Does Containerisation Reduce the Constraints Imposed by Distance in Seaborne Trade?

Ignacio del Rosal

Department of Applied Economics

University of Oviedo

Avenida del Cristo, s.n.

33006, Oviedo, Spain

Email: irosal@uniovi.es

ORCID ID: https://orcid.org/0000-0002-3047-398X

This manuscript has been published and is available at Maritime Policy & Management, https://www.tandfonline.com/ (04 Sept 2022), https://doi.org/10.1080/03088839.2022.2115572

Funding details

This work was supported by the Spanish Ministry of Science and Innovation (MCIN/AEI//10.13039/501100011033) under Grant PID2020-115183RB-C21.

Acknowledgements

The author with to thank the Associate Editor and two anonymous reviewers for their excellent comments and suggestions that substantially improved the paper.

Abstract

Containerisation has changed the geography of production, trade and distribution in the global economy. Particularly, the use of containers may have reduced the constraints imposed by distance. However, this hypothesis has not been specifically addressed in the literature, arguably due to a lack of available data. This paper makes use of the European Comext database and examines if there are significant differences in the effect of distance on EU containerised and non-containerised seaborne trade flows with third countries. The empirical results support the idea that containerization reduces the effect of distance on seaborne trade. The estimates of distance elasticity for containerised seaborne trade flows are smaller than those for non-containerised ones, both at the aggregate and sectoral levels. The container may bring remote and less developed countries closer to the central nodes of the world economy.

Keywords

Containerisation, seaborne trade, distance, containerised trade flows, non-containerised trade flows

1. Introduction

Sea transport is at the heart of the globalization of modern economies. The steady growth of trade between nations, the development of global supply chains and the arrival of China and other emerging economies as major players in the global economy all would not have been possible without maritime transport. To accommodate the growing demand for freight transport, the world shipping industry evolved and introduced important innovations in both bulk and containerised shipping. Among these innovations, the literature emphasizes the importance of the 'container revolution', which has changed the geography of production, trade and distribution in the global economy (Levinson 2016; Bernhofen, El-Sahli, and Kneller 2016; Rodrigue 2020). In particular, containerisation may have mitigated the constraints imposed by distance.

The robust adverse impact of distance on trade, one of the best-known empirical results in economics, has also been confirmed in the maritime literature (Guerrero, Grasland, and Ducruet 2016; Saeed, Cullinane, and Sødal 2021). This paper also explores the effect of distance on seaborne trade, investigating the hypothesis that containerisation reduces the constraints imposed by distance. It has been argued that containerisation increases the transportability of freight and that therefore the location of industry becomes less constrained by distance (Stopford 2009; Rodrigue 2020; Notteboom, Palli, and Rodrigue 2022). However, examination of this hypothesis has been challenging due to limitations in data availability, a common problem in maritime literature.

To get data about the importance of sea transport in world trade, the UNCTAD's *Review of Maritime Transport* is usually cited. For instance, UNCTAD (2016) states that sea transport was responsible for more than 80% of world merchandise trade in terms of volume in 2015, and about 60% in terms of value. Rodrigue (2020) gives similar figures, although the share of seaborne trade is higher at 90% in volume and

73% in value in 2008. Containerised cargo accounts for half of the value of seaborne trade (Valentine, Benamara, and Hoffmann 2013) and one quarter in terms of volume (UNCTAD 2019). Interestingly, all these references based their figures on data from private consultancy firms. It could be tempting to assume that no official statistics can be used to analyse the importance of seaborne trade. In this sense, Guerrero, Grasland, and Ducruet (2016) argues that the lack of studies of the patterns of maritime trade in the literature is due to a lack of trade statistics by transport mode.

In reality, official statistics on international trade with information about transport modes do exist. For instance, this information is available for key economies such as the US and the EU. According to the US Bureau of Transport Statistics[1], waterborne transport accounted for 69.9% of US international trade by volume in 2020 and for 40.2% in value terms. For the EU, Eurostat offers information through its Comext database[2]. In 2020, seaborne trade represented 74.1% of EU exports and 83.9% of EU imports in terms of volume, whereas the shares in terms of value were 41.4% and 51.2%, respectively. Thus, it can be said that, according to US and EU official statistics, sea transport handles around three quarters of international trade of goods in terms of volume and accounts for around half of value. These figures are quite close to those offered by the UNCTAD and those obtained from private firms.

