Aaditya Mattoo, Robert M. Stern, and Gianni Zanini, eds, *A Handbook of International Trade in Services*, New York: Oxford University Press, pp. 169-220.

Egger, Peter. 2008. “On the Role of Distance for Bilateral Trade” *The World Economy* 31(5): 653-662.

Fink, Carsten, Aaditya Mattoo and Ileana C. Neagu. 2002. "Trade in International Maritime Services: How Much Does Policy Matter?" *The World Bank Economic Review*, 16(1): 81-108.

Harrigan, James. 2010. "Airplanes and comparative advantage" *Journal of International Economics* 82(2), pp. 181-194.

Hummels, David. 2007. "Transportation Costs and International Trade in the Second Era of Globalization", *Journal of Economic Perspectives*, vol. 21, n° 3 Summer 2007

Hummels, David. 1999. "*Toward a Geography of Trade Costs*" Global Trade Analysis Project Working Paper 17.

Hummels, David and Volodymyr Lugovskyy. 2006. "Are Matched Partner Trade Statistics a Usable Measure of Transportation Costs?" *Review of International Economics,* 14(1): 69-86.

Hummels, David, Volodymyr Lugovskyy and Alexandre Skiba. 2009. "The trade reducing effects of market power in international shipping" *Journal of Development Economics* 89: 84–97.

Kimura, Fukunari, Mitsuyo Ando and Takamune Fujii. 2004. "Estimating the Ad Valorem Equivalent of Barriers to Foreign Direct Investment in the Maritime and Air Transportation Services sector in Russia." Available at: http://siteresources.worldbank.org/INTRANETTRADE/Resources/Topics/kimura-Ando-Fujii-RussiaTransport.pdf

Korinek, Jane. 2011. "*Clarifying Trade Costs in Maritime Transport*", Document No. TAD/TC/WP(2008)10/FINAL of 29 March 2011, OECD: Paris.

Korinek, Jane and Patricia Sourdin. 2009. "*Maritime Transport Costs and Their Impact on Trade*" available at: http://www.etsg.org/ETSG2009/papers/korinek.pdf

Kumar, Shashi and Jan Hoffmann, "Globalization: the Maritime Nexus," in Costas T. Grammenos, ed, *Handbook of Maritime Economics and Business*, London: Lloyds List Press, 2002, pp. 35-62.

Li, Kevin X. and Jin Cheng. 2007. "The Determinants of Maritime Policy." *Maritime Policy and Management*, 34(6): 521-533.

Limao, Nuno and Anthony J. Venables. 2001. "Infrastructure, Geographical Disadvantages, Transport Costs and Trade." *The World Bank Economic Review*, 15(3): 451-479.

Márquez-Ramos, Laura, Inmaculada Martínez-Zarzoso, Eva Pérez-García and Gordon Wilmsmeier. 2006. "*Determinants of Maritime Transport Costs: Importance of Connectivity Measures*" available at: http://www.univ-lehavre.fr/actu/itlcsge/ramos.pdf

Martinez-Zarzoso, Inmaculada and Felicitas Nowak-Lehmann. 2007. "Is Distance a Good Proxy for Transport Costs? The Case of Competing Transport Modes." *Journal of International Trade and Economic Development*, 16(3): 411-434.

Martinez-Zarzoso, Inmaculada, Eva Maria Perez-Garcia and Celestino Suarez-Burguet. 2008. "Do Transport Costs Have a Differential effect on Trade at the Sectoral Level?" *Applied Economics*, 40: 3145-3157.

Martinez-Zarzoso, Inmaculada and Celestino Suarez-Burguet. 2005. "Transport Costs and Trade: Empirical Evidence for Latin American Imports from the European Union." *Journal of International Trade and Economic Development*, 14(3): 353-371.

McGuire, Greg, Michael Schuele and Tina Smith. 2000. "*Restrictiveness of International Trade in Maritime Services*" in: Christopher Findlay and Tony Warren, eds, *Impediments to Trade in Services: Measurement and Policy Implications*, London: Routledge, pp. 189-200.

