Economics Bulletin

Volume 39, Issue 4

The trade-reducing effects of market power in international ports

Gabriel F De Oliveira
LEAD, Université de Toulon

Nicolas Peridy
LEAD, Université de Toulon

Abstract

This paper empirically investigates the impact of port competition on trade developments. The integration of port-competitive environment in an original gravity model shows that: (i) a one-standard-deviation rise in port concentration leads to a reduction in bilateral trade by at least 7%; (ii) the trade-creation effect from port competition is greater on the export side than on the import side; and (iii) the effect on trade is higher when port competition intensity is measured at regional or global levels (more than 300 km) rather than at a local level.

We are very grateful to an anonymous reviewer for very helpful comments

Citation: Gabriel F De Oliveira and Nicolas Peridy, (2019) "The trade-reducing effects of market power in international ports", *Economics Bulletin*, Volume 39, Issue 4, pages 2674-2687

Contact: Gabriel F De Oliveira - figueiredo.univ@gmail.com, Nicolas Peridy - nicolas.peridy@univ-tln.fr.

Submitted: May 22, 2019. **Published:** November 24, 2019.

Economics Bulletin

Submission Number: EB-19-00467

The trade-reducing effects of market power in international ports

Gabriel F De oliveira
LEAD, Université de Toulon

Nicolas Peridy
LEAD, Université de Toulon

Abstract

This paper empirically investigates the impact of port competition on trade developments. The integration of various ports' and maritime container services' quality indexes in augmented gravity models shows that: (i) services that use transshipment instead of direct services between the trading partners decrease the probability to trade by 11 %; (ii) a one-standard-deviation rise in port concentration leads to a reduction in bilateral trade by 15%; (iii) the trade-creation effect from port competition is greater on the export side than on the import side; and (iv) the effect on trade is higher when port competition intensity is measured at regional or global levels (more than 300 km) rather than at a local level.

Submitted: May 22, 2019.

1. Introduction

As 90% of international trade in volume is conducted at sea, globalization using multiple sourcing has been due, to a large degree, to the development of cost-effective and timely ocean shipping services. This also means that remoteness from international maritime trade routes is a significant factor that explains lower bilateral trade.

This element has been recognized in the literature by the role played by transport to explain trade (Anderson 2004). For instance, trade costs would amount to 170% in tariff equivalent, with 75% related to international costs and 21% to transport costs. Furthermore, an improvement in transport infrastructure and customs procedures would generate a 4.7% increase in world GDP, whereas a full tariff removal would only increase world GDP by 0.7% (World Economic Forum 2013). These elements are considered within gravity models that incorporate some of the key attributes of maritime transportation such as port infrastructure, port efficiency, transport costs and freight rate, transit time, logistic performance and connectivity indexes. However, with the notable exception of Hummel et al. (2009) who investigates the trade reducing effects of market power in international shipping, the impact of market power in shipping and port competition is seldom considered. The objective of this paper is to account for the market power of international container ports with the rationale that, similar to shipping, a limited competition between ports within a region or within a range of competing ports could lead to substantial port inefficiency and, therefore, hamper trade development.

The main research question is then to assess to what extent the port competitive environment affects trade development. This paper contributes to the literature by investigating two main directions: (i) our paper extends the literature that examines the effect of maritime transport services' quality (Korinek and Sourdin, 2010; Hoekman and Nicita, 2011, Djankov and al., 2010; Arvis et al., 2016); and (ii) we add to Hummels et al. (2009) research by providing evidence on the extent to which competition between ports within a region or within a range of competing ports could lead to substantial port inefficiency and, therefore, impacts trade development.

To investigate such an issue, this paper is organized as follows. Section 2 is dedicated to a short literature review on the trade impact of ports' attributes. Section 3 presents the international trade model used in the paper. Section 4 shows the econometric estimations and discusses the main findings while Section 5 concludes.

2. Literature review

Most gravity models consider the characteristics of maritime services either directly or indirectly, to explain bilateral trade levels. In the empirical literature dealing with the determinants of trade flows, transport costs are traditionally represented by geographical factors, including distance that increases the cost of transportation. In order to better capture the effect of transport costs, some authors use c.i.f./f.o.b ratio (Baier and Bergstrand 2001; Hummels and Lugovskyy, 2006) or deduce the freight rates from import-charges data (freight and insurance costs) provided by customs declarations (Martínez-Zarzoso and Suárez-Burguet 2005; Korinek and Sourdin 2010). Several studies point out the importance of the impact port efficiency and of port infrastructure on trade (Limao and Venables, 2001; Clark et al., 2004; Wilson et al., 2003; Blonigen and Wilson, 2008).