Few papers in the maritime literature use official trade statistics which contain details about the mode of transport, which allows the measurement of seaborne trade flows. Another purpose of this paper is to show that public and official sources of data can be used to analyse patterns of seaborne trade at country level. Particularly, this paper

[1]See https://data.bts.gov/stories/s/International-Freight-Gateways/4s7k-yxvu.[Accessed 20/7/2022]
[2] See https://ec.europa.eu/eurostat/statistics-explained/index.php/International_trade_in_goods_by_mode_of_transport#Trade_by_mode_of_transport_in_value_and_quantity. [Accessed 20/7/2022]

makes use of the Eurostat's Comext database, a public database freely available for bulk download. A key difference in comparison with previous literature lies in the fact that the Comext database allows us to finely measure seaborne import and export flows between European Union and third countries. That is, the presence of information about the mode of transport means that seaborne trade flows can be correctly measured, not proxied from total (i.e. any mode of transport) trade flows. Furthermore, the availability of information regarding the use of containers also allows accurate measurement of two basic cargo types in maritime trade, containerised and uncontainerised. Making use of these data, this paper examines if there are significant differences in the effect of distance on containerised and uncontainerised seaborne flows, a hypothesis not addressed in the maritime literature due to a lack of accurate data.

The empirical results of this paper, both with aggregated and sectoral data, support the idea that containerisation reduces the effect of distance on seaborne trade. The adverse effect of distance is lower for containerised seaborne trade flows than for non-containerised ones. This differential effect of distance is also observed across sectors, although it appears to be more relevant for certain manufacturing sectors. Thus, this novel evidence highlights the importance of containerisation in fostering trade connectivity for countries.

The rest of the paper is organised as follows. Section 2 briefly reviews of the literature. Section 3 documents the main characteristics of the maritime trade between EU member states and the rest of the world. Section 4 details the methodology used to estimate the effect of distance on containerised and uncontainerised maritime trade flows and discusses the main econometric results. Section 5 provides the conclusions.

2. Literature review

The strong negative impact of distance on bilateral trade is one of the best-known empirical results in economics. Disdier and Head (2008) comprehensively analysed the gravity estimates of the distance elasticity in the literature and found that mean distance elasticity is around –0.9, with most estimates lying between –0.28 and –1.55. The distance effect is quite persistent. In maritime literature, a number of recent studies have confirmed the consistent negative impact of distance on maritime trade flows at country level (Korinek and Sourdin 2010; Martí and Puertas 2017; Guerrero, Grasland, and Ducruet 2016; Fugazza and Hoffmann 2017; Hoffmann, Saeed, and Sødal 2020; Saeed, Cullinane, and Sødal 2021; Dunford, Liu, and Xue 2020). The same occurs when seaborne traffic is analysed at port level (Ducruet and Notteboom 2012). In general, the distance elasticity estimates for seaborne trade lie in the same range as in the literature reported in Disdier and Head (2008). Guerrero, Grasland, and Ducruet (2016) confirmed that distance is important in explaining the geographical distribution of trade flows, although distance is somewhat less relevant for 'containerisable' flows.

In fact, the container may have changed the relationship between distance and trade flows. Since its introduction into international seaborne trade in 1966, the container has become the workhorse of global trade. In the decades since, the volume of container cargo has grown much faster than world economic activity and world trade, but also much faster than other types of maritime shipping, thus becoming one of the most dynamic factors in globalization (Stopford 2009; Notteboom, Palli, and Rodrigue 2022). This growth of seaborne containerised trade has been concentrated in three groups of routes on the East-West axis: the Trans-Pacific, the Trans-Atlantic and the Europe-East Asia lines (see, e.g., Valentine, Benamara, and Hoffmann 2013). China clearly predominates in containerised trade flows, with the highest scores by far on the Liner

