The Impact of Liner Shipping Trade Restrictions on Maritime Transport Cost and Trade Flows

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(Preliminary version)

Abstract

This paper aims at assessing the impact of liner shipping barriers to trade in mode 3 on MTCs and seaborne trade flows. In order to quantify the overall level of restrictions in mode 3 in the liner shipping sector, I construct an original Service Trade Restrictiveness Index (STRI). The original STRI is included in a two-stage econometric analysis. Since barriers to trade in mode 3 are likely to influence seaborne trade through transport costs, in a first stage, I assess the impact of trade restrictions on MTCs. And, in a second stage I assess the impact of MTCs on seaborne trade flows. Following an IV-like approach developed by Limao and Venables (2001), this two-stage structure allows to address the endogeneity issue arising in the second stage. This two-stage framework also allows disentangling direct and indirect effects of distance and restrictions in mode 3 on seaborne trade flows.

Concerning barriers to trade in mode 3, I find a monotonically, positive and significant impact of my STRI split into quartiles on MTCs. After controlling for a data reporting issue, I conclude that MTCs are 25% higher on the routes classified in the second quartile than on the routes classified in the first quartile. And, on the routes classified in the third and the fourth quartile, MTCs are 52% and 79% higher than on the routes classified in the first quartile, respectively. Then, since barriers to trade in mode 3 affect MTCs and MTCs affect seaborne trade flows, barriers to trade in mode 3 affect indirectly seaborne trade flows.

Concerning distance, I show that it affects positively MTCs. And, consistently with the literature, I show that distance explains a small share of the MTCs variance. Then, the results suggest that besides affecting negatively seaborne trade through MTCs, distance also affect directly and positively seaborne trade. Thus, the farer trading partners are from each other, the more likely their containerizable trade will be transported by sea. This result confirms a pattern often stated but never proved -- to my knowledge.

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1. Introduction

This paper deals with the liner shipping sector with a focus on the impact of barriers to trade in services on Maritime Transport Costs (MTCs) and seaborne trade flows. Liner shipping is a key intermediate service. The sector is of particular interest since most manufactured and semi-manufactured goods are transported in liner shipping vessels. Furthermore, the sector's efficiency is a determinant of countries' competitiveness and is crucial for their integration into international trade. Since barriers to trade in goods have sharply decreased over the last decades, the share of MTCs in total trade costs has become substantial. Most determinants of MTCs are exogenous (e.g. distance, trade volume and trade imbalance). Therefore, restrictions on trade in the liner shipping service are the only field upon which policy makers can bear to decrease MTCs.

Many experts and professionals claim that the liner shipping market is free. However, some restrictions remain and are likely to affect MTCs. In this paper, I focus on regulations restricting commercial presence -- barriers to trade in mode 3. Such a choice stems from three aspects. First, since the 1980s the most significant barriers to cross-border trade (i.e. mode 1 of supply) have disappeared. For instance, nowadays cargo reservations only affect very specific goods and they represent a tiny share of total seaborne trade. Therefore, they are not likely to affect MTCs (Fink *et al.*, 2002). Second, the regulatory information available in mode 1 and the form of my sample and model do not allow to take restrictions in mode 1 into account. Third, even though mode 1 is the key mode of supply for international shipping services, mode 3 is likely to be crucial in order to efficiently provide liner shipping services. Eventually, several heterogeneous restrictions affect trade in international liner shipping in mode 3. Therefore, to assess and quantify the overall level of restrictions in the sector, I construct a composite index of restrictiveness.

This paper aims at assessing the impact of barriers to trade in mode 3 on MTCs and seaborne trade flows. It comprises two parts: the construction of a liner shipping Service Trade Restrictiveness Index (STRI) in mode 3 and an econometric analysis. The econometric analysis is, in turn, organized in two stages. Since barriers to trade in mode 3 are likely to influence seaborne trade through transport costs, in a first stage, I assess the impact of trade restrictions on MTCs. And, in a second stage I assess the impact of MTCs on seaborne trade flows. Following an IV-like approach developed by Limao and Venables (2001), this two-stage structure allows to address the endogeneity issue arising in the second stage -- i.e. when the MTCs are included in the seaborne trade flow gravity equation. This two-stage framework also allows disentangling direct and indirect effects of distance and restrictions in mode 3 on seaborne trade flows.

The sample comprises two importers (New Zealand and the United States) and 56 exporters. Among exporters, ten are high income countries, 42 are middle income and 4 are low income.[2] MTCs as trade costs are of particular interest for developing countries since most restrictions remain in these countries. Additionally, trade integration is a crucial issue for them.

The paper is organized as follows: the first section is the introduction. In the second section, I present the methodology used to construct the original STRI. In the third section, I estimate a MTC equation. In the fourth section, I estimate a gravity equation. The fifth section concludes and provides some policy recommendations.

2. A liner shipping Service Trade Restrictiveness Index (STRI)

In this section, I present the methodology used to construct the liner shipping STRI in mode 3. First, I motivate my choice to measure barriers to trade in services by computing an STRI. Second, I detail how the STRI is constructed. Third, I present the results.

Measuring barriers to trade in services

Considering the nature of services, barriers to trade are essentially regulatory. For economists working on this issue, one challenge consists in measuring the restrictiveness of regulations -- in other words, to quantify qualitative information. Toward this goal, various methodologies have been developed. Broadly speaking, they are categorized in two types, bottom-up and top-down approaches -- also called direct and indirect measurement, respectively (Deardorff *et al.*, 2004). In this paper, I opt for the direct measurement methodology, precisely for the construction of a restrictiveness index. It consists in observing

[2] The sample is detailed in Annex 1.

policies to construct a composite index. STRIs are powerful tools providing a broad vision of the regulatory regimes' restrictiveness. They are useful for policy-makers and economists since they allow comparison and benchmarking across countries and sectors (OECD, 2009a). Furthermore, STRI are of particular interest for economists because they can easily be included in quantitative impact assessments.

STRIs have been developed first by the Australian Productivity Commission (OECD, 2009a). Then, the OECD extended and refined the methodology.[3] Various STRIs have been constructed for a large amount of services sector -- see Deardorff and Stern (2008) for a review of this literature. With regards to maritime transport I found two attempts, by McGuire *et al.* (2000) and Li and Cheng (2007).[4] McGuire *et al.*'s set of indexes was used by Kang (2000) in order to compute price impacts, while Li and Cheng use their index to investigate determinants of maritime policies. One contribution of this paper is to use of the most relevant regulatory data available on the applied regulatory regime of countries. Another novelty is to use state of the art methodological developments in order to construct the best possible index. Finally, my index is constructed as closely as possible to the reality thanks to discussions and debates with experts and professionals.

Constructing the Service Trade Restrictiveness Index (STRI) in liner shipping[5]

The construction of an STRI comprises five steps: the selection of restrictions, the scoring of restrictions' modality, the weighting of restrictions, their aggregation and the robustness checks.

Considering the difficulty to collect regulatory information (due to source limitation) it is not possible to include in the index all barriers to trade in mode 3. I use information collected through the World Bank survey on impediments trade integration (World Bank, 2008). Nevertheless, it is important to note that considering data availability the most **relevant restrictions** are included in the composite index (Table 1).

Table 1: Summary of restrictions in international shipping services in mode 3

[3] See Conway *et al.* (2005), Conway and Nicoletti (2006) and OECD (2008, 2009a and 2009b).
[4] The McGuire *et al.* methodology was used to construct STRIs in maritime transport for Russia (Kimura *et al.*, 2003) and Maghrebian countries (Achy *et al.*, 2005).
[5] A detailed description of the STRI construction is presented in Annex 2.

Regulatory measures	Type of variable	Restrictiveness
Form of the ownership (Greenfield)	Multiple binary	Additive
% of ownership in Greenfield project	Continuous	Gradual
% of ownership in private entity	Continuous	Gradual
% of ownership in public entity	Continuous	Gradual
Joint Venture	Multiple binary	Additive
Licensing	Multiple binary	Gradual
Regulatory body	Multiple binary	Additive
% of national employees	Continuous	Gradual
% of nationals on the board of director	Continuous	Gradual
Repatriation on earnings	Multiple binary	Additive

Notes: gradual restrictiveness means that it is possible to classify modalities from the less to the most restrictive. Additive restrictiveness means that it is not possible to classify modalities from the less to the more restrictive. Thus, the level of restrictiveness is determined according to the number of modalities applied in the country.

The **scoring** consists in transforming information on the restrictiveness level of regulatory measures (i.e. principally qualitative information) in scores. In countries, each restrictions takes the shape of a modality. Each modality is ranked according to its level of restrictiveness and a numerical value is assigned from the least to the most restrictive. Scores increase with the restrictiveness of modalities. They are normalized on a 0 to 6 scale.[6] I assume that the test case represents the entire population of reference. Thus, the least and the most restrictive modalities respectively take the value 0 and 6. For matters of interpretation and transparency it is not advisable to include binary and continuous variables in a composite index (OECD, 2009a). Considering the dataset, I choose to reject “pure” binary scores (i.e. 0 and 1) because they prevent from taking into account the variations in the data. And, considering the dataset, continuous scores are not more appropriate. Hence, I transform all measures into multiple binary scores. According to the measures, the level of restrictiveness can be gradual or additive. A gradual level of restrictiveness means that it is possible to classify modalities from the least to the most restrictive. On the contrary, additive restrictiveness means that it is not possible to classify modalities from the least to the most restrictive.[7] Thus, the level of restrictiveness is determined according to the number of modalities applied in the country (e.g. repatriation of earnings, quality of the regulator). Continuous scores (e.g. percentage of ownership limitation) are transformed into binary scores through specific thresholds. Importantly, thresholds are based on economic explanations. For instance, for ownership limitation I choose 0.5 as a threshold based on the

[6] The 0 to 6 scale has been chosen arbitrarily. Obviously, the scale does not affect the results of the index.