Another important aspect of service quality that may affect trade is the time delay. According to Djankov and al. (2010), each additional day to deliver a product would have the same effect on trade as increasing the distance by 70 km between importer and exporter. Arvis et al, (2016) have highlighted, that logistics performance (LPI) and maritime connectivity (LSCI) are together a more importance source of variation in trade cost than the geographical distance.

Among the significant variables, the number of carriers providing a regular service on a route plays a determinant role on bilateral trade. Because competition is more intense and more services are usually offered, shipping lines also have an incentive to reduce their margins on these routes and decrease transportation costs, as shown by Hummels et al. (2009).

These approaches capture the impact of ports (or of pairs of ports) on trade levels, expressed either in volume or in value, as the trade transiting between two inefficient ports is likely to be lower than when occuring between two efficient ports. However, the potential effect from market power at the port (or by port operators) level has usually been ignored. In this context, a pairwise or route specific measurement of port competition is not any longer adequate. Indeed, competition should be assessed amongst ports located within a similar geographic area or more generally, amongst ports presenting alternatives to import or export a given cargo. In its extended form, the relevant geographic area could also be enlarged to the ports' hinterland (Notteboom and Rodrigue 2005).

Defilippi and Flor (2008) illustrate the impact of competition on port efficiency. In the case of a port subject to limited demand and benefiting from a natural monopoly, it might suffer in term of efficiency from higher competition. Haralambides et al. (2002) also stress this element, when showing that under the assumption of economies of scale in port production, higher intra-port competition due to the allocation of dedicated terminals within a given port may lead to port inefficiency.

More recently, this issue was also stressed by two-stage DEA models used to explain port efficiency scores (first stage). For instance, Yuen et al. (2013) on the efficiency of 21 major Chinese container ports, stress that the level of inter-port and intra-port competition has an impact, amongst other attributes, on port efficiency. Inter-port competition, as in Yuen and Zhang (2009), is measured by the log distance between a port and its nearest competitor while the number of container terminal operators in a port captures intra-port competition. The authors conclude that both intra-port and inter-port competition may enhance container terminal efficiency, albeit the fact that inter-port competition is negatively correlated with efficiency growth, which suggests an ambiguous role over time. De Oliveira and Cariou (2015) use a truncated regression with a parametric bootstrapping model to show that inter-port competition impacts the port efficiency scores. This paper also shows that increasing competition decreases port efficiency but that this impact varies when the degree of competition is measured at the local (less than 400 km) or regional level (between 400 to 700 km).

Luo et al. (2012) apply a two-stage game model to predict the expected outcomes from competition when demand increases in a duopoly environment with a dominating port (Hong Kong instead of Shenzhen). Their main findings are that, due to competitive power, pricing and capacity might not be effective. Finally, inter-port competition also explain the efficiency observed along the entire supply-chain. Notteboom and Rodrigue (2012) indicate, for instance, that higher competition leads to overinvestment, duplication and redundancy, and therefore to inefficiency in the Rhine/Scheldt delta region.

3. The model

The gravity model is derived from Anderson and van Wincoop's (2003) seminal paper. The model has the main advantage, compared to the traditional gravity model, to account, simultaneously, for bilateral and multilateral trade resistance. Assuming a product differentiation framework and considering that consumers have CES preferences, the reduced form of the model can be written as:

$$X_{ij} = \frac{Y_i Y_j}{Y_w}\left(\frac{T_{ij}}{P_i P_i}\right)^{1-\sigma} \quad (1)$$

where X_{ij}, Y_i, Y_j and Y_w denote, respectively, bilateral exports between i and j, GDP in countries i, j and world GDP. T_{ij} reflects bilateral trade costs between i and j; P_i and P_j reflect implicit aggregated equilibrium prices (multilateral resistance), and θ_i et θ_j correspond to the GDP ratio shared by country *i* and *j*. This specification is the starting point of any gravity model. As Baldwin and Taglioni (2006) state, omitting multilateral resistance would lead to a significant bias ("gold mistake"), which leads Baier et al. (2014) to introduce multilateral resistance in a theoretical model for regional integration. In the standard specification of recent gravity models, equation (1) is usually estimated as follows:

$$LnX_{ij} = \alpha_1 lnY_i + \alpha_2 lnY_j + (1-\sigma)\alpha_3 ln\, T_{ij} + (1-\sigma)\alpha_4 ln\, \mathrm{P}_i + (1-\sigma)\alpha_5 ln\, \mathrm{P}_j + \varepsilon_{ij} \quad (2)$$