Shipping Connectivity Index created by the UNCTAD (2019). Moreover, containerisation has been a key driver of intermodal transportation, providing a wide array of logistic advantages such as, among others, standardisation of the load unit, flexibility for carrying a great variety of goods, simplification of management, warehousing and security as well as increases in operational speed and reduction in transport time (Rodrigue 2020). The reduction in transport cost resulting from these advantages is important. Thanks to containerization, maritime transport costs may have been reduced from 5-10% to about 1.5% of the retail price, depending on the type of goods (Rodrigue 2020, 202). These cost savings have transformed world economic geography, encouraging global sourcing strategies by international firms and the shaping of global supply chains. In this new scenario, distance keeps its traditional role as a key impediment to bilateral trade, but arguably its effect has been reduced. The development of containerization and intermodal transportation has improved “the velocity of freight” and caused “a decrease of the friction of distance and a spatial division of production” (Rodrigue 2020, 269). With the use of containers, “distance from the market and transport costs became a less important consideration in the location of manufacturing industry” (Stopford 2009, 512). Container shipping networks have “significantly shortened the maritime cost distances between production and consumption centers around the world” (Notteboom, Palli, and Rodrigue 2022, 7), and “a key advantage of maritime shipping is that it substantially attenuates the negative effects of long distances on trade, as the development of containerized shipping underlines” (12).

Analysis of the effects of containerization on maritime trade at country level is challenging due to the fact that information about the use of containers, or even the mode of transport, is not as available as one would like. Clark, Dollar, and Micco

(2004) studied the sources of shipping cost using detailed maritime data from the US Department of Transportation, including shipping characteristics such as the degree of containerization. Wilmsmeier and Martínez-Zarzoso (2010) studied seaborne trade costs with a sample comprising data on containerised seaborne trade flows between 21 Latin American and Caribbean countries. Coşar and Demir (2018) documented how containerisation affects transport costs using confidential micro data from Turkish exporting firms obtained from official customs records. In a number of papers general trade data lacking details concerning the transport mode and the container adoption is somewhat refined to include only 'highly containerisable' goods, i.e. goods with a clear likelihood of being containerised (Wilmsmeier, Hoffmann, and Sanchez 2006; Guerrero, Grasland, and Ducruet 2016; Fugazza and Hoffmann 2017; Hoffmann, Saeed, and Sødal 2020; Saeed, Cullinane, and Sødal 2021). A similar strategy of 'containerisability' for proxying containerised flows was followed by Bernhofen, El-Sahli, and Kneller (2016) and Bertho, Borchert, and Mattoo (2016). Very different sources of data are used by a large body of literature that studies seaborne flows at the port level, including topics such as port connectivity and shipping networks (see, e.g., the recent review by Ducruet 2020). This vast literature is based on accurate data about inter-port vessel movements, containership movements, liner schedule data, etc. These newly available data always come from private consulting firms.

Finally, official trade statistics allowed a proper measurement of containerised trade in very few cases. In a related paper, Del Rosal and Moura (2022) made use of Comext database to analyse the effects of liner shipping connectivity on maritime containerised trade. Using a gravity equation, the authors found a positive impact of UNCTAD's Liner Shipping Bilateral Connectivity Index (LSBCI) on seaborne containerised trade flows in manufactures between coastal EU and partner countries. To deal with the endogeneity of shipping connectivity, country-pair fixed effects were included in the gravity model so time-invariant determinants such as distance cannot be identified. Unlike previous work, the present paper focuses on the effect of distance on containerised and uncontainerised maritime trade, both at the aggregate and disaggregate levels. Furthermore, the analysis is not restricted to coastal countries. Additionally, this paper also documents in some detail the main characteristics of seaborne trade between EU countries and their partners in the next section.

3. EU seaborne trade

The European Union provides access to international trade in goods statistics with the Comext database[3]. Maintained by the European Statistical Office (Eurostat), Comext comprises several datasets, providing data on the value and quantity of the trade flows between EU countries and their partners, according to different product classifications. For analysing seaborne trade, the ‘Transport_NSTR’ dataset is especially interesting because it provides details about the mode of transport of the trade flow and whether or not the cargo is containerised. This detailed information, extracted from the mandatory administrative documents that are needed for customs clearance, is only available for trade between EU countries and their non-EU partners. The complete information, including transport mode and container usage, is available for the 28 EU countries since 2010, although for Croatia the information is only complete from 2013 onwards. Comext’s ‘Transport_NSTR’ dataset owes its name to the product classification used to provide the trade data, the Nomenclature uniforme des marchandises pour les

[3] See https://ec.europa.eu/eurostat/web/international-trade-in-goods/data/focus-on-comext [Accessed 20/7/22]. Comext database is available at https://ec.europa.eu/eurostat/data/bulkdownload. [Accessed 20/7/22]

Statistiques de Transport, Révisée (NSTR). Finally, it is important to note that the mode of transport identifies how goods leave or enter the EU. This implies that EU landlocked countries such as Austria, for instance, will report import and export seaborne flows with non-EU countries, which in turn may be coastal or landlocked. Thus, the seaborne trade between EU countries and their partners documented in this paper does not exclude landlocked countries.