[7] For instance, it is not possible to rank different level of restrictiveness concerning measures on the form of commercial presence -- e.g. a restriction on branches is not more restrictive than a restriction on subsidiaries. The important for foreign investors is the freedom in choosing the appropriate form of commercial presence with respect to their objectives.

fact that 50% represents the majority control of a firm. Two thresholds of 1/3 and 2/3 are introduced reflecting minority ratios granting rights to block management decisions (OECD, 2009b). The number of modalities within each measure has to be as close as possible from the number of modalities within the others measures.

The **weighting** scheme captures the relative importance of measures in terms of trade restrictiveness. I use equal weights -- summed to one. This weighting scheme has two benefits. First, it is transparent. Second, it makes the value of the index independent of the number of measures within each category (OECD, 2008).

Table 2: Construction of the liner shipping STRI in mode 3 -- Summary

Measures	**Modality (mo) scoring (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 line corresponds to modalities and the second line to scores. [a] Criteria: right to appeal regulatory decision and regulatory changes noticed. [b] Criteria: free transfer, free convertibility and free use.

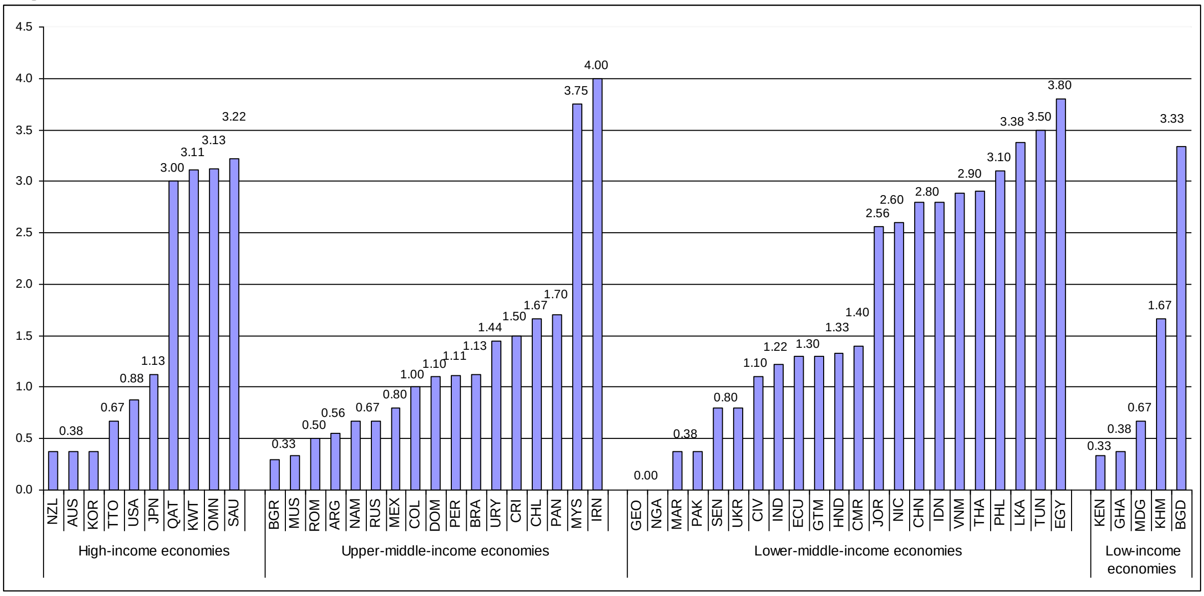
The fourth step consists in the **aggregation** of the categories. Again, for a question of transparency and interpretation, I choose a linear method of aggregation.

Finally, I **check the robustness** of the index. First, I test the relevance to include the measures selected. I estimate a MTC equation that includes all measures separately. Since most regulations affect MTC negatively, I conclude that restrictions selected have their rightful place in the index. Second, I test the sensitivity of my index with respect to the use of various weighting schemes. Considering that I use the index split into quartile, I use the Spearman rank correlation methodology in order to check whether the ranking of countries is driven by a particular weighting scheme. The result of the Spearman rank correlation allows to confirm that the ranking of countries are strongly robust to the weighting scheme.[8]

Results

Broadly speaking, and as suggested by the existing literature, the liner shipping sector is relatively opened to foreign trade in comparison to other services. This is not so surprising considering that the sector is international by nature (Kumar and Hoffmann, 2003). No country has a very restrictive regulatory regime. The index ranges from 0 to 4. The median of the index is 1.17, the average 1.58 and the standard deviation is 1.18.

Figure 1: Service Trade Restrictiveness Indexes (STRI) in mode 3



Sources: Author’s calculation. Note: Level of development according to World Bank (2010).

The level of openness of the liner shipping sector in mode 3 measured by my STRI is not easily explainable. By computing simple correlations, I do not find any relationship between the STRI and the countries’ GDP per capita and level of trade integration.[9] Geographical and political characteristics of countries are more satisfactory to explain the intensity of restrictiveness in the sector. First, insular countries for which international shipping is key have a lower STRI (Figure 1). It is the case for Australia, New Zealand,

[8] The robustness checks are presented in Annex 2 -- including the results of MTC estimations and the Spearman rank correlation.

[9] Simple correlations do not provide any evidence. Figures are available upon request.

Mauritius and Trinidad and Tobago -- a Caribbean's maritime transport hub. Then, cultural and political ties are likely to explain the countries' level of restrictiveness. Indeed, geographical groups of countries as Arabian Gulf countries or Caribbean and the South-American countries have very close indexes (Figure 1).

Bilateralize the restrictiveness index

In the previous sub-section, I computed a set of unilateral STRIs. However, considering the form of my empirical models (in which the index will be included), I have to compute a set of bilateral indexes. In other words, I have to construct a set of STRIs for bilateral maritime routes. To "bilateralize" the STRI, it is important to understand how liner shipping services are affected by restrictions in mode 3. For shipping lines, it is important to establish a commercial presence abroad (or at least have the possibility to do so) in order to provide some sub-services and therefore provide the final service more efficiently.[10] Importantly, the sub-services mentioned here are provided in countries of origin and destination. Thus, restrictions in mode 3 are likely to affect the efficiency of sub-services at both ends of the journey. Therefore, on a maritime route the restrictions in mode 3 applied at both end of the journey are likely to affect MTCs. Considering that potential inefficiencies in ports of origin and destination (resulting from restrictions) add-up together, I assume that on a given route, the restrictions in mode 3 in the origin country add up to the restrictions in the destination country. Therefore, in order to obtain a bilateral STRI, origin and destination countries' indexes are add up together.

3. The Maritime Transport Costs (MTC) equation

This section aims at assessing the impact of trade restrictions on liner shipping MTCs. I regress MTCs on policy variables created in the previous section and on other common control variables. The censored data issue is addressed by running tobit estimations and the endogeneity issue is addressed by running IV regressions. This section is organized as follows, first, I review the literature about determinants of MTCs. Second, I present the empirical model and the data. Third, I present results of estimations.

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[10] These sub-services are the followings: administration and organization of vessels' calls, management of cargoes in ports of origin and destination and administration and organization of intermodality in countries of origin and destination.

Determinants of maritime transport costs -- Review of the literature

In the related literature, few papers include **policy variables** as determinants of MTCs. Fink *et al.* (2002), Micco and Pérez. (2002) and Clark *et al.* (2004) focus on the impact of competition rules in the liner shipping sector. Particularly, they assess the impact of price-fixing and cooperative agreements -- e.g. conferences and consortia. To do so, they include simple dummy variables. Fink *et al.* (2002) go further by adding a dummy variable in order to assess the impact of cargo reservations. They also include simple indexes to assess the impact of restrictions in cargo handling and port services sectors. Finally, a recent paper by Wilmsmeier and Martinez-Zarzoso (2010) includes several variables in order to assess the impact of being an open registry country on MTCs. The main contribution of this paper is to include refined policy variables related to trade restrictions as a determinant of MTCs.

Maritime distance can be used as a proxy for various operating costs such as fuel and labour costs (Korinek, 2011). Hence, it is likely to be an important determinant of MTCs. Unsurprisingly, it is included as an explanatory variable in all papers quoted in this section. However, most of these empirical works, show that the explanatory power of the distance is actually weak. This could be explained by the features and the functioning of the sector. Indeed, in liner shipping, most maritime journeys between two countries are not direct. Some services sail along the coast and call at many ports -- the so-called “dash of milk” model. For other services, long journeys between main ports are performed by large vessels and the distribution of cargo within regions is performed by feeders after a transhipment -- this is the “hub and spoke model”. For instance, among the routes of my sample, a direct service exists on 51 routes while a transhipment is needed on 59. With few exceptions, accurate data that reflects the true distance covered by vessels (i.e. data that takes into account calls at ports and transhipments) does not exist.[11] In order to address this issue, some papers include time at sea instead of maritime distance as an explanatory variable. However, these studies fail to take into account neither time of calls due to transhipments nor variations of vessels’ speed along journeys -- related to canals, straits or cape passages.

[11] Data from the “Trade Trans -- Spanish Trade Flows” database is one of these exceptions. Marquez-Ramos *et al.* (2006) and Martinez-Zarzoso and Nowak-Lehmann (2007) use this data.

Considering above-mentioned imperfections of the distance variable, the absence of direct liner shipping services between two trading partners have to be taken into account -- in other words, it means that a transhipment is needed to link these countries. Marquez-Ramos *et al.* (2006) and Wilmsmeier and Hoffmann (2008) include transhipment as a single dummy variable. Marquez-Ramos *et al.* (2006), Wilmsmeier and Hoffmann (2008) and Wilmsmeier and Martinez-Zarzoso (2010) include transhipment within composite indexes of connectivity. Connectivity indexes are proxy variables for the regularity and the quality of services to and from countries.[12] They are composite indexes of the following variables: number of carriers on the route between the two countries, total TEUs deployed on the route, number of vessels on the route, maximum ship size on the route, number of shipping possibility between each ports on the route and number of direct services.