Micco, Alejandro and Natalia Pérez. 2002. "*Determinants of Maritime Transport Costs*" Inter-American Development Bank Research Department working paper 441.

OECD. 2009. "*Methodology for Deriving the Services Trade Restrictiveness Index*" Presentation at the Organization for Economic Cooperation and Development Experts Meeting on the Services Trade Restrictiveness Index, Paris 2-3 July 2009.

OECD. 2008. "*Handbook on Construction Composite Indicators: Methodology and User Guide.*" Paris: OECD Publications.

OECD. 2007. "*The Maritime Transport Costs (MTC) database*" series: Ad Valorem and Unitary Maritime Transport Costs, available at: http://stats.oecd.org/Index.aspx?datasetcode=MTC.

OECD. 2002. "*Competition Policy in Liner Shipping – Final Report*," Doc. No. DSTI/DOT(2002)2, 16-Apr-2002, Paris: OECD.

Radelet, Steven and Jeffrey Sachs. 1998. "*Shipping Costs, Manufactured Exports and Economic Growth*," available at: http://admin.earth.columbia.edu/sitefiles/file/about/director/pubs/shipcost.pdf

Sanchez, Ricardo J., Jan Hoffmann, Alejandro Micco, Georgina V. Pizzolitto, Martin Sgut and Gordon Wilmsmeier. 2003. "Port Efficiency and International Trade, Maritime: Port Efficiency as a Determinant of Maritime Transport Costs." *Maritime Economics and Logistics*, 5: 199-218

UNCTAD. 2011. "*Review of Maritime Transport 2011, Chapter 2: Structure, Ownership, and Registration of the World Fleet,*" New York and Geneva: United Nations.

Wilmsmeier, Gordon and Jan Hoffmann. 2008. "Liner Shipping Connectivity and Port Infrastructure as Determinants of Freight Rates in the Caribbean." *Maritime Economics and Logistics*, 10: 130-151.

Wilmsmeier, Gordon, Jan Hoffmann and Ricardo J. Sanchez. 2006. "The Impact of Port Characteristics on International Maritime Transport Costs", *Port Economics*, 16: 117-140.

Wilmsmeier, Gordon and Inmaculada Martinez-Zarzoso. 2010, “Determinants of Maritime Transport Costs -- A Panel Data Analysis for Latin American Trade.” *Transportation Planning and Technology*, 33(1): 105-121.

World Integrated Trade Solution [WITS]. 2007. “*Most Favoured Nation and Applied Tariffs: HS2 Chapter by Country of Origin and Destination*” Tariffs and Trade Analysis.

Supplementary Material

1. Tariffs and Maritime Transport Costs

Table A.1: Gap between tariffs and MTCs, selected products, 2007

Commodity	Description	Average tariffs [a]	Average MTCs [b]	Difference [a - b]
46	Manufactures of straw, esparto/other plaiting mat	3.45	15.45	12.00
47	Pulp of wood/of other fibrous cellulosic mat; was	1.09	11.76	10.67
97	Works of art, collectors' pieces and antiques.	0.58	9.77	9.19
36	Explosives; pyrotechnic prod; matches; pyrop allo	2.42	11.61	9.19
44	Wood and articles of wood; wood charcoal.	2.73	11.84	9.10
68	Art of stone, plaster, cement, asbestos, mica/sim	2.96	11.44	8.47
67	Prepr feathers & down; arti flower; articles huma	3.50	11.04	7.53
69	Ceramic products.	5.20	12.60	7.40
53	Other vegetable textile fibres; paper yarn & wove	2.90	10.17	7.27
70	Glass and glassware.	4.62	11.65	7.03
48	Paper & paperboard; art of paper pulp, paper/pape	3.04	9.36	6.32
86	Railw/tramw locom, rolling-stock & parts thereof;	3.15	9.12	5.97

Sources: OECD (2007) and WITS (2007).