Official statistics on international trade with information regarding the mode of transport and/or container usage are available for other countries such as the US. With a worldwide reach, the United Nations' COMTRADE is the most used database in gravity as well as maritime literature, despite its lack of information about how the cargo is handled, i.e. which mode of transport is used. As of a few years ago, COMTRADE now includes information about the mode of transport of trade flows for a growing number of reporting countries. However, information about container usage is not available in COMTRADE and its inclusion is not planned, a fact that emphasizes the importance and usefulness of databases such as Comext.

Figure 1 shows the transport mode distribution of EU trade flows with Rest-of-the-World (ROW) countries, in both value and volume (metric tons) terms. As expected, maritime trade clearly is the most important mode of transport for EU export and import flows. Around 50% of EU trade flows in terms of value is carried by sea, whereas the percentage share is close to 80% in volume. These figures are similar to those reported in UNCTAD (2016), although transport by sea plays a lesser role in value terms in the case of EU trade. Furthermore, the importance of seaborne trade is quite stable over the period 2010 to 2019. Air transport is becoming more relevant in terms of value, but its importance in terms of volume is negligible, at less than 1%. Road transport also has a significant role in both value and volume terms and especially so in the former. Table 1 details the transport mode breakdown by trade flow for the whole period 2010 to 2019. In value terms, the role of seaborne trade is somewhat more important for import flows than for export ones, mainly due to the fact that air and road transport are relatively more frequent in EU exports. In terms of volume, the clear pre-eminence of sea transport is very similar for both trade flows, with a slightly large share in EU exports. Table 1 also shows a breakdown of the 'Other' category. Fixed transport installations such as pipelines are the most relevant, especially in EU imports in volume terms.

[Figure 1 near here]

[Table 1 near here]

Focusing on sea transport, Figure 2 shows the extent of containerisation in EU trade flows. The left panel of Figure 2 plots the percentage share in value terms of containerised export and import flows. As can be seen, containerisation is below 50%, in the 30-40% range for imports and 40-50% for exports. The share in value increases for both flows until 2015-2016, but there is some reduction after that. When containerisation of EU seaborne trade is analysed in volume terms (right panel of Figure 2), the most noticeable characteristic is the increased difference between the flows, being around 20 percentage points higher in EU exports. As expected, containerisation is lower in volume terms and quite stable for both flows.

[Figure 2 near here]

Containerisation shows the same pattern, higher in value terms and for EU export flows, when analysed by sector. Table 2 shows the percentage shares of containerised cargo in EU trade flows at the sectoral level for the whole period 2010 to 2019. The sectors are defined as 1-digit categories of the NSTR product classification (NSTR1). Containerisation is higher in EU export flows in both value and volume terms for all industries with the exception of machinery, transport equipment and manufactured articles. Containerisation reaches three quarters of EU exports in value terms in two industries, one being foodstuffs and animal fodder, and the other crude and manufactured minerals and building materials. EU exports in foodstuffs and animal fodder also show the highest degree of containerisation in volume terms. Not surprisingly, the use of containers is negligible in industries such as petroleum products. The same occurs for EU import flows in solid mineral fuels and fertilizers, although containerisation is considerably higher in the corresponding EU export flows. Arguably, the gap in containerisation between EU export and import flows in these industries, and in others such as foodstuffs and animal fodder, may reflect differences in product processing.

[Table 2 near here]