The level of **competition** in the sector is also an important determinant of MTCs. It is particularly important in the liner shipping market which is exempted from competition regulations in many developed countries and where collusive practices have been the rule until the 1990s. In order to take the level of competition on routes into account, Wilmsmeier *et al.* (2006) include the number of direct liner services per month between partners as a proxy. Marquez-Ramos *et al.* (2006) include the number of lines deployed between partners while Wilmsmeier and Hoffmann (2008) include a dummy variable coded one when more than three carriers deploy vessels on the route.

Economists acknowledge that international shipping is an industry facing increasing returns to scale. In order to reflect this reality, most papers include **bilateral trade volume** as a determinant of MTCs..[13] However, considering the feature and the functioning of the shipping market, this variable is challenging to design. On a given route, vessels call at many ports and serve many countries. And, the volume of seaborne trade between regions would be more appropriate than the volume of trade between countries. For instance, concerning a liner shipping service between Auckland and Shenzhen it is more relevant to use the volume of trade between "Australasia" and the Far East rather than between New Zealand and China. Unfortunately, this data is not available.

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[12] The first connectivity index has been developed by the UNCTAD, the so called Liner Connectivity Index (LCI). Other connectivity indexes are inspired by this work.

[13] See Fink *et al.* (2002), Micco and Pérez (2002), Clark *et al.* (2004), Marquez-Ramos *et al.* (2006), Wilmsmeier *et al.* (2006) and Wilmsmeier and Martinez-Zarzoso (2010).

Trade imbalance on the route is also a determinant of MTCs. It is especially true for liner shipping which is a regular service. Indeed, liner carriers have to transport empty containers in one direction or the other. Carriers are aware that the demand for transport services (and so the share of vessel capacity utilisation) varies based on the direction travelled. Therefore they adapt prices based on the leg of the trip. Hence, the service is relatively more expensive for the leg of the trip where more goods are being traded. On the opposite, MTCs are higher on the leg of the trip with the larger amount of traffic. To take into account this phenomenon, Clark *et al.* (2004), Wilmsmeier *et al.* (2006) and Wilmsmeier and Hoffmann (2008) include a directional imbalance ratio.[14] Marquez-Ramos *et al.* (2006) include two variables: a trade imbalance in absolute terms and an interaction of the absolute terms with an imbalance dummy variable. Finally, Wilmsmeier and Martinez-Zarzoso (2010) include a simple dummy variable that takes the value one when the trade imbalance on the route is negative.

Some papers on determinants of MTCs show that **port infrastructure** plays an important role in MTCs, notably because the cost and the time of the port passage impacts the final shipping cost. Micco and Pérez (2002) and Clark *et al.* (2004) include GDP per capita and a composite index of the overall quality of countries infrastructures as a proxy for the quality of their ports. They also include (as Wilmsmeier *et al.*, 2006) the index of perception of port quality developed by the World Economic Forum in its Global Competitiveness Report. Wilmsmeier and Hoffmann (2008) include a composite index of port infrastructure endowment composed of the following variables: port area, storage area, length of quays and maximum draft.

In most papers, the variable used for MTCs includes insurance costs. In order to control for insurance costs various product-specific variables are included. The **unitary value of products** are included by Wilmsmeier and Martinez-Zarzoso (2010), Martinez-Zarzoso and Nowak-Lehmann (2007), Marquez-Ramos *et al.* (2006), Wilmsmeier *et al.* (2006), Clark *et al.* (2004), Micco and Pérez (2002). Some papers include dummy variables for **refrigerated** or for **time sensitive cargo** -- Marquez-Ramos *et al.* (2006) and Wilmsmeier and Martinez-Zarzoso (2010). Finally, some papers choose a more radical (and simpler) approach by including a **product fixed-effect**.

[14] In Clark *et al.* (2004), the ratio is measured as exports minus imports divided by total trade. Wilmsmeier *et al.* (2006) and Wilmsmeier and Hoffmann (2008) compute a simple ratio -- imports divided by exports.

Finally, most variables discussed above are included in my empirical model -- i.e. the equation [1.4], below. However, I do neither include country-specific (such as port and infrastructure variables) nor product-specific variables (such as the unitary value of products, refrigerated and time sensitive dummies) since I include country and product fixed-effects. Additionally, my variable of interest is the STRI in mode 3. It is likely to affect the competition in the sector. Therefore, I do not include competition variables since they would absorb the effects of the STRI variable.

Model specifications and data[15]

As a theoretical basis, I use the model of liner shipping prices developed by Fink *et al.* (2002).[16] In this model, the MTC for a product k on a maritime route between two countries (hereafter, a route), denoted by MTC_{odk} is assumed to be equal to the marginal cost for the service, C_{odk} multiplied by a mark-up term, M_{odk}.[17] The reduced form, once log-linearized is:

$$mtc_{odk} = c_{odk} + \mu_{odk} \qquad [1.1]$$

Where,

- o corresponds to the origin country (exporter);
- d corresponds to the destination country (importer);
- k corresponds to the containerizable product, disaggregated at 2-digits of the Harmonized System (HS) classification.[18]

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[15] Data sources are detailed in Annex 3.
[16] This model is also used in Micco and Pérez (2002), in Clark *et al.* (2004) and in Wilmsmeier and Martinez-Zarzoso (2010).
[17] MTC is a term used by the literature, even if it rather corresponds to the price paid by consumers. As a rule, I keep using the term MTC.
[18] Following the OECD Maritime Transport Costs Database (2006), I assume that containerizable cargo corresponds to all lines except 10, 12, 15, 25-29, 31, 72, and 99 in the Harmonized System (HS) disaggregated at 2-digits.

The marginal cost is assumed to take the following form:

$$c_{odk} = \beta_1 distance_{od} + \beta_2 transhipment_{od} + \beta_3 tv_{od} + \beta_4 ti\_absolute_{od} + \beta_5 ti\_interaction_{od} + \varpi_o + \theta_d + \lambda_k + \varepsilon_{odk} \qquad [1.2]$$

Where,

The first term (*distance*$_{od}$) is the maritime distance between the two main container ports of trading partners. It corresponds to the shortest way by capes, straits or canals expressed in nautical miles. When countries have coasts on various oceans and/or seas (as Colombia, Mexico, Russia and the United States) ports for which the journey is the shortest are chosen. For example, in the case of the US, it is more relevant to choose the port of Los Angeles for a transport to China whereas the port of New York/New Jersey is more relevant for a journey to Europe. For this variable I expect a positive coefficient.

The second term (*transhipment*$_{od}$) is a dummy variable that expresses the connectivity on bilateral routes. The variable is coded 1 if a direct liner shipping is not available between trading partners, and 0 otherwise. For this variable, a positive coefficient is expected.

The third term (tv_{od}) is the total bilateral seaborne import volume of containerized products. The variable is included to take into account economies of scale. For this variable a negative coefficient is expected.

The fourth and the fifth terms (*ti_absolute*$_{od}$ and *ti_interaction*$_{od}$) are trade imbalance variables. I include two variables because both the direction and the “magnitude” of the trade imbalance are likely to have an impact on MTCs. The latter term is a magnitude variable, it is calculated as a trade imbalance in absolute terms.[19] The former term is an interaction between the magnitude variable in absolute terms and a directional imbalance dummy variable -- it takes the value of 1 if the trade imbalance of containerized products of the origin country[20] in volume is negative, and 0 otherwise. A positive coefficient is expected for this interaction variable. Concerning the absolute terms variable, I expect either a positive or a negative sign, as it depends on the direction of the trade imbalance (Marquez-Ramos *et al.*, 2006).

[19] More precisely, it is the absolute term of the following expression [(Exports - Imports)/Max (Exports, Imports)]

[20] i.e. if exports of the origin are greater than its imports.

The sixth, seventh and eighth terms (ω_o, θ_d and λ_k) are origin, destination and commodity fixed effects. The first two variables control for country-specific characteristics which are likely to affect the cost to provide international shipping services as port efficiency for instance. The last variable controls for product characteristics (e.g. products stowage factor, refrigerated or time-sensitive products) and insurance costs that are likely to influence the dependant variable. An product fixed effect is mush more effective in controlling for product characteristics than a value to weight ratio which is incomplete.

Theoretically, cargo reservations affect the marginal cost. Hence, ideally I should include a variable for this restriction in the equation. Considering the information available and considering that cargo reservations affect imports of the country applying the restriction (i.e. the destination country), the only solution to take them into account consists in including a dummy variable when the destination country applies cargo reservations. However, the sample comprises two destination countries and, among them only the US applies cargo reservations. Therefore, the information available, the shape of the sample and the form of the equation prevents me from assessing the impact of cargo reservations because the related dummy variable would be perfectly collinear with the US fixed-effect. In other words, include would be cargo reservation dummy variable is equivalent to include a destination country fixed-effect.

Then, the shipping companies' mark-up is assumed to has the following form:

$$\mu_{odk} = \beta_1 mode\_3_{od} + \chi_o + \nu_d + \rho_k \qquad [1.3]$$

Where,

The first term (*mode_3*$_{od}$) is the variable of interest. It is a set of dummy variables that measures restrictions to trade in mode 3 in liner shipping on routes. The set is constructed by splitting the distribution of my bilateral STRI into quartiles.[21] By doing this, I define four

[21] I split the STRI into quartile for three main reasons. First, it is a division commonly use in economics. Second, it allows defining four types of routes: liberal, middle liberal, middle restrictive and restrictive. Third, considering my sample, the division of the distribution in quartile allows to take into account most of the variation in the data. Importantly, to test whether the division of the STRI into quartile influences the results, it also include it split into terciles.

dummy variables associated to four types of routes: from least to most restrictive (that correspond to the first and to the fourth quartile dummy variables, respectively -- *mode_3_1* and *mode_3_4*). I assume that restrictions in mode 3 affect the entry of new carriers in the market. Hence, they affect the intensity of competition in markets and are determinants of the mark-up term. For this variable, a positive coefficient is expected.