The multilateral resistance variables (P_i, P_j) are generally estimated through fixed effects (Matyas, 1997; Harrigan, 1996; Feenstra, 2002). However, considering a temporal dimension requires to include time varying multilateral resistance terms, i.e. export-time effects (α_{it}) and import-time effect (α_{jt}) (Baltagi et al, 2003, Bair and Bergstrand 2007; Magee, 2008; Zarzoso, 2014). However, estimating these country-time fixed effects would lead to eliminate all the variables that explain the ability of a country to export, e.g. GDP, institutional variables and also the variable of interest: port competition. To avoid such a drawback and following Head and Mayer (2014), we use three strategies to estimate the model. First, we control for the multilateral resistances by considering the "remoteness indexes"

$$\begin{aligned} lnX_{ij,t} = \beta_0 + \beta_1 RTA_{ij,t} + \beta_2 lnY_{i,t} + \beta_3 lnY_{j,t} + \beta_4 lnCUR_{i,t} + \beta_5 lnCUR_{j,t} + \beta_6 lnREM_{i,t} \\ + \beta_7 lnREM_{j,t} + \beta_8 lnHHI_{i,t} + \beta_9 lnHHI_{j,t} + \mu_{ij} + \gamma_t + \varepsilon_{ij,t} \end{aligned}$$

Y_{it}, Y_{jt}, RTA_{ijt}, $CUR_{i,t}$ $CUR_{j,t}$ respectively, denote GDPs in countries i and j, the Regional Trade Agreement between the two countries' and the exchange rates in countries i and j. The variables of interest ($HHI_{i,t}$ and $HHI_{j,t}$) are the port-competitive environment of the export and the import countries.

The remoteness indexes, $lnREM_{i,t}$ and $lnREM_{j,t}$, are introduced in order to capture multilateral resistance. These variables are constructed, as the logarithms of output- weighted averages of bilateral distance (Yotov et al, 2016):

$$lnREM_{i(j),t} = \ln(\sum_j D_{ij} / \left(\frac{Y_{j(i),t}}{Y_T}\right)$$

Finally, μ_{ij}, γ_t and $\varepsilon_{ij,t}$ are respectively the bilateral fixed effect, the time-specific effect and the error term.

The second approach consist in modeling the exporter-time effect $(\alpha_{i,t})$ as the sum of the effects of some exporter specific control $(C_{i,t})$, the average characteristics of each exporter, $\overline{(D_i} = \sum_j DIST_{ij}/N)$ And an error term $(\psi_{i,t})$.

$$\alpha_{i,t} = Y_{i,t} + POP_{i,t} + CUR_{i,t} + \overline{D}_i + \psi_{i,t}$$

Substituting this equation into equation 1 yields a new version of the one-step equation:

$$lnX_{ij,t} = \beta_0 + \beta_1 RTA_{ij,t} + \beta_2 Ci_{i,t} + \beta_3 lnHHI_{i,t} + \eta_{j,t} + \mu_{ij} + \gamma_t + (\psi_{i,t} + \varepsilon_{ij,t})$$

Finally, we estimated a two-step model. In the first step, the dependent variable is regressed only on the explanatory variables Z_{ijt} that vary over the three dimensions (import, export and time), as we have introduced import-time effects (α_{jt}), export-time effects (α_{it}) as well as bilateral effects (α_{ij}). In the second step, export-time effects (previously estimated) are regressed on monadic variables country fixed-effects (time-invariant). More precisely, in our model, the export-time effects will depend on GDP, exchange rates and the degree of port competition. These two steps can be illustrated in the following equations. In the first step, the model includes the three dimensions-varying variables, i.e. regional agreements.

$$LnX_{ijt} = \alpha_{it} + \alpha_{jt} + \alpha_{ij} + \beta ln\, Z_{ijt} + \varepsilon_{ijt} \qquad (3)$$

The second step corresponds to the following equation:

$$\hat{\alpha}_{it} = \upsilon_i + \gamma_t + \delta_1 lnY_{it} + \delta_2 lnCUR_{it} + \delta_4 lnHHI_{it} + \omega_{it} \qquad (4)$$

Where $\hat{\alpha}_{it}$ corresponds to the export-time fixed effects which are regressed on control variables, i.e. the exporting country GDP (Y_{it}), exchange rates (CUR_{it}), the variable of interest (port concentration HHI_{it} which captures the impact from port competition within a given area), a country fixed effect (υ_i) and an error term ω_{it}.