2. Country coverage

Table A.2: Country coverage

Country	Income group	Country	Income group
Albania	Lower middle income	Malaysia	Upper middle income
Argentina	Upper middle income	Mauritius	Upper middle income
Australia	High income	Mexico	Upper middle income
Bahrain	High income	Morocco	Lower middle income
Bangladesh	Low income	Mozambique	Low income
Brazil	Upper middle income	Namibia	Upper middle income
Bulgaria	Upper middle income	New Zealand	High income
Cambodia	Low income	Nicaragua	Lower middle income
Cameroon	Lower middle income	Nigeria	Lower middle income
Canada	High income	Oman	High income
Chile	Upper middle income	Pakistan	Lower middle income
China	Lower middle income	Panama	Upper middle income
Colombia	Upper middle income	Peru	Upper middle income
Costa Rica	Upper middle income	Philippines	Lower middle income
Cote d'Ivoire	Lower middle income	Poland	Upper middle income
Dominican Republic	Upper middle income	Qatar	High income
Ecuador	Lower middle income	Romania	Upper middle income
Egypt, Arab Rep.	Lower middle income	Russian Federation	Upper middle income
Georgia	Lower middle income	Saudi Arabia	High income
Ghana	Low income	Senegal	Low income
Guatemala	Lower middle income	South Africa	Upper middle income
Honduras	Lower middle income	Sri Lanka	Lower middle income
India	Low income	Tanzania	Low income
Indonesia	Lower middle income	Thailand	Lower middle income
Iran, Islamic Rep.	Lower middle income	Trinidad and Tobago	High income
Japan	High income	Tunisia	Lower middle income
Jordan	Lower middle income	Turkey	Upper middle income
Kenya	Low income	Ukraine	Lower middle income
Korea, Rep.	High income	United States	High income
Kuwait	High income	Uruguay	Upper middle income
Lebanon	Upper middle income	Venezuela, RB	Upper middle income
Lithuania	Upper middle income	Vietnam	Low income
Madagascar	Low income		

Notes: Income group according to the World Bank's income classification as of 2010.

3. Descriptive Statistics

Table A.3: Descriptive Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
Maritime Transport Costs [1]	4787	0.5343	3.35	0	167.8
Distance	9984	6780	2870	1248	17914
Transhipment [2]	9984	0.5697	0.50	0	1
Log total seaborne import volume	9984	16.50	4.01	6.14	24.65
Log absolute import value imbalance	9984	17.56	2.70	9.56	23.78
Liner shipping STRI	9984	2.19	1.18	0.375	4.875
Cargo reservations	9984	0.16	0.37	0	1
Liner conference	9984	0.31	0.46	0	1
Port/terminal costs	8790	586	131	353	1041
Seaborne import value [3]	9984	47.67	891	0	57320
Contiguity	9984	0.0085	0.09	0	1
RTA	9984	0.1011	0.30	0	1
Avg applied tariff	5578	2.9052	9.62	0	350

Notes: [1] Descriptive statistics refer to the non-censored part of the variable; missing values arise from zero trade flows. [2] We would like to thank Jan Hoffmann, UNCTAD, for sharing these data. [3] In millions of USD.

Product-level seaborne import data were obtained from the following sources:

New Zealand Statistics. 2010. “Overseas Trade Imports and Exports Statistics: HS2 Chapter by Country of Origin and Destination by Sea Freight.” New Zealand Statistics. http://www.stats.govt.nz/.

US Census Bureau. 2010. “Annual Port-level Trade.” USA Trade Online. https://www.usatradeonline.gov/.

Tariff information was obtained from the following source:

World Integrated Trade Solution. 2011. “Most Favoured Nation and Applied Tariffs: HS2 Chapter by Country of Origin and Destination.” Tariffs and Trade Analysis. http://wits.worldbank.org/wits/.