Table 3 gives more information about EU containerised and non-containerised seaborne trade by sector for the whole period from 2010 to 2019. The NSTR1 sector comprising machinery, transport equipment and manufactured articles is the most important by far in value terms, accounting for about half of EU imports and exports with ROW countries. It is followed in importance by petroleum products, chemicals and foodstuffs and animal fodder. In volume terms, petroleum products clearly predominate accounting for more than 40% of total EU seaborne cargo in the 2010-2019 period. They are followed by solid mineral fuels and ores and metal waste. Naturally, as was already shown in Table 2, maritime shipping in these sectors is largely dominated by bulk cargo. The importance of machinery, transport equipment and manufactured articles is also reflected in EU trade in volume terms, especially in containerised shipping, accounting for one third of total containerised cargo. Finally, Table 3 also depicts average value/weight ratios. As expected, there is great heterogeneity in terms of value to weight ratio. On the one hand, the differences by sector follow the logic that one would expect, with lower value/weight ratios in raw materials and intermediate products such as solid mineral fuels and crude and manufactured minerals, building materials, and higher ratios for manufactures, foodstuffs and chemical and metal products. On the other hand, and more interestingly because this evidence is rarely documented in the maritime literature, the average value/weight ratio is greater in containerised trade across sectors, a fact that also makes sense. But there is an important exception: the value/weight ratio is higher for non-containerised seaborne trade in manufactures (though the difference is not as large as in other sectors for containerised flows). This highlights the fact that other forms of break-bulk shipping are important in manufactures trade; for instance, roll-on/roll-off shipping used to transport new cars and trucks from assembly plants to main buyer markets (see, e.g., Stopford 2009). This is an important example of non-containerised seaborne trade in manufactures, especially in the EU case, and contributes to explain the high average value to weight ratio.

[Table 3 near here]

It would be interesting to have further information about shipping conditions. In particular for non-containerised maritime trade, which is comprised of two main types of cargoes, bulk and general, which are carried by different types of ships such as bulk ships, general cargo ships, roll-on/roll-off ships and ferries. More detail about non-containerised shipping would allow a nuanced analysis, but this information does not exist in the Comext database. Nevertheless, the reported facts about EU trade are of interest because there is not much literature documenting the degree of containerisation in maritime trade flows at the country level. Rodrigue (2020) stated that containerised freight has grown substantially in recent decades, rising to 85% of all non-bulk cargo in 2015. Valentine, Benamara, and Hoffmann (2013) reported that containerised cargo accounted for 52% of the value of seaborne trade in 2007. According to UNCTAD's *Review of Maritime Transport*, around one quarter of international maritime trade in volume is containerised (UNCTAD 2019). When comparable, Comext data for seaborne trade flows between EU and ROW countries show somewhat lower figures for containerisation. In the aggregate for the whole period 2010-2019, the degree of containerisation for EU seaborne trade is 39.5% in value and 14.7% in volume. However, Tables 2 and 3 clearly show that containerisation is more prevalent in some manufacturing industries. To make a better comparison, it would be desirable to see information from the UNCTAD and other institutional/official sources about the importance of containerisation in seaborne trade flows with some breakdown by sector.

4. Empirical analysis

4.1. Methodology and data

This section is concerned with the distance deterrent effect on seaborne trade flows. Particularly, the main empirical question to investigate is how distance affects containerised and uncontainerised maritime trade, an issue that has not been investigated in the literature so far. It can be hypothesized that the distance elasticity of maritime trade will be lower for containerised flows, for at least two economic reasons. First and most important, it can be argued that the container revolution and modern intermodal transport have reduced transport costs and shortened distances (Stopford 2009; Rodrigue 2020; Notteboom, Palli, and Rodrigue 2022). Second, there is some previous evidence of the effect of distance on homogeneous and bulky goods (Berthelon and Freund 2008), suggesting that distance elasticity may be larger for non-containerised trade flows.

How distance affects seaborne trade flows between EU countries and their partners is investigated using a gravity equation, surveyed for transportation economics in Baier, Kerr, and Yotov (2018). Several empirical issues important for the proper specification and estimation of a gravity equation are well known in the literature. Two methodological issues are especially noteworthy. First, the gravity equation formulated in multiplicative form and estimated using a Pseudo Poisson Maximum Likelihood (PPML) estimator is currently the most used alternative in the literature. The gravity equation in multiplicative form can account for zero trade flows and the PPML estimator is robust to the heteroskedasticity problem that is present in trade data (Santos Silva and Tenreyro 2006). And second, gravity specification should include inward and outward multilateral resistance terms (Anderson and Van Wincoop 2003). These multilateral resistance terms are unobservable but can be controlled for by exporter-year and importer-year fixed effects when panel data is used (see, e.g., Baier, Kerr, and Yotov 2018).