The three last terms (χ_o, υ_d, ρ_k) are origin, destination and product fixed-effects.

Finally, by substituting equations [1.2] and [1.3] in equation [1.1], I obtain the following empirical model:

$$mtc_{odk} = \beta_1 distance_{od} + \beta_2 transhipment_{od} + \beta_3 tv_{od} + \beta_4 ti\_absolute_{od} + \beta_5 ti\_interaction_{od} + \beta_6 mode\_3_{od} + \varphi_o + \psi_d + \delta_k + \varepsilon_{odk} \quad [1.4]$$

Where,

The dependant variable (mtc_{odk}) is the MTC paid by the service's consumers. It represents the transport cost from the point of the shipment (i.e. the moment when the good is loaded by a carrier) to the point of entry into the importing country. It includes the price of the transport, insurance costs and cargo handling but not customs charges. It is an unitary cost and it is expressed in Dollar per tonne.

Where,

$\varphi_o = \omega_o + \chi_o$
$\psi_d = \theta_d + \upsilon_d$,
$\delta_k = \rho_k + \lambda_k$

And where, ε_{odk} is the error term.

Finally, total import volume is endogenous to MTCs because of a reverse causality relationship. Indeed, MTCs have an impact on the choice of the transport mode, therefore on total seaborne import volume. To address the endogeneity issue, I run IV Two-Stage Least Squares (2SLS) regressions in the empirical part below. In the existing literature various instruments were used for total import volume. For instance, Clark *et al.* (2004) used the exporting country's GDP and Marquez-Ramos *et al.* (2006) used the population of the importing country. However, these instruments vary across one dimension while the endogenous variable vary across country-pairs. In this paper, I use an index of tariff protection (precisely, the average of bilateral Most Favoured Nation -- MFN -- tariffs) as an instrument for total import volume. My instrument varies across country-pairs. Furthermore, it is correlated with the endogenous variable (import volumes) and influences only the dependant variable (MTCs) through the endogenous variable. In other words, my instrument satisfies the exclusion conditions. In this respect, the instrument chosen is more relevant than instruments used previously in the literature.

Results of estimations

The sample includes 2 importers (destination countries) and 56 exporters (origin countries).[22] It represents 9,284 observations. The sample accounts for 32% of New Zealand total seaborne imports and for 48% of US total seaborne imports. I run cross-section estimations of the model given by the equation [1.4] for the year 2006. Variables *mtc*, *distance*, *tv,* and *ti_absolute* are included in logarithms. The error term is assumed to be independently distributed across countries and products. Since, the dependant variable (*mtc*), is derived from trade flows, the MTCs data is censored for zero trade flow observations -- this represents around 50% of the sample. MTCs are censored insofar as they exist but I am not able to observe them. In order to deal with this issue, I estimate an upper limit tobit model by assuming that trade does not occur because of too high MTCs (Limao and Venables, 2001). In other words, for zero trade flow observations, MTCs are systematically replaced by the highest value of MTCs in the dataset (Carson and Sun, 2007). The results of regressions are presented in Table 3. Tobit estimations are presented in columns 1 to 4 and 5 while the IV tobit estimations are presented in columns 5 and 7.

First, I focus on the results of the tobit estimations. The specifications 1 to 3 are basic, they include control variables only. The set of policy variables is included in the specification 4. In these specifications, most variables are very significant and coefficients have the expected sign. In specifications 1 and 2, coefficients attached to distance and transhipment variables are significant at the 1% level. Consistently with results of the existing literature, the

[22] For details on the sample, see Annex 1.

explanatory power of both variables included separately is similar. With regard to the full control variables model (column 3), the distance and total seaborne import volume variables are significant at the 1% level while the transhipment variable is significant at the 5% level. Trade imbalance variables are never significant. As mentioned previously, this could be due to the difficulty in designing these variables. Turning to specification 4, all variables (except the trade imbalance) are significant at the 1% level and coefficients hold the expected sign. According to this specification, if the distance increases by 100% (i.e. if the distance double), unitary MTCs increase by 74%. Moreover, whether a transhipment is needed in order to connect two countries, unitary MTCs increase by around 79%. In other words, transhipment leads to an increase in MTCs which is higher than doubling the transport distance. Concerning economies of scale, if the total volume of seaborne import increases by 1%, unitary MTCs decrease by 0.41%.

Table 3: Estimation results -- the MTCs equation

						Robustness check	
	1	2	3	4	5	6	7
	Tobit	Tobit	Tobit	Tobit	IV Tobit	Tobit	IV Tobit
distance	1.848***		0.656***	0.742***	0.646	0.479***	0.310
	(0.179)		(0.214)	(0.189)	(0.432)	(0.102)	(0.221)
transhipment		1.508***	0.417**	0.582***	0.548**	0.184**	0.118
		(0.312)	(0.168)	(0.131)	(0.244)	(0.0785)	(0.139)
tv			-0.416***	-0.406***	-0.448***	-0.227***	-0.294***
			(0.0633)	(0.0578)	(0.163)	(0.0317)	(0.0863)
ti_absolute			-0.162	-0.123	-0.151	-0.0577	-0.110
			(0.110)	(0.121)	(0.184)	(0.0595)	(0.0908)
ti_interaction			0.459	0.440	0.564	0.271	0.522
			(0.321)	(0.327)	(0.622)	(0.170)	(0.325)
mode_3_second				0.682***	0.683***	0.224**	0.221**
				(0.153)	(0.151)	(0.0914)	(0.0872)
mode_3_third				1.009***	0.998***	0.417**	0.438***
				(0.296)	(0.306)	(0.166)	(0.168)
mode_3_fourth				1.183***	1.181***	0.584***	0.611***
				(0.404)	(0.420)	(0.201)	(0.210)
Pseudo-R-squared	0.195	0.187	0.200	0.201	-	0.273	-
Observations	9,284	9,284	9,284	9,284	9,113	8,739	8,582

Source: Author's calculation. Notes: * Significant at the 10 % level. ** Significant at the 5 % level. *** Significant at the 1 % level. The dependant variable is a unitary maritime transport cost, it is expressed in dollars per kilogram and in logarithm. The variables *distance*, *tv* and *ti_absolute* are in logarithms. Cross section for year 2006. Model 1 to 4 and 6 are estimated by tobit. Model 5 and 7 are estimated by IV tobit and the instrument is an MFN simple average tariff. For these estimations the amount of observations falls from 9,284 to 9,113 and from 8,739 to 8,582 because MFN tariffs are not available for Cameroon. Coefficients correspond to the marginal effects for the unconditional expected value of the dependant variable. The pseudo R-squared is the McFadden's pseudo R-squared. T-statistics are given in parentheses. Estimations use White heteroskedasticity-consistent standard errors and standard errors are adjusted for clusters in country-pairs. Origin, destination and commodity fixed-effects are included in all regressions. Intercepts are included in all specifications but not reported. The correlation matrix is available in Annex 4.

Regarding variables of interest (*mode_3*), since I do not include the dummy variable corresponding to the first quartile (corresponding to the less restrictive routes) it is taken as the benchmark. All policy dummy variables are significant at the 1% level and positive. Interestingly, they increase monotonically across quartiles. Thus, MTCs are 97% higher on the routes classified in the second quartile than on routes classified in the first quartile. MTCs are 174% and 227% higher on the routes classified in the third and the fourth quartile than on routes classified in the first quartile, respectively. It is important to note that the bilateral STRI included directly in the equation is not statistically significant. This suggests that the impact of the index is not linear. However, this is not so surprising since the index has been constructed from a combination of various measures.

Obviously, my model overestimates the impact of MTCs determinants. On the one hand, coefficients associated with control variables are high in comparison to coefficients obtained in the existing literature. On the other hand, coefficients associated with policy variables are too high to be realistic. I will show in the next sub-section ("*Robustness check*") that this is likely to be due to a bias in the data.

Turning to the IV tobit estimation (column 5), results of statistical tests are very satisfactory. Indeed, in the first stage of the regression the coefficient of the instrument is significant at the 1% level and negative. And, in the second stage the Wald test indicates that explanatory variables are jointly significant at the 1 % level.[23] Furthermore, results of the specification 5 are consistent with results of the specification 4. Policy variables are still very significant even though results for the control variables are less satisfactory. The distance variable becomes insignificant and the level of significance of the transhipment variable decreases. Finally, the size of the coefficients for the IV estimation are similar to the coefficients for the simple tobit estimation. This is likely to indicate that the endogeneity issue is negligible. The Wald test for exogeneity which is not rejected confirms this intuition.[24] I conclude that specification 4 is a better estimation than specification 5.

Robustness check

In order to check the robustness of results obtained above, I estimate the specification 4 of the MTC equation using different policy variables and various samples. First,

[23] When running the regression with the robust option only, Wald chi2(149) = 9330.36 with Prob > chi2 = 0.0000.