4. Liner Shipping Conferences

Our estimation sample encompasses 118 routes. A carrier agreement is active on 37 routes, see Table A.4 below. Discussion agreements are particularly prevalent on routes involving the United States. Anecdotal evidence suggests that the market share of such agreements is fairly high, often in excess of 90 percent, as these are agreements between conference and non-conference members. Carrier agreements are relatively active in Asian countries such as China, Korea and Japan, whereas no agreement calls at a European Union country since the block exemption was repealed in 2006. While in the United States conferences are still exempted from competition rules, passage of the OSRA led to the disappearance of significant conferences on routes to the US.

Table A.4: Active price-fixing agreements, by route, as of July 2010

Route		Type of	Route		Type of
Exporter	Importer	agreement	Exporter	Importer	agreement
AUS	NZL	Conference	JOR	USA	Discussion
AUS	NZL	Discussion	JPN	USA	Stabilisation
CAN	NZL	Discussion	KHM	USA	Stabilisation
CHN	NZL	Conference*	KOR	USA	Stabilisation
JPN	NZL	Conference*	KWT	USA	Discussion
PHL	NZL	Conference	LKA	USA	Stabilisation
USA	NZL	Discussion	MEX	USA	Discussion
BGD	USA	Stabilisation	MYS	USA	Stabilisation
CHL	USA	Discussion	OMN	USA	Discussion
CHN	USA	Stabilisation	PAK	USA	Stabilisation
COL	USA	Discussion	PAN	USA	Discussion
CRI	USA	Discussion	PER	USA	Discussion
DOM	USA	Discussion	PHL	USA	Stabilisation
ECU	USA	Discussion	QAT	USA	Discussion
GTM	USA	Discussion	RUS	USA	Stabilisation
HND	USA	Discussion	SAU	USA	Discussion
IDN	USA	Stabilisation	THA	USA	Stabilisation
IND	USA	Stabilisation	TTO	USA	Discussion
IRN	USA	Discussion	VNM	USA	Stabilisation

Source: Own calculation from CI Online database (2010). * Agreements for which tariff filing is required.

5. Construction of the liner shipping STRI in mode 3

Table A.5 lists the policy measures considered in constructing the liner shipping STRI. The scoring and the construction of the index follows closely the methodology set out by Conway and Nicoletti (2006) for the OECD's Product Market Regulation (PMR) indicators. Information on applied service trade policies in the maritime shipping sector is taken from the Services Trade Restrictions Database described in Borchert, Gootiiz and Mattoo (2014); technical details are discussed in a Guide to this database (Borchert, Gootiiz and Mattoo, 2012).

Table A.5: Construction of the liner shipping STRI in mode 3

Measures	Scores (s_i)			
Form of the ownership (Greenfield)	Branch and subsid. allowed 0	Only subsidiary allowed 3	Green. project not allowed 6	
% of ownership in Greenfield project	100-66% 0	65-50% 2	49-33% 4	33-0% 6
% of ownership in private entity	100-66% 0	65-50% 2	49-33% 4	33-0% 6
% of ownership in public entity	100-66% 0	65-50% 2	49-33% 4	33-0% 6
Joint Venture	Not required 0	For one type of entity 2	For two types of entities 4	For three types of entities 6
Licensing	No license required 0	Criteria av. and auto. 2	Criteria av. but not auto. 4	Criteria non av. 6
Regulatory body [a]	3 criterions on 3 0	2 criterions on 3 2	1 criterion on 3 4	0 criterion on 3 6
% of national employees	33-0% 0	49-33% 2	65-50% 4	100-66% 6
% of nationals on the board of director	33-0% 0	49-33% 2	65-50% 4	100-66% 6
Repatriation on earnings [b]	3 criterions on 3 0	2 criterions on 3 2	1 criterion on 3 4	0 criterion on 3 6
Country score (0-6)	Σs_i			

Notes: For each measure the first row indicates the threshold used whereas the second line corresponds to the score associated with this particular range of values. [a] Criteria used: authority independent from sector ministry, right to appeal regulatory decision, regulatory changes noticed. [b] Criteria used: free transfer, free convertibility and free use.