To estimate the port-competitive environment of the export and the import countries, we rely on the Hirschman-Herfindhal Index (HHI) that is calculated from the number of ports within a given area. This index is based on a varying radius that ranges from 100 to 1000 km, with 100 km increments. Expectations are that higher competition should lead to an increase in port efficiency, and therefore, to an increase in bilateral trade (De Oliveira and Cariou 2015).

Furthermore, reverse causation could also be in place since higher trade volumes might also contribute to develop their port network. In order to deal with this problem, we propose an instrument correlated with HHI index, but not with exports. This instrument, the degree of foreign competition, measures the ease with which the domestic market may be reached by foreign ports located in the vicinity. The accessibility for foreign ports to reach the domestic market should affect bilateral trade by improving the port-competitive environment of importer and exporter countries. This index is constructed as follows:

$$RI_{i,t} = \sum_{j=1}^{J} \frac{TEU_{j,t}}{DIST_{ij}}$$

Where $TEU_{j,t}$ is the traffic of the neighboring port *j* at period *t* located less than 1000 km from the main city of country *i*., D_{ij} is the distance between the main city of country *i* and port *j*.

4. Data and port competition index

We use a panel dataset of 73[1] countries covering a 16-year period dating from 2000 to 2015 at aggregated level with a maximum of 84,096 observations (73 × 72 × 16). All export values are taken from the UNCTAD database and are based on the Standard International Trade Classification (SITC) under Revision 3 and expressed in nominal values to avoid measurement error (Baldwin & Taglioni, 2006). As our focus is on containerized trade, and since fuels and mining products are not transported by container, we excluded bulk trade (SITC 2 and SITC 3) from the total export. GDP and GDP per capita data in nominal values are derived from the World Bank Development Indicators data series. The Regional Trade Agreement (TRA) variable is obtained from Larch's RTA Database from Egger and Larch (2008).

To construct proxies of on the port-competitive environment for these three scales, we rely on the Hirschman-Herfindhal Index (HHI) that is calculated from the market share of ports within a given area. To do so, we first gather information on traffic (in Twenty-equivalent Unit or TEU) for the two hundred ninety-two largest container ports in the world[2] from 2000 to 2015[3]. The sample represents 89% of world total TEU traffics in 2014. Second, we identify the number of ports for each degree of competition. The traffic in TEU for each port was then used to estimate the HHI concentration index so that $HHI_{ij} = \sum_{k=1}^{N} \eta_{ijk}^{2}$, where η_{ijk} is the market share of port k (in terms of TEU throughput) in the market defined by the distance j from the port i. N is the number of ports for configuration j. HHI is always between 1/N (pure competition) and 10,000 (monopoly). To calculate the HHI, we define 10 neighborhood radii for a distance[4] varying from 0 to 1000 km, with a 100 km increment.

5. Estimation and results

We use the panel data models described in Section 2 to measure the effect on trade of the level of competition in Container Port System. The main results are presented in Tables 1, 2 and 3. Compared to cross-sectional data, panel data can be applied to distinguish the specific effects across countries and capture the characteristics of concentration effect on trade over time.

The first three estimations of Table 1 control for multilateral resistance by using a remoteness index. Results reported in Table 1 show that traditional variables considered in gravity models are significant and show the expected signs. International trade increases with GDPs in country i and j.

Furthermore, the HHI variable is significant and with a negative sign, especially for exporting countries. For instance, an increase of one standard deviation of HH-500km exporter[5] reduces bilateral trade at least by 7.5 %. This finding confirms that an increase in port competition is favorable to trade development, especially in the port of origin. This result is particularly interesting as it contradicts the general assumption under which the predominance of a limited number of large ports in a country or a region could lead to more trade.

---

[1] Due to the unavailability of port statistics for some countries, the number of country pairs reduces to 5256. In 2015, those countries account for 75% of international trade value.

[2] The panel is balanced except for new ports, e.g. Tangiers for which data are available from 2008 onward

3 Sources are derived from Containerization International Yearbook 2001-2011, Lloyd's List Intelligence, Eurostat; the American Association of Port Authorities (AAPA), the UN-ECLAC database and port authorities.

4 The orthodromic distance between each port is calculated using the geodist stata module.

[5] The increase in trade is obtained by multiplying the coefficient and the standard deviation of port concentration index (0.075=-0.143*0.526). For instance, the standard deviation of HH-500km exporter is 0.526.