[24] Wald test of exogeneity: chi2(1) = 0.07 with Prob > chi2 = 0.7846.

observations for which the weight of trade reported is low are likely to suffer from a data reporting issue (Baldwin and Harrigan, 2007). Therefore, I drop all observations for which the weight of trade reported is less than one metric tonne. The amount of observations decreases from 9,284 to 8,739. Results of this regression is presented in the column 6. Interestingly, although the number of observations decreases, the Pseudo-R-squared increases sharply -- even though the significance of the transhipment, the second and the third quartiles decreases. More interestingly, the coefficients associated with control and policy variables become much more credible. Thus, according to this specification, doubling the distance leads to an increase in MTCs of 48% and when transhipment is needed in order to connect two countries, unitary MTCs increase by 20%. Concerning barriers to trade in mode 3, MTCs are 25% higher on the routes classified in the second quartile than on routes classified in the first quartile. And, the routes classified in the third and the fourth quartile, MTCs are 52% and 79% higher than on routes classified in the first quartile, respectively. Results for the IV tobit estimations are still relevant -- column 7. As a second robustness check, I test whether the division of the STRI into quartile influences the results by including the index split into terciles instead of quartiles. For this estimation, the level of significance remains stable for the control variables *distance, transhipment* and *total trade volume,* while the level of significance increases for *trade imbalance* variables, making them significant. Policy variables are significant at the 1% level and still increase monotonically. The sizes of coefficients remain consistent with previous results. Third, in these estimations I control for the competition between maritime and air transport by including a commodity fixed-effect. Since trading partners sharing a border are likely to transport their international trade by road, I check for the competition with surface transport modes by dropping observations that involve direct neighbours -- this is the case of the US-Mexican trade that represents 85 observations. Unsurprisingly, the results remain consistent.[25]

The results obtained in this section suggest two important comments. First, one contribution of this paper is showing that restrictions in mode 3 affect MTCs non-linearly. Indeed, I find a monotonically, positive and significant impact of my set of restrictiveness indexes on MTCs. Second, consistently with other papers in the literature, my results suggest that distance explains a small share of the MTC's variance. Therefore, contrary to what is assumed in many gravity equation estimations, distance is likely to be a poor proxy for

[25] Results of other robustness check estimations are available upon request.

transport costs. It demonstrates the importance to choose a better proxy variable (Korinek and Sourdin, 2009b). Section 4 aims at addressing this issue by including MTCs directly in the gravity equation.

4. The seaborne trade flow equation

This section aims at assessing the impact of MTCs on seaborne trade flows. I estimate a seaborne trade gravity equation augmented with MTCs. The endogeneity issue is addressed by using an IV-like approach developed by Limao and Venables (2001). This approach also allows disentangling direct and indirect effects (i.e. through MTCs) of some variables such as distance on seaborne trade flows. This section is organized as follows, first, I review the literature assessing the impact of transport costs on trade flows. Second, I present the empirical model and the data. Third, I present results of estimations.

Review of the literature

In the literature, several papers assess the impact of MTCs (or the determinants of MTCs) on seaborne trade flows.[26] The approach followed by these papers is very similar and it is also the approach followed in this paper. In a first stage, it consists in measuring MTCs determinants (Section 3). In a second stage, it consists in estimating a gravity equation including MTCs and/or its determinants as explanatory variables (Section 4).

It is critical to study the relationship between transport costs and trade flows in a gravity framework, at least for two reasons. First, in gravity model estimations, distance is often taken as a proxy for transport costs (Korinek and Sourdin, 2009b). However, as shown in the previous section, it explains only a small share of the MTCs' variance. Second, some determinants of MTCs (e.g. distance) are likely to have direct and indirect effects on trade flows. Therefore, by including MTCs in the gravity equation an endogeneity issue appears. However, the existing literature does not succeed in addressing satisfactorily this issue. For instance, some papers do not refer to the endogeneity issue at all -- e.g. Martinez-Zarzoso *et al.* (2008). Other papers such as Martinez-Zarzoso and Suarez-Burguet (2005), Marquez-Ramos *et al.* (2006) Korinek and Sourdin (2009b) run IV 2SLS. All these papers use the

[26] 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, Perez-Garcia and Suarez-Burguet (2008), Korinek and Sourdin (2009b).

unitary value of goods transported as an instrument for MTCs. Although, the unitary value of goods corresponds to the products' price. In this respect, it influences trade directly and not only through the endogenous variable. Therefore, in these papers, the exclusion conditions of the instrument are not satisfied. Finally, Martinez-Zarzoso and Nowak-Lehmann (2007) address the endogeneity issue of the MTC variable by estimating simultaneously a transport cost and a gravity equation. This is possible since in their system of equations, trade volume (varying across country-pairs and products) is the dependant variable in the gravity equation and an explanatory variable in the MTC equation. Nevertheless, Martinez-Zarzoso and Nowak-Lehmann do not provide justifications for including trade volume as an explicative variable in the MTC equation. It cannot be a proxy variable for economies of scale since the bilateral trade disaggregated by product is not appropriate. Indeed, in the liner shipping segment it is not the amount of the various products transported that creates economies of scale but the total amount of bilateral trade. Finally, almost no paper quoted uses state of the art gravity techniques and concepts. Only Korinek and Sourdin (2009b) mention the key concept of multilateral resistance.

As mentioned above, I deal with the endogeneity issue by using an IV-like approach developed by Limao and Venables (2001). This two-stage approach also allows disentangling the direct and indirect (i.e. through MTCs) impact of distance and STRI in mode 3 on seaborne trade flows. And, I take into account the multilateral resistance by estimating an Anderson and van Wincoop (2003) model with fixed-effects.

Model specifications and data[27]

As a theoretical basis, I use the Anderson and van Wincoop (2003) model who derived theoretically the gravity equation for trade value. Importantly, this model is applicable to cross-section estimations (Baldwin and Taglioni, 2006). In this model, the authors showed the importance of all other bilateral relations in a particular bilateral trade relation. Even though trade costs increase on all routes except on the route between the country o and the country d, the trade between o and d will be affected. This effect is called multilateral resistance. In the Anderson and van Wincoop (AvW) model the multilateral resistance effects are captured by price indices. The classic form of the model is presented in the equation [2.1] below.

[27] For more details about data sources, see Annex 3.

$$ln(M_{odk}) = ln(Y_{dk}) + ln(E_{ok}) - ln(Y) + (1-\sigma_k)[\tau_{odk} + ln\,\Pi_{dk} + ln\,P_{ok}] + \varepsilon_{odk} \qquad [2.1]$$

Where, the dependant variable (M_{odk}) is the seaborne import in value from the origin to the destination country of the product k. The first term (Y_{dk}) is the value added of the destination country in the sector k. The second term (E_{ok}) is the expenditure of the origin country in the product k. The third term (Y) is the world value added. The fourth term (σ_k) is the elasticity of substitution of product k. The fifth term (τ_{odk}) represents trade costs between o and d for the product k. The sixth and the seventh variables are respectively the inward and the outward multilateral resistance terms. And, ε_{odk} is the error term.

And where,

$$\tau_{odk} = distance_{od} + com\_lang_{od} + contiguity_{od} + pta_{od} + tariff_{odk} + mtc_{odk} \qquad [2.2]$$

Where, the first term ($distance_{od}$) is the maritime distance between o and d. The second term, (com_lang_{od}) is a dummy variable coding 1 if o and d have a common language and 0 otherwise. The third term, ($contiguity_{od}$) is a dummy variable coding 1 if o and d share a common border and 0 otherwise. The fourth term (pta_{od}) is a dummy variable coding 1 if o and d are parts to the same PTA (Preferential Trade Agreement) and 0 otherwise. The fifth term ($tariff_{odk}$) is the average MFN tariff between o and d for the product k. Here, I provide an adjustment to classical gravity specification by adding the transport cost variable (mtc_{odk}) directly in the trade costs equation. Concerning this variable, I use either the actual either the predicted values computed through the best specifications of the MTC equations in Section 3.

The model presented above has one important drawback since the data for certain variables is not observed and/or not available. It is the case for the sectoral value-added and expenditures and for the crucial relative prices representing the multilateral resistance terms. To control for these variables, the common way is to include fixed-effects. Precisely, since unobserved variables vary across commodity and countries (origin or destination), the solution should consists in including cross commodity-country fixed-effects -- i.e. a commodity-origin and a commodity-destination fixed-effect. However, considering the sample, cross commodity-origin fixed-effects represent more than 4,500 dummy variables. Since the sample comprises around 4,500 observations (without zero values) this approach cannot be used. In order to control for the appropriate commodity-origin dimension of unobserved variables I construct cross fixed-effects between commodities and the exporters' level of development. This approach has the advantages to generate a manageable amount of dummy variables. By including such fixed-effect I assume that relative prices vary across commodities and the exporters' level of development. By replacing the equation [2.2] in the equation [2.1] and including fixed effects, I obtain the equation [2.3] to estimate. Where π_{dk} is a cross commodity-destination fixed-effect and ρ_{ok} is a cross-fixed effects between commodity and the level of development of exporters.[28]

$$M_{odk} = \beta_1 distance_{od} + \beta_2 com\_lang_{od} + \beta_3 contiguity_{od} + \beta_4 pta_{od} + \beta_5 tariff_{odk} + \beta_6 mtc_{odk} + \pi_{dk} + \rho_{ok} + \varepsilon_{odk} \qquad [2.3]$$

Finally, as mentioned above, by estimating the gravity equation augmented with transport costs, an obvious endogeneity issue appears. Indeed, certain determinants of MTCs also affect seaborne imports. However, it is very difficult to find an IV for MTCs since it has to vary across origin, destination and commodity and to satisfy the exclusion conditions. In other words, it is very difficult to use the common IV 2SLS methodology here. Hence, in order to address the endogeneity issue, I use the IV-like approach developed by Limao and Venables (2001). Thus, I estimate the seaborne trade gravity equation by including the predicted instead of the actual value of MTCs as an explanatory variable. The predicted value is computed through the best specifications of the section 3 -- i.e. the specification 4 and 6. In these regressions, I also include determinants of MTCs which are likely to affect seaborne imports directly: the distance and the set of policy variables. Common gravity control variables are also included in these estimations.

Results of estimations

The sample is similar to the one used in the previous section, without zero trade values it represents 4,614 observations. The variables *M*, *distance* and *mtc* are included in logarithms. The error term is assumed to be independently distributed across countries and products. First, I estimate a classic gravity model augmented with the MTC variable (equation [2.3]) by OLS. These results are presented in Table 4. Then, I estimate the gravity equation *à*

[28] I use the level of development defined by the World Bank. For more details see the Annex 1.

la Limao and Venables by OLS in order to deal with the endogeneity issue. These results are presented in Table 5.