Specifically, scoring the restrictiveness embodied in a particular measure consists of assigning a numerical value to qualitative information on a scale from 0 to 6; the more trade-restricting a measure is, the higher is the assigned score (OECD, 2009). The mapping into discrete scores takes into account that some measures considered in the liner shipping STRI are continuous (e.g. ownership and employment limitations) whereas others are discrete (often binary). For instance, concerning ownership limitations we choose 50% as a threshold based on the fact that this value typically separates minority and majority control of a firm. Two additional thresholds of 1/3 and 2/3 are introduced reflecting minority ratios granting rights to block management decisions (OECD, 2009b).

In order to aggregate these scores, a weighting scheme has to be chosen. The weights captures the relative importance of each type of measure in terms of trade restrictiveness. We use an equal weighting scheme which has the benefit of being straightforward and transparent (OECD, 2008). A number of alternative linear weighting schemes are considered for robustness but the results do not depend on the particular set of weights. An alternative strategy to obtain weights that has been popular in the literature is to employ factor analysis, in particular Principal Component Analysis (PCA). PCA is a statistical method that determines weights according to the categories' contribution to the entire variance of the sample. We abstain from using this methodology because of two major disadvantages. First, derived weights depend on the sample and cannot be used in future analyses with different countries or at later points in time. Second, and perhaps more importantly, PCA assign largest weights to variables which are responsible for the largest part of the variance. In other words, weights determined through a PCA do not necessarily reflect the real degree of categories' restrictiveness.

Borchert, Ingo, Batshur Gootiiz and Aaditya Mattoo. 2012. "*Guide to the Services Trade Restrictions Database.*" World Bank Policy Research Working Paper No. 6108.

OECD. 2008. "*Handbook on Construction Composite Indicators: Methodology and User Guide.*" Paris: OECD Publications.

OECD. 2009b. "Services Trade Restrictiveness Index: Telecommunication Services." Presentation at the Organization for Economic Cooperation and Development Experts Meeting on the Services Trade Restrictiveness Index, Paris 2-3 July 2009.

6. IV estimation of Maritime Trade Cost equation

Table A.6: Instrumental variables estimation, MTC equation

	(1)	(2)	(3)	(4)	(5)	(6)
Distance	1.2299**	1.2707**	1.0855*	2.1532	1.2607**	2.1272
Transhipment	0.5825	0.5875*	0.4853	1.6857	0.8438***	1.6431*
Total Import Vol	-0.6124**	-0.5376*	-0.6867**	-0.0321	-0.6881***	-0.0781
Abs Import Imbalance	-0.0764	-0.1153	-0.0382	-0.1956	-0.0334	-0.1808
Cargo Reservations		0.6377				1.0895
Liner Conference			-0.3273			-0.314
Port Terminal Costs				0.0421		0.0332
STRI 2nd quartile					1.3255***	1.5864**
STRI 3rd quartile					2.1280***	1.9886*
STRI 4th quartile					2.6758***	2.0897*
Observations	9984	9984	9984	8790	9984	8790
Right-censored obs	5199	5199	5199	4512	5199	4512
Censoring threshold	4785	4785	4785	4278	4785	4278
Pseudo R2	0.2053	0.2055	0.2054	0.2032	0.2059	0.2038

Source: Authors' calculation. Notes: significance levels: * 10% level, ** 5% level, *** 1% level. The dependant variable is the log of per-unit maritime transport cost expressed in dollars per kilogram. The variables *Distance*, *Total import volume* and *Absolute Import Imbalance* are in logarithms. All models are estimated by IV tobit using MFN simple average tariffs and log of non-seaborne import volume as instruments for total seaborne import volume. The R-squared is McFadden's pseudo R-squared. Estimations use White heteroskedasticity-consistent standard errors which are clustered at the country-pair level. Origin, destination and commodity fixed-effects as well as intercepts are included in all models but not reported.