At this stage, estimates leave aside zero bilateral flows that are not considered, or about 7 percent of the sample. In a log-log model, most authors have solved this problem by adding one to each bilateral flow, then suppressing zero flows. In a more recent literature, the Poisson Pseudo Maximum Likelihood (PPML) can be used in order to address a bias related to log linearization (heteroscedasticity) and also to tackle the problem of zero-observations (Silva and Tenreyro 2006). The second column of Table 1 reports estimates from PPML procedure, i.e., PPML Fixed-Effects (PPML-FE). Results are quite stable compared to previous results. Traditional gravity variables remain significant and with the expected signs. Concerning the port competition, we note that its coefficient is also negative and significant.

Finally, in the third column of Table 1, we control for the potential endogeneity of the variable of interest by using the degree of foreign competition as an instrument for port-competitive environment. First, the F-statistics of the Cragg–Donald test of weak identification well exceeds the rule of thumb value (10) in the model. This suggests the strong partial correlation between the included endogenous variable and the excluded instrument in our study. The first-stage results (not reported here) suggest that our instruments are individually correlated with port competition. The result suggests that port competition is important not only for exporters, but also for importers.

The next three estimations in table 1, include bilateral fixed effect, importer-time effect, while the control of exporter multilateral resistance is done by modeling the exporter-time effect ($C_{i,t}$). The results are similar to those reported by the first methodology, which suggests that low ports competition tend to reduce trade. Concerning the potential endogeneity, we find as before, that the magnitude of the coefficient is larger when using instrumental variable.

The last two columns of table 1 correspond to the model with two steps. In the first step, our estimation follows Eq. (3) and includes exporter-time, importer-time and country-pair effects. Only the RTA has been introduced, since these variables vary over the three dimensions (i, j and t). By doing so, we control for all determinants that vary in those dimensions with it and jt (such as GDP and population in countries i and j) and also the time-invariant dyadic effects between two countries (such as distance, common language and border). Results provide unbiased estimates for $RTA_{ij,t}$. The coefficient of $RTA_{ij,t}$ are statistically significant and the positive coefficient indicates the importance of intra-regional trade.

In the second stage (last column in Table 1), the estimated first-stage fixed effects is used as dependent variable. The number of observations is less than 1168 (73*16) across specification due to missing data. The exporter-time effect represents the ability of a country to export to all destinations and it depends on the exporter GDP, the exchange rate and the level of port competition. The coefficient of the port concentration is significant with a negative sign. This finding confirms that port competition is favorable to trade development.

The last estimates provided in Table 2, 3 and 4 test whether port competition impacts trade. The trade-reducing effect of port concentration (trade-enhancing effect of competition) is generally observed, as respective coefficients are negative and significant. Furthermore, the effect from competition is larger from 300 to 900 km. These two results complement our previous findings by showing that when the geographical area used to measure competition increases, the impact of competition on trade also increases. The degree of competition at a local level has a limited impact on the export side and is even without any effect when we take into account the first perimeter (100km).

The impact increases when larger areas are used such as regional areas (300-700 km) or global level (more than 800 km). This interesting result shows that the existence of a quasimonopoly at a large geographical scale leads to a large trade-reducing effect. Consequently, remoteness that often goes in-hand with a port monopoly is a major determinant to explain poor bilateral trade development.

6. Conclusion

This paper empirically investigates the impact of port competition on trade developments. The integration of port-competitive environment in traditional augmented gravity models shows that: (i) a one-standard-deviation rise in port concentration leads to a reduction in bilateral trade by at least 7%; (ii) the trade-creation effect from port competition is greater on the export side than on the import side; and (iii) the effect on trade is higher when port competition intensity is measured at regional or global levels (more than 300 km) rather than at a local level.

These various findings tend to confirm that the variables considered in gravity models should not only consider maritime-related transport geographical attributes such as distance, port infrastructure and connectivity index, but also some market-related attributes such as the degree of competition. Hummel et al. (2009) stress this element when considering the level of competition in international container shipping, and our paper confirms that this accounts for the level of competition in international container ports. These initial findings could be refined in many ways. This could be done first, by a better definition of the pertinent market to assess competition by including, for instance, the origin and final destination of cargoes (hinterland). Second, this could be carried out by including indicators on the existence of market power for both shipping and port services. Third, replicating similar studies with trades other than container-related can further refine the initial findings. For instance, some of the major oil and dry bulk trades are largely dependent on a large but limited number of ports of origin and destination ports. For these markets, the degree of port competition could also be assumed to be one of the major determinants for trade development.