With respect to the common gravity estimations, all results are similar (Table 4). MTC and tariff variables are significant at the 1% level and as expected they are negative. In contrast, all other variables are not significant. It is important to note that common gravity variables do not become significant when the MTC is not included -- columns 3 and 6. This means that the MTC variable does not absorb the impact of *distance, com_language* and *contiguity* on seaborne trade. However, *mtc* and *tariff* are likely to be the only significant variables since they are the only variables varying across all dimensions of the dependant variable -- i.e. across origin, destination and commodity.

Table 4: Estimation results -- The gravity equation

				Robustness check		
	1	2	3	4	5	6
	OLS	OLS	OLS	OLS	OLS	OLS
distance	0.153		-0.131	0.461		0.263
	(0.481)		(0.505)	(0.447)		(0.460)
mtc	-1.028***	-1.014***		-0.746***	-0.690***	
	(0.128)	(0.133)		(0.143)	(0.151)	
com_language	0.309	0.333	0.337	0.0962	0.181	0.120
	(0.515)	(0.488)	(0.536)	(0.488)	(0.461)	(0.494)
contiguity	-0.400	-0.529	-0.330	0.125	-0.257	0.182
	(0.688)	(0.562)	(0.749)	(0.652)	(0.516)	(0.687)
pta	0.323	0.257	0.333	0.250	0.0513	0.247
	(0.548)	(0.556)	(0.595)	(0.495)	(0.491)	(0.521)
tariff	-0.0160***	-0.0157***	-0.0162***	-0.0152***	-0.0144***	-0.0153***
	(0.00425)	(0.00433)	(0.00427)	(0.00442)	(0.00443)	(0.00442)
Observations	4,614	4,614	4,614	4,076	4,076	4,076
R-squared	0.397	0.397	0.359	0.325	0.321	0.304

Source: Author's calculation. Notes: * Significant at the 10 % level. ** Significant at the 5 % level. *** Significant at the 1 % level. The dependant variable is seaborne import, it is expressed in US$. Seaborne imports, distance and MTCs are in logarithms. Cross section for year 2006. Model 1 to 4 are estimated by OLS. T-statistics are given in parentheses. Estimations use White heteroskedasticity-consistent standard errors and standard errors are adjusted for clusters in country-pairs. Cross commodity-origin and commodity-destination fixed-effects are included in all regressions. Intercepts are included in all specifications but are not reported. The correlation matrix is available in Annex 4.

Concerning the IV-like estimations, I focus on the results for the full sample -- i.e. specifications 1 and 2 (Table 5). The tariff variable is still significant at the 1% level and negative. If tariffs increase by one percentage point, trade flows decrease by 1.5 %. The predicted value of MTCs comes up very significant and negative. If MTCs double, seaborne imports decrease proportionately. Furthermore, in the specifications 1 and 2 the distance variable becomes significant at the 5% level and the contiguity variable at the 1% and 10%

level. At first sight, the coefficient of both variables could seem counterintuitive. However, since my analysis is based on seaborne trade rather than on trade as a whole, results are consistent.

Table 5: Regressions dealing with endogeneity

			Robustness check	
	1	2	3	4
	OLS	OLS	OLS	OLS
predicted_mtc_4	-1.040***	-1.025***		
	(0.0523)	(0.0505)		
predicted_mtc_6			-1.659***	-1.636***
			(0.103)	(0.103)
distance	0.499**	0.526**	0.759***	0.758***
	(0.213)	(0.228)	(0.193)	(0.190)
mode_3_2		0.160		-0.0215
		(0.260)		(0.264)
mode_3_3		0.398		0.278
		(0.290)		(0.287)
mode_3_4		0.304		0.180
		(0.282)		(0.302)
contiguity	-0.989***	-0.807*	-0.790**	-0.558
	(0.361)	(0.413)	(0.312)	(0.353)
com_language	-0.338	-0.199	-0.454**	-0.353
	(0.226)	(0.229)	(0.227)	(0.216)
pta	0.0674	0.0629	0.0556	0.0155
	(0.280)	(0.300)	(0.236)	(0.258)
tariff	-0.0147***	-0.0148***	-0.0141***	-0.0142***
	(0.00462)	(0.00456)	(0.00438)	(0.00441)
Observations	4,614	4,614	4,076	4,076
R-squared	0.643	0.644	0.593	0.594

Source: Author's calculation. Notes: * Significant at the 10 % level. ** Significant at the 5 % level. *** Significant at the 1 % level. The dependant variable is seaborne import, it is expressed in US$. Seaborne imports, distance and MTCs are in logarithms. Cross section for year 2006. Model 1 to 4 are estimated by OLS. T-statistics are given in parentheses. Estimations use White heteroskedasticity-consistent standard errors and standard errors are adjusted for clusters in country-pairs. Cross commodity-origin and commodity-destination fixed-effects are included in all regressions. Intercepts are included in all specifications but are not reported. The correlation matrix is available in Annex 4.

Concerning distance, besides affecting seaborne trade flows through MTCs (as suggested in the section 3), it also affects seaborne trade flows directly and positively. This suggests an opposite direct and indirect effect of distance on seaborne trade flows. Indeed, once the impact of distance on MTCs has been controlled, distance has a direct positive impact on seaborne trade. The farer trading partners are from each other, the more likely the cargo will be transported by sea. Interestingly, this result confirms a pattern often stated in the literature. Additionally, the negative sign of the contiguity variable is the other side of this distance story. When two trading partners share a common border, the importance of the maritime transport mode decreases significantly -- for the benefit of road transport. Moreover, as suggested in specification 2 and contrary to the distance, restrictions in mode 3 do not affect trade flows directly. However, since barriers to trade in mode 3 affect MTCs and MTCs affect seaborne trade flows, I can conclude that barriers to trade affect seaborne trade flows indirectly. More interesting, it is possible to derive this indirect impact. Thus, since MTCs affect proportionally seaborne trade flows (the coefficient is close to one therefore, double MTCs lead to an equivalent decrease in seaborne trade), STRI in mode 3 affect seaborne trade flows in the same proportion as it affect MTCs. Finally, other control variables such *pta* and *com_language* are not significant. This could be due to overlaps between the *pta*, *com_language* and *contiguity* variables (e.g. the US and Mexico share a common border and they are partners in the NAFTA, Australia and New Zealand share a common language and they are partners in the CER -- Closer Economic Relation). Furthermore, countries of my sample are involved in few and not the most dynamic PTAs.[29]

Robustness check

Like in the section 3, I estimate the various specifications by dropping observations for which the weight of trade reported is less than one metric tonne. Indeed, even though the dependant variable is expressed in value, observations for which the weight of trade is low are likely to suffer from reporting errors (Baldwin and Harrigan, 2007). The amount of observations decreases from 4,614 to 4,076. These results are presented in Columns 4, 5 and 6 of Table 4 and Columns 3 and 4 of Tables 5. Except some changes in the value of coefficients, the most important results described in the previous sub-section are still true.

5. Conclusion and recommendations

One contribution of this paper to the literature is the construction of an original liner shipping STRI measuring the overall intensity of restrictions in mode 3. To construct this index I use high quality information on the regulatory regime applied by countries (World Bank, 2008). Another novelty is to use state of the art methodological developments. Moreover, my index is constructed as closely as possible to the reality thanks to discussions and debates with experts and professionals. The study of my set of STRIs suggests that liner

[29] They are the NAFTA, the CER, the agreements between Thailand and New Zealand, between the United States and Australia, Chile, Jordan, Morocco and CAFTA -- Central America Free Trade Agreement.

shipping is an open sector. This is not surprising since it is a tradable service by nature. Finally, except geographical and political factors, it is difficult to find patterns explaining the restrictiveness of countries' regulatory regime in the sector.

Concerning the impact of trade barriers on MTCs and seaborne trade flows, first, I show that barriers to trade in mode 3 have a direct and positive impact on MTCs. Indeed, I found a monotonically, positive and significant impact of my STRI split into quartiles on MTCs. Therefore, the more maritime routes are restrictive, the more MTCs on routes are high. Precisely, after controlling for a data reporting issue, the results suggest that MTCs are 25% higher on the routes classified in the second quartile than on the routes classified in the first quartile. And, on the routes classified in the third and fourth quartiles, MTCs are 52% and 79% higher than on the routes classified in the first quartile, respectively. Beyond these quantitative results, the impact of the STRI on MTCs brings two important conclusions. First, by showing that barriers in mode 3 affect MTCs, I demonstrate that even though mode 1 is the key mode of supply in maritime transport, commercial presence (i.e. mode 3 of supply) is of crucial importance to provide efficient liner shipping services. Second, considering the methodology used to bilateralize the STRI (i.e. the additive form), these results suggest that on maritime routes, restrictions in mode 3 are crucial at both ends of journeys -- i.e. in origin and destination countries. Then, I show that barriers to trade in mode 3 do not affect seaborne trade flows directly. However, since I show that barriers to trade in mode 3 affect positively MTCs and that MTCs affect negatively seaborne trade flows, I can conclude that barriers to trade affect seaborne trade flows negatively through MTCs. More interesting, it is possible to derive this indirect impact of trade barriers on seaborne trade flows. Thus, since MTCs affect proportionally seaborne trade flows (double MTCs lead to an equivalent decrease in seaborne trade), STRI in mode 3 affects seaborne trade flows in the same proportion as it affects MTCs.

These results have important policy implications. First, I show that restrictive regulatory regimes lead to additional transport costs that, in turn, have a negative impact on seaborne trade flows. This result demonstrates that MTCs are compressible and suggests that policy-makers have a role to play in decreasing MTCs until they reach their minimum level. Second, my results suggest that commercial presence is a key issue in liner shipping. This should encourage policy-makers to pay more attention to restrictions in mode 3. Third, my results suggest that on maritime routes, trade restrictions affect both the countries of origin and destination. Thus, restrictive regulations and additional MTCs affect all trading countries including the most liberal ones. This suggests that restrictions in maritime transport are a multilateral issue that has to be tackled within the GATS framework. Importantly, my results, suggesting a substantial impact on MTCs, are an incentive for all countries to invest in negotiations to remove barriers to trade in mode 3 in the liner shipping sector. These results are an incentive to reopen GATS negotiations which are at a standstill since 1997.