In line with these considerations, the first econometric specification of the gravity equation examines aggregated seaborne trade flows between EU countries and their partners:

$$X_{ijt} = exp[\beta_1 lnDistance_{ij} + \beta_2 Contiguity_{ij} + \beta_3 Island_{ij} + \beta_4 Landlooked_{ij} + \beta_5 Colony_{ij} + \beta_6 Language_{ij} + \eta_{it} + \lambda_{jt}] + \varepsilon_{ijt} \qquad (1)$$

where *i* denotes the exporter, *j* the importer and *t* denotes time. The nominal seaborne trade flow from exporter country *i* to importer country *j* at time *t* (X_{ijt}) are related to the log of the distance between *i* and *j* and several gravity indicators. $Contiguity_{ij}$ is an indicator variable with a value equal to 1 if countries *i* and *j* have a common border, and 0 otherwise; $Island_{ij}$ is an indicator variable with a value equal to 1 if both *i* and *j* are islands countries, and 0 otherwise; $Landlocked_{ij}$ is an indicator variable with a value equal to 1 if both *i* and *j* are landlocked countries, and 0 otherwise; $Colony_{ij}$ is an indicator variable with a value equal to 1 when countries *i* and *j* have colonial ties, and 0 otherwise; and $Language_{ij}$ is an indicator variable with a value equal to 1 when the same official language is used in countries *i* and *j*, and 0 otherwise. Finally, η_{it} and λ_{jt} are respectively the exporter-year and importer-year fixed effects and ε_{ijt} is the error term.

An important difference with previous literature is that three alternatives for the dependent variable X_{ijt} are considered in this paper: total seaborne trade, containerised seaborne trade and non-containerised seaborne trade. The estimation of equation (1) with these three alternative dependent variables will show if there are significant differences in the estimates for the main parameter of interest, distance elasticity (β_1). Thus, the availability of these alternatives for the dependent variable allows examination of the hypothesis about reduction of the distance effect for containerised seaborne trade flows. As was previously pointed out, non-containerised seaborne trade is a more heterogeneous category, comprising several types of cargo that require different modes of shipping. In this sense, the distance elasticity for non-containerised seaborne trade can be better understood as the average effect that distance has on these types of cargo. The data at hand do not allow a finer analysis of non-containerised seaborne trade, but the results may be qualified with estimation results at the sectoral level.

Therefore a gravity equation for sectoral seaborn trade flows is also estimated. The econometric specification of the gravity equation for each class of sector takes the following form:

$$X_{ijt}^{k} = exp[\beta_1^k lnDistance_{ij} + \beta_2^k Contiguity_{ij} + \beta_3^k Island_{ij} + \beta_4^k Landlooked_{ij} + \beta_5^k Colony_{ij} + \beta_6^k Language_{ij} + \eta_{it}^{k} + \lambda_{jt}^{k}] + \varepsilon_{ijt}^{k} \quad (2)$$

where *k* is the NSTR1 sector, as in Tables 2 and 3. In Equation (2), the nominal seaborne exports in sector *k* from country *i* to country *j* in year *t* is related with the same regressors as in Equation (1). In this disaggregated analysis, two alternatives for the dependent variable X_{ijt}^{k} will be considered, containerised seaborne trade and non-containerised seaborne trade. The main interest lies in comparing the sectoral estimates of the distance elasticity β_1^k for these two types of seaborne cargo, containerised and non-containerised.

The data sources are as follows: Comext data for the period 2010-2019, described in Section 3, is used to compute the different versions of the dependent variable, both at the aggregate and sectoral (NSTR1) levels. Data on bilateral distance between countries comes from the CERDI-seadistance database (Bertoli, Goujon, and Santoni 2016). For any country pair, the measure of distance is the result of adding the sea distance between the relevant port of the two countries as well as the road distances between the capital of each country and its relevant port (see Bertoli, Goujon, and Santoni 2016 for details). Data for the geographical and cultural dummies are from the Dynamic Gravity dataset[4].

The sample comprises 27 EU and 183 ROW countries[5]. The maximum number of observations therefore is 27x183x2x10 = 98,820, including zero-trade flows. The presence of zeros is moderate at the aggregate level (27% with total seaborne trade, for instance), but can be majority at the sectoral level, especially for some NSTR1 sectors such as solid mineral fuels in which the share of zero-trade flows reaches 90%. The actual number of observations included in the regressions will be below the maximum due to the presence of 'singletons' (groups defined by the fixed effects included in the regressions that are observed only once). According to Correia (2015), singletons have to be eliminated to avoid bias in the standard errors. This issue is more relevant for the sectoral regressions. Finally, the statistical inference is based on multiway cluster-robust standard errors (Egger and Tarlea 2015).