References:

Anderson, J E, and E. Van Wincoop. (2003) "Gravity with gravitas: a solution to the border puzzle*." American Economic Review* **93** (3), 170-192.

Anderson, J E, and E. Van Wincoop (2004) "Trade costs." *Journal of Economic literature* **42** (3), 691-751.

Arvis, J., Y. Duval, C. Utoktham, B. Shepherd and A. Raj (2015). "Trade Costs in the Developing World: 1995-2012". *World Trade Review* **15**(3), 451-474.

Baier, S. and J. Bergstrand (2001) "The growth of world trade: tariffs, transport costs, and income similarity." *Journal of international Economics* **53**(1), 1-27.

Baier, S. and J. Bergstrand (2007) "Do free trade agreements actually increase members' international trade?" *Journal of international Economics*, **71**(1), 72-95.

Baier S., J. Bergstrand and R. Mariutto (2014) "Economic Determinants of Free Trade Agreements revisited: Distinguishing Sources of Interdependence" *Review of International Economics*, **22**(1), 31-58.

Baldwin, R. and D. Taglioni (2006) "Gravity for Dummies and Dummies for Gravity Equations" *CEPR discussion paper* 5850.

Baltagi, B., P. Egger and M. Pfaffermayr (2003) "A generalized design for bilateral trade flow models". *Economics Letters*, **80**(3), 391-397.

Blonigen, B. and W. Wilson (2008) "Port efficiency and trade flows". *Review of International Economics,* **16**(1), pp.21-36.

Clark, X., D. Dollar and A. Micco (2004) "Port efficiency, maritime transport costs, and bilateral trade" *Journal of development economics* **75**(2), 417-450.
De Oliveira, G. and P. Cariou (2015) "The impact of competition on container port (in) efficiency." *Transportation Research Part A: Policy and Practice* **78**, 124-133.
Defilippi, E., and L. Flor. 2008. "Regulation in a context of limited competition: A port case." *Transportation Research Part A: Policy and Practice* **42**(5), 762-773.
Djankov, S., C. Freund and C. Pham (2010) "Trading on time" *The Review of Economics and Statistics* **92**(1), 166-173.
Egger, P. (2004) "On the problem of endogenous unobserved effects in the estimation of gravity models." *Journal of Economic Integration* **19**(1), 182-191.
Egger, P. and M. Larch (2008) "Interdependent Preferential Trade Agreement Memberships: An Empirical Analysis". *Journal of International Economics* **76**(2), 384-399.
Feenstra, R. (2002) "Border effects and the gravity equation: consistent methods for estimation" *Scottish Journal of Political Economy*, **49**(5), 491-506.
Haralambides H., P. Cariou, and M. Benacchio (2002) "Costs, benefits and pricing of dedicated container terminals." *International Journal of Maritime Economics* **41**(1), 21-34.
Harrigan, J. (1996) "Openness to Trade in Manufactures in the OECD" *Journal of International Economics*, **40**(1-2), 23-39.
Head, K. and T. Mayer (2014) "Gravity Equations: Workhorse, Toolkit, and Cookbook", in G. Gopinath, E. Helpman and K. Rogoff Editors, *Handbook of International Economics*, Volume 4, Elsevier, Ch.3, 131-195.
Hoekman, B., and A. Nicita (2011) "Trade policy, trade costs, and developing country trade." *World Development* **39**(12), 2069-2079.
Hummels, D., and V. Lugovskyy (2006) "Are matched partner trade statistics a usable measure of transportation costs?" *Review of International Economics*, **14**(1), 69-86.
Hummels, D., V. Lugovskyy, and A. Skiba (2009) "The trade reducing effects of market power in international shipping" *Journal of Development Economics* **89**(1), 84-97.
Korinek, J. and P Sourdin (2010) "Clarifying Trade Costs: Maritime Transport and Its Effect on Agricultural Trade" *Applied Economic Perspectives and Policy* **32**(3), 417-435.
Limao, N. and A. Venables (2001) "Infrastructure, geographical disadvantage, transport costs and trade" *The World Bank Economic Review* **15**(3), 451-479.
Luo, M., L. Liu, and F. Gao (2012) "Post-entry container port capacity expansion" *Transportation Research Part B: Methodological* **46**(1), 120-138.
Magee, C. (2008) "New measures of trade creation and trade diversion". *Journal of International Economics* **75**(2), 349-362.
Martínez-Zarzoso, I., and C. Suárez-Burguet (2005) "Transport costs and trade: empirical evidence for Latin American imports from the European Union." *Journal of International Trade & Economic Development* **14**(3), 353-371.
Martinez-Zarzoso, I. and S. Yang (2014) "A panel data analysis of trade creation and trade diversion effects: The case of ASEAN–China Free Trade Area" *China Economic Review* **29**, 138-151.
Matyas, L. (1997) "Proper econometric specification of the gravity model". *The World Economy*, **20**(3), 363-68.
Notteboom, T. and J-P. Rodrigue (2005) "Port regionalization: towards a new phase in port development" *Maritime Policy & Management* **32**(3), 297-313.
Notteboom, T. and J-P. Rodrigue (2012) "Dry ports in European and North American intermodal rail systems: Two of a kind?" *Research in Transportation Business & Management* **5**, 4-15.
Silva, J., and S. Tenreyro (2006) "The Log of Gravity" *Review of Economics & Statistics* **88**(4), 641-658.