Eventually, barriers to trade in mode 3 are likely to affect MTCs through marginal costs and the market structure. One drawback of this analysis is of not being able to disentangle both effects.

Coming to the impact of distance on MTCs and seaborne trade flows, first, I show that distance affects MTCs positively. And, consistently the literature, I show that distance explains a small share of the MTCs variance. Second, I succeed in disentangling direct and indirect effects of distance on seaborne trade flows. On the one hand, I show that distance has a positive impact on MTCs and MTCs have a negative impact on seaborne trade flows. Therefore, these results suggest that distance has a negative impact on seaborne trade flows through MTCs. On the other hand, after controlling for the indirect impact of distance through MTCs following the IV-like approach developed by Limao and Venables (2001), I show that distance affects seaborne trade positively. Thus, the farer trading partners are from each other, the more likely their containerizable trade will be transported by sea. This result confirms a pattern often stated but never proved -- to my knowledge. Interestingly these results suggest opposite direct and indirect effects of distance on seaborne trade flows. Third, consistently with another maritime transport stylized fact, I show that if trading partners share a common border, the importance of the maritime transport mode decreases sharply (Hummels, 2007).

From a theoretical and empirical point of view, the results obtained concerning distance are crucial. As stated by the literature, since distance explains a small share of the MTC’s variance, it is likely to be a poor proxy variable for transport costs -- contrary to what is assumed in many gravity equation estimations. Furthermore, by showing opposite direct and indirect effects of distance on seaborne trade flows, I show that distance is definitely a poor proxy for MTCs.

Finally, this paper calls for further research. First, the results obtained concerning distance call for similar research dealing with trade as a whole and trade for other transport modes -- notably air transport for which accurate data is available. These works should allow to better understand the entangled direct and indirect effects of distance on transport costs and trade.

Second, once computed, the STRI could be used in different ways. One approach would consist in estimating *ad valorem* equivalents of barriers to trade in mode 3. *Ad valorem* equivalents can be computed by regressing MTCs on the STRI -- and using for the dependant variable Cif-Fob ratios instead of unitary transport costs. The step further would be to include these *ad valorem* equivalents in an international trade model to assess through a different methodology the impact of liner shipping trade restrictions on seaborne trade flows.

Third, the results obtained call for enlarging the scope of the study in terms of period, country, and product coverage. This would allow to better generalize the conclusions drawn. A decisive improvement would consist in estimating panel instead of cross-section regressions. However, this requires better regulatory information. Then, it would be interesting to enlarge the country sample and notably the number of importing countries. This is possible to some extent since accurate data (needed to compute MTCs) is available for other countries such as Australia and some Latin-American countries.

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7. Annexes

Annex 1: Sample description

Destination countries (2) Importers	
New Zealand	High-income
United States	High-income

Origin countries (56) Exporters	
Argentina	Upper-middle-income
Australia	High-income
Bangladesh	Low-income
Bulgaria	Upper-middle-income
Brazil	Upper-middle-income
Chile	Upper-middle-income
China	Upper-middle-income
Côte d'Ivoire	Lower-middle-income
Cameroon	Lower-middle-income
Colombia	Upper-middle-income
Costa Rica	Upper-middle-income
Dominican Republic	Upper-middle-income
Ecuador	Upper-middle-income
Egypt	Lower-middle-income
Georgia	Lower-middle-income
Ghana	Lower-middle-income
Guatemala	Lower-middle-income
Honduras	Lower-middle-income
Indonesia	Lower-middle-income
India	Lower-middle-income
Iran	Upper-middle-income
Jordan	Upper-middle-income
Japan	High-income
Kenya	Low-income
Cambodia	Low-income
South Korea	High-income

Origin countries (56) Exporters	
Kuwait	High-income
Sri Lanka	Lower-middle-income
Morocco	Lower-middle-income
Madagascar	Low-income
Mexico	Upper-middle-income
Mauritius	Upper-middle-income
Malaysia	Upper-middle-income
Namibia	Upper-middle-income
Nigeria	Lower-middle-income
Nicaragua	Lower-middle-income
New Zealand	High-income
Oman	High-income
Pakistan	Lower-middle-income
Panama	Upper-middle-income
Peru	Upper-middle-income
Philippines	Lower-middle-income
Qatar	High-income
Romania	Upper-middle-income
Russia	Upper-middle-income
Saudi Arabia	High-income
Senegal	Lower-middle-income
Thailand	Upper-middle-income
Trinidad & Tobaggo	High-income
Tunisia	Upper-middle-income
Ukraine	Lower-middle-income
Uruguay	Upper-middle-income
United States	High-income
Venzuela	Upper-middle-income
Viet Nam	Lower-middle-income
South Africa	Upper-middle-income

Source: World Bank (2010). Notes: High-income economies (Growth National Income -- GNI -- per capita of 12276 dollars or more), upper-middle-income economies (GNI per capita between 3976 and 12275 dollars), lower-middle-income economies (GNI per capita between 1006 and 3975 dollars) and low-income economies (GNI per capita of 1005 dollars or less).

Annex 2: Details on the construction of the liner shipping STRI in mode 3

The relevance of restrictions included

This section aims at checking the relevance to include the various restrictions to trade in mode 3 used in my liner shipping STRI. I include all restrictions separately in the model given by the equation [1.4] and I estimate these specifications by tobit. Each restriction is included as a dummy variable. Since the regulatory framework is very similar for both destination countries, I include the origin countries' restrictions only. Policy variables are coded as follows:

- *subs_not_allowed_o* is coded 1 if commercial presence cannot be established as a subsidiary in the origin country, 0 otherwise.

- *branch_not_allowed_o* is coded 1 if commercial presence cannot be established as a branch in the origin country, 0 otherwise.

- *rest_control_green_o* is coded 1 if the share of foreign ownership is limited to less than 50% in greenfield projects in the origin country, 0 otherwise.

- *rest_control_private_o* is coded 1 if the share of foreign ownership is limited to less than 50% in existing private entities in the origin country, 0 otherwise.

- *rest_control_public_o* is coded 1 if the share of foreign ownership is limited to less than 50% in existing public entities in the origin country, 0 otherwise.

- *jv_requiered_private_o* is coded 1 if a joint venture is required for, at least, one form of commercial presence (either on greenfield project or existing public and private entities) in the origin country, 0 otherwise.

- *lic_requiered_o* is coded 1 if a licence is required in order to establish a commercial presence in the origin country, 0 otherwise.

- *bad_reg_frame_o* is coded 1 if the regulatory framework of the origin country is of bad quality, 0 otherwise.[30]

- *restrictions_employee_o* is coded 1 if some restrictions concerning the nationality of employees exist in the origin country, 0 otherwise.

- *restrictions_board_o* is coded 1 if some restrictions concerning the nationality of the members of the Board of Directors exist in the origin country, 0 otherwise

- *rest_repat_o* is coded 1 if some restrictions on the repatriation of earnings by foreign carriers exist in the origin country, 0 otherwise

Since the individual policy variables vary across origin countries I do not include the corresponding fixed effect. Moreover, because of multicollinearity, it is not possible to include policy variables all together in the same regression. I use the correlation matrix to define the various relevant specifications. The results of these specifications are presented in the table below. Broadly speaking, the econometric analysis confirms my intuitions on the relevance to include all restrictions used in the STRI.

[30] The regulatory framework is considered of bad quality when companies do not have the right to appeal regulatory decisions and when a mechanism of prior notice of regulatory changes does not exist.

Table: Estimations results -- MTC equation including policy variables individually

	1	2	3	4	5
	Tobit	Tobit	Tobit	Tobit	Tobit
distance	-0.331	-0.0558	-0.255	-0.499	-0.460
	(0.367)	(0.338)	(0.356)	(0.310)	(0.301)
transhipment	1.358*	1.694**	1.298*	0.846*	0.814*
	(0.696)	(0.711)	(0.695)	(0.476)	(0.477)
tv	-0.949***	-0.849***	-0.951***	-1.115***	-1.110***
	(0.121)	(0.124)	(0.125)	(0.0956)	(0.0952)
ti_absolute	-0.116	-0.0566	-0.115	-0.0435	-0.0461
	(0.279)	(0.288)	(0.288)	(0.159)	(0.155)
ti_interaction	2.275***	2.012**	1.864**	1.475**	1.445**
	(0.877)	(0.899)	(0.815)	(0.740)	(0.719)
branch_not_allowed_o				0.439	0.430
				(0.315)	(0.316)
rest_control_green_o				0.676*	
				(0.365)	
rest_control_private_o	0.750*				0.587*
	(0.387)				(0.349)
rest_control_public_o		0.765**			
		(0.346)			
jv_requiered_private_o			0.824***		
			(0.288)		
lic_requiered_o	-0.524	-0.692	-0.491		
	(0.743)	(0.739)	(0.708)		
bad_reg_frame_o	2.669***	3.012***	2.795***		
	(0.911)	(0.863)	(0.934)		
restrictions_employee_o	0.336	0.328	0.136		
	(0.370)	(0.362)	(0.353)		
restrictions_board_o		0.167	0.0964	0.0248	
		(0.470)	(0.499)	(0.414)	
rest_repat_o	-2.613**	-2.860*	-2.945**	-0.0574	-0.0477
	(1.207)	(1.606)	(1.232)	(0.409)	(0.402)
Pseudo-R-squared	0.187	0.191	0.187	0.178	0.178
Observations	5,495	5,166	5,495	8,943	8,943

Source: Author's calculation. Notes: * Significant at the 10 % level. ** Significant at the 5 % level. *** Significant at the 1 % level. The dependant variable is a unitary maritime transport cost, it is expressed in dollars per kilogram and in logarithm. The variables *distance*, *tv* and *ti_absolute* are in logarithms. Cross section for year 2006. All models are estimated by tobit. The pseudo R-squared is the McFadden's pseudo R-squared. T-statistics are given in parentheses. Estimations use White heteroskedasticity-consistent standard errors and standard errors are adjusted for clusters in country-pairs. Destination and commodity fixed-effects are included in all regressions. Intercepts are included in all specifications but are not reported.

First, I focus on the control variables. The distance variable is never significant while the transhipment variable is at 10% or 5% with the expected positive coefficient. In all specifications the economies of scale variable is significant at 1% and negative. The trade imbalance interaction is always significant at 5% or 1% and as expected the coefficients are positive. Turning to policy variables, the dummy variables related to restrictions on ownership (either on greenfield project or existing public and private entities), the joint venture requirement and the bad regulatory framework are significant. These variables have a positive impact on MTCs. In contrast, dummy variables related to restrictions on the establishment of branches, the licence requirement and restrictions on the nationality of employees and of the

Board of Directors are not significant. However, some explanations can be provided. Concerning the restriction on branches, many developed countries prohibit the establishment of this form of commercial presence. The main objective of this measure is not protectionist, it is rather a fiscal and legal matter. It establishes practical jurisdiction over maritime incidents in territorial waters and ensures that ships do not leave port without paying their bills. Then, the insignificance of the licence requirement variable can be explained by the weakness of raw regulatory information. Indeed, in some countries the licensing process is automatic and easy while in others it is expensive and burdensome. Hence, more information are needed to reflect the real degree of restrictiveness of this variable. Concerning restrictions on employees and board of Directors, they are often applied in developed countries that enjoy relatively lower MTCs. This is likely to affect the results of the regressions. Finally, the variable corresponding to repatriation of earnings is either significant or not but negative.

Weighting

Weights capture the relative importance of measures in terms of trade restrictiveness. In order to determine weights, I explore three options generally used in the literature. The first solution consists in using an equal weighting scheme. This method offers the advantage of being transparent. However, equal weights do not reflect the potential restrictiveness of each category. The second alternative is to use the factor analysis methodology and most particularly a Principal Component Analysis (PCA). The PCA is a statistical method. It determines weights according to the categories' contribution to the entire variance of the sample. The first step of a PCA is to determine the number of latent factors (also called eigenvalues) representing the most important part of the sample's variance.[31] In a second step, loadings (i.e. the principal components, also called eigenvectors) are computed. They represent the correlation between index's components and latent factors. Third, I produce weights, normalizing eigenvectors to one. This methodology had two major drawbacks. Weights depend on the sample and could not be used in a future analysis with different countries. And, PCAs 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.

[31] In order to determine the relevant latent factors I use two thumb rules: the Kaiser criterion (eigenvalues below one are dropped) and the variance explained criterion (latent factors must explain more than 70% of the entire variance) (OECD, 2008)

Table: Weighting through Principal Component Analysis

	Factor 1			Factor 2			Factor 3			
Explained variance	0.475			0.146			0.125			
Indicators of restrictivness	**Loadings**	**SFL [a]**	**Weights**	**Loadings**	**SFL [a]**	**Weights**	**Loadings**	**SFL [a]**	**Weights**	**Final weights**
form	0.242	0.059	0.059	-0.290	0.084	0.084	-0.659	0.434	0.434	**0.192**
greenfield	0.451	0.203	0.203	-0.026	0.001	0.001	-0.016	0.000	0.000	**0.068**
private	0.451	0.203	0.203	-0.026	0.001	0.001	-0.016	0.000	0.000	**0.068**
public	0.373	0.139	0.139	-0.151	0.023	0.023	-0.112	0.012	0.012	**0.058**
joint venture	0.434	0.189	0.189	-0.117	0.014	0.014	0.089	0.008	0.008	**0.070**
licence	0.321	0.103	0.103	0.455	0.207	0.207	0.053	0.003	0.003	**0.104**
employment	0.006	0.000	0.000	-0.596	0.355	0.355	0.552	0.304	0.304	**0.220**
board of directors	0.300	0.090	0.090	0.362	0.131	0.131	0.466	0.217	0.217	**0.146**
regulation	-0.117	0.014	0.014	0.430	0.185	0.185	-0.145	0.021	0.021	**0.073**
repatriation of earnings	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	**0.000**
		1.000	0.333		1.000	0.333		1.000	0.333	

Source: Author's calculation. Note: [a] Squared Factors Loadings.

The third method is based on experts' judgement, taking into account their sector's knowledge and experience. However, considering the number and the diversity of restrictions selected, it is very difficult for experts (even with dozens of years' experience) to assess the relative restrictiveness of each measures. Additionally, it is very difficult to reach a consensus among experts. Considering the feasibility and considering advantages and drawback of the various methodologies presented, I choose to use an equal weighting scheme.

Robustness Check

One drawback when using a composite index to measure trade restrictiveness is about the subjectivity of the weighting methodology. The weighting scheme is likely to affect the final outcome of the STRI. Hence, I test the sensitivity of results to choices that have been made during the weighting step. Precisely, I check whether the countries' ranking is driven by a particular weighting scheme by using the Spearman rank correlation methodology. I compute the Spearman rank correlation between two different STRIs -- the one computed using the equal weighting and the one computed through the PCA. The result of the robustness check allows to say that the rank of countries is robust to the weighting scheme.[32]

[32] The Spearman Rho is 0.907.

Annex 3: Data description

Table: Variables included in the MTC equation

Variable	Description	Dimension	Source
mtc	Ad valorem maritime transport costs. Computed as follow: [(imports valued in cif-customs value of imports)/(imports valued in cif)]. Expressed in percentage	odk	OECD (2006)
distance	Shortest maritime distance by canal, straits and caps between main container ports, expressed in miles	od	CI Online (2006) and AXS marine (2010)
transhipment	Dummy variable coded 1 if a transhipment is needed by trade partners	od	UNCTAD (2007) [a]
tv	Total seaborne imports of containerizable products, in kilogramme	od	Computed with data from New Zealand Statistics (2006) and US Census Bureau (2006)
ti_absolute	Trade imbalance of seaborne trade of containerizable products. Computed as the absolute term of the following expression [(Exports - Imports)/Max (Exports, Imports)]	od	Computed with data from New Zealand Statistics (2006) and US Census Bureau (2006)
ti_interaction	Intercation of ti_absolute and a trade imbalance dummy variable coded 1 if the seaborne trade imbalance is negative.	od	Computed with data from New Zealand Statistics (2006) and US Census Bureau (2006)
mode_3_first	Dummy variable coded 1 if the route is clasified in the first quartile	od	Own calculation with data from World Bank (2008) [b]
mode_3_second	Dummy variable coded 1 if the route is clasified in the second quartile	od	Own calculation with data from World Bank (2008) [b]
mode_3_third	Dummy variable coded 1 if the route is clasified in the third quartile	od	Own calculation with data from World Bank (2008) [b]
mode_3_forth	Dummy variable coded 1 if the route is clasified in the forth quartile	od	Own calculation with data from World Bank (2008) [b]
MFN simple average tariff [c]	-	od	World Integrated Trade Solution (2006)

Notes: [a] I would like to thank Jan Hoffmann for sharing his data. [b] World Bank Survey on Impediments to Trade Integration. Realized between 2006 and 2008. [c] The instrument for total seaborne imports.

Table: Variables included in the gravity equation

Variable	Description	Dimension	Source
Seaborne imports	-	odk	New Zealand Statistics (2006) and US Census Bureau (2006)
contiguity	Dummy variable coded 1 if trade partners share a common border.	od	Head et al. (2010)
common language	Dummy variable coded 1 if trade partners share an official language.	od	Head et al. (2010)
pta	Dummy variable coded 1 if trade partners are part of the same Preferential Trade Agreement.	od	De Sousa (2011)
simple average AHS	-	odk	World Integrated Trade Solution (2006)
predicted_mtc_advalorem	Computed through specification 4 of the section 4.	odk	Own calculation

Notes: The distance and the policy variables are described in the table above.

Annex 4: Correlation matrixes

Table: Correlation matrix -- MTC estimations

	distance	transhipment	tv	ti_absolute	ti_interaction	mode_3_second	mode_3_third
distance	1						
transhipment	0.5017	1					
tv	-0.516	-0.7305	1				
ti_absolute	0.2548	0.2472	-0.4027	1			
ti_interaction	-0.0491	-0.266	0.4692	0.071	1		
mode_3_second	-0.142	0.1085	-0.0769	-0.094	-0.0112	1	
mode_3_third	-0.2955	-0.3024	0.2132	0.0252	0.2098	-0.3002	1
mode_3_forth	0.1871	-0.063	0.1138	0.069	-0.0326	-0.3251	-0.3016

Note: Distance, trade volume and trade imbalance in absolute term variables are included log-linearized.

Table: Correlation matrix -- Gravity estimations

	mtc	distance	predicted_mtc_4	contiguity	pta	com_language	tariff	mode_3_2	mode_3_3
mtc	1								
distance	0.1835	1							
predicted_mtc_4	0.2648	0.2122	1						
contiguity	-0.0694	-0.3533	-0.0964	1					
pta	-0.0762	-0.4181	-0.1303	0.3177	1				
com_language	0.0196	0.1729	-0.0632	-0.0739	0.009	1			
tariff	0.021	0.0078	0.0093	0.0163	0.0035	-0.0144	1		
mode_3_2	-0.045	-0.1881	0.0453	0.2406	-0.0989	-0.0378	-0.0103	1	
mode_3_3	-0.0478	-0.2699	-0.1139	-0.0761	0.1345	-0.2119	-0.0161	-0.3162	1
mode_3_4	0.0133	0.2795	0.0102	-0.0742	-0.1164	-0.1786	0.0409	-0.3082	-0.3508

Note: MTC and distance variables are included log-linearized.