World Economic Forum (2013) *The Global Competitiveness Report 2012-2013*
Wilson, J., C. Mann and T. Otsuki (2003) "Trade facilitation and economic development: A new approach to quantifying the impact" *The World Bank Economic Review* **17**(3), 367-389.
Yotov, Y., R. Piermartini, J. Monteiro and M. Larch (2016) *An advanced guide to trade policy analysis: The structural gravity model* Geneva: World Trade Organization.
Yuen, A., A. Zhang and W. Cheung (2013) "Foreign participation and competition: A way to improve the container port efficiency in China?" *Transportation Research Part A: Policy and Practice* **49**, 220-231.
Yuen, A. and A. Zhang (2009) "Effects of competition and policy changes on Chinese airport productivity: An empirical investigation" *Journal of Air Transport Management* **15**(4), 166-174.

Table1. Results with different methodologies

	Method 1			Method 2			Method 3	
	FE	PPML-FE	Instrument	FE	PPML-FE	Instrument	First step	Second step
$RTA_{ij,t}$	0.005	0.050	-0.026	0.003	0.070***	-.033	0.028*	
	(0.13)	(1.62)	(-1.02)	(0.16)	(4.27)	(-1.21)	(1.73)	
Ci				0.013***	0.024***	0.009**		
				(4.42)	(9.38)	(2.44)		
$Ln\ Y_{i,t}$	0.583***	0.569***	0.612***					1.279***
	(13.94)	(13.07)	(21.30)					(62.13)
$Ln\ Y_{j,t}$	0.861***	0.635***	0.916***					
	(25.26)	(18.13)	(36.46)					
$Ln\ CUR_{i,t}$	-0.005	0.078***	0.003					-0.009
	(-0.46)	(2.92)	(0.17)					(-0.49)
$Ln\ CUR_{j,t}$	-0.036**	0.066***	-0.483					
	(-2.19)	(3.47)	(1.27)					
$Ln\ REM_{i,t}$	0.104	-0.131	3.090**					
	(0.24)	(-0.36)	(2.01)					
$Ln\ REM_{ij,t}$	0.061	-0.528	6.298***					
	(0.15)	(-1.05)	(4.20)					
$Ln\ HHI_{i,t\ (500km)}$	-0.137**	-0.293***	-1.743**	-0.166***	-0.958***	-4.549***		-0.15**
	(-2.44)	(-4.44)	(-2.17)	(-5.72)	(-19.49)	(-5.38)		(-1.97)
$Ln\ HHI_{j,t\ (500km)}$	0.062	0.005	-3.103***					
	(1.13)	(0.09)	(-4.05)					
N	76278	84496	76960	77324	82176	76759	292533	1078
Exporter-time effects	No	No	No	No	No	No	Yes	Exporter effects
Importer-time effects	No	No	No	Yes	Yes	Yes	Yes	
Country-pair effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
Time -effect	yes	yes	yes	Yes	Yes	Yes	Yes	Yes
Under-identification test			131.58***			198.05***		
Weak instrument			65.83***			181.18***		

Note: Robust standard errors are in parentheses. ***, **, *, significantly different from 0, respectively 1%, 5% and 10.

Table 2: **First strategy: using a remoteness index and estimation by FE**

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
$RTA_{ij,t}$	0.003	0.004	0.003	0.002	0.005	0.005	0.005	0.005	0.004	0.005
Ln $Y_{i,t}$	0.581***	0.585***	0.585***	0.586***	0.583***	0.580***	0.579***	0.581***	0.575***	0.576***
Ln $Y_{j,t}$	0.862***	0.860***	0.861***	0.861***	0.861***	0.862***	0.862***	0.861***	0.863***	0.865***
Ln $CUR_{i,t}$	-0.003	-0.005	-0.003	-0.007	-0.005	-0.007	-0.005	-0.005	-0.003	-0.007
Ln $CUR_{j,t}$	-0.037**	-0.037**	-0.037**	-0.036**	-0.036**	-0.036**	-0.037**	-0.037**	-0.037**	-0.036**
Ln $REM_{i,t}$	-0.185	-0.028	0.143	0.301	0.104	0.098	0.127	0.146	0.065	0.032
Ln $REM_{j,t}$	0.186	0.124	0.150	0.087	0.061	0.085	0.125	0.048	0.105	0.017
$HHI_{i,t\ (100km)}$	-0.184*									
$HHI_{j,t\ (100km)}$	0.076									
$HHI_{i,t\ (200km)}$		-0.219***								
$HHI_{j,t\ (200km)}$		0.096								
$HHI_{i,t\ (300km)}$			-0.279***							
$HHI_{j,t\ (300km)}$			0.028							
$HHI_{i,t\ (400km)}$				-0.289***						
$HHI_{j,t\ (400km)}$				0.059						
$HHI_{i,t\ (500km)}$					-0.137**					
$HHI_{j,t\ (500km)}$					0.062					
$HHI_{i,t\ (600km)}$						-0.133**				
$HHI_{j,t\ (600km)}$						0.049				
$HHI_{i,t\ (700km)}$							-0.177***			
$HHI_{j,t\ (700km)}$							0.036			
$HHI_{i,t\ (800km)}$								-0.166***		
$HHI_{j,t\ (800km)}$								0.072		
$HHI_{i,t\ (900km)}$									-0.173***	
$HHI_{j,t\ (900km)}$									0.056	
$HHI_{i,t\ (1000km)}$										-0.132**
$HHI_{j,t\ (1000km)}$										0.109**
	(0.09)	(-0.06)	(-0.32)	(-0.49)	(-0.21)	(-0.23)	(-0.32)	(-0.25)	(-0.19)	(-0.04)
N	76278	76278	76278	76278	76278	76278	76278	76278	76278	76278

Table 3: Second strategy: modeling the exporter-time effect and estimation by FE

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
$RTA_{ij,t}$	0.003	0.004	0.003	0.001	0.005	0.005	0.006	0.005	0.003	0.003
C_{it}	0.020***	0.019***	0.020***	0.019***	0.019***	0.019***	0.019***	0.019***	0.019***	0.019***
$HHI_{i,t\ (100km)}$	-0.186***									
$HHI_{i,t\ (200km)}$		-0.202***								
$HHI_{i,t\ (300km)}$			-0.301***							
$HHI_{i,t\ (400km)}$				-0.308***						
$HHI_{i,t\ (500km)}$					-0.165***					
$HHI_{i,t\ (600km)}$						-0.193***				
$HHI_{i,t\ (700km)}$							-0.226***			
$HHI_{i,t\ (800km)}$								-0.207***		
$HHI_{i,t\ (900km)}$									-0.248***	
$HHI_{i,t}$ (1000km)										-0.206***
N	77324	77324	77324	77324	77324	77324	77324	77324	77324	77324

Note: Robust standard errors in parentheses. ***, **, *, significantly different from 0, respectively 1%, 5% and 10%.

Table 4: **Third method: a two-step model and estimation by FE**

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
lYi	1.284***	1.283***	1.284***	1.284***	1.289***	1.290***	1.283***	1.282***	1.286***	1.285***
l_CUR_o	-0.011	-0.014	-0.013	-0.016	-0.016	-0.016	-0.015	-0.016	-0.015	-0.017
HHI_10_o	-0.285**									
HHI_20_o		-0.305***								
HHI_30_o			-0.271***							
HHI_40_o				-0.214***						
HHI_50_o					-0.077					
HHI_60_o						-0.040				
HHI_70_o							-0.133**			
HHI_80_o								-0.151**		
HHI_90_o									-0.103	
HHI_100_o										-0.110
N	1065	1065	1065	1065	1065	1065	1065	1065	1065	1065

Note: Robust standard errors in parentheses. ***, **, *, significantly different from 0, respectively 1%, 5% and 10%. The dependent variable is the exporter-time effects obtained in Model 7 table 1.