4.2 Results

Table 4 shows PPML estimation results with aggregated seaborne trade between EU countries and their partners. Columns (1) - (3) report the results of running Equation (1) for three alternative dependent variables: total, containerised and uncontainerised maritime trade respectively. The main interest lies with the point estimates of β_1, the

[4] See https://www.usitc.gov/data/gravity/dgd.htm. [Accessed 20/7/22]
[5]The information about container usage for Croatia trade flows is missing for the first three years of the sample, so this EU reporting country is excluded from the sample. The 183 ROW countries included in the sample have at least one non-zero export and import seaborne flow with the EU in the sample period 2010 to 2019 and have data on sea distance.

distance elasticity. The estimates are statistically significant at the 1% level in all three cases. Column (1) shows that total seaborne trade is inversely proportional to distance. The coefficient β_1= –1.015 indicates that a 10% increase in sea distance should generate a 10.15% decrease in seaborne trade. The most interesting results so far, however, are the estimates of the distance elasticity with containerised and non-containerised trade flows. These estimates are –0.639 and –1.151, respectively. These results imply that the deterrent effect of distance is larger, in fact nearly double, with seaborne non-containerised trade flows. We recall that the distance elasticity estimate for non-containerised trade flows averages the effect for the different types of cargo which make up this definition of the dependent variable. Nonetheless, it can be said that containerisation reduces the constraints of distance in seaborne trade between EU and ROW countries. To the best of my knowledge, this is the first consistent evidence favouring the hypothesis that the use of containers reduces the effect of distance on trade.

Table 4 also reports the estimated coefficients for the gravity controls. Common border only has a statistically significant effect when the regressand is containerised trade, this effect being negative. Although sharing a common border usually increases trade in gravity estimations, there is previous evidence showing that the effect is negative for seaborne trade flows (Bertho, Borchert, and Mattoo 2016). Insularity in both partners does not have a statistically significant effect on total and uncontainerised trade, but the effect is positive and statistically significant for containerised trade flows. Seaborne trade is reduced if both partners are landlocked, but this negative effect is only statistically significant for non-containerised flows, being sizable but imprecisely estimated for total trade flows and negligible for containerised trade. In sum, the estimated coefficients of these geographical gravity variables seem to indicate that containerisation may alleviate the isolation and landlockedness of countries. Finally, cultural ties (colonial relationships and common languages) have positive and significant impact on seaborne trade, except in the case of common language for containerised flows.

[Table 4 near here]

Table 5 provides regression evidence at the sectoral level (NSTR1). Panel A of Table 5 shows the regression results for seaborne containerised trade flows, while panel B shows the regression results for non-containerised ones. For the sake of completeness, the results for all 10 NSTR1 sectors with both dependent variables are reported in Table 5, although the degree of containerisation for some sectors such as solid mineral fuels and petroleum products is very marginal (recall Table 2). The standard errors are also three-way clustered by exporter, importer and year, but not reported to save space. Again, the main interest lies with the point estimates for the distance elasticity at the sectoral level (β_1^k). These estimates are correctly signalled and show statistical significance for the majority of NSTR1 sectors. With containerised trade flows, statistically significant estimates of the distance elasticity range from –0.401 (fertilizers) to –0.955 (agricultural products and live animals). With non-containerised trade flows, significant estimates of β_1^k range from –0.590 (fertilizers) to –1.242 (foodstuffs and animal fodder). Although there is variability in the distance effect across sectors, the general conclusion that emerges is in line with the aggregate regression results, indicating that the deterrent effect of distance on seaborne trade is reduced when the cargo is containerised. Only in one case, ores and metal waste, is the effect of distance similar for both types of cargo. On the contrary, containerisation nearly halves the distance effect for key sectors such as machinery, transport equipment and manufactured articles. The reduction of the negative impact of distance on trade is also noteworthy in other manufacturing sectors such as chemicals and metal products. In the case of foodstuffs and animal fodder, the distance elasticity with non-containerised cargo is –1.242, but only –0.217 with containerised cargo (although not significant). Finally, the estimates for gravity variables show considerable variability, although in some cases there is somewhat more homogeneity. Colonial ties have a prevailingly positive effect for both containerised and non-containerised trade flows across sectors, while contiguity is negatively related with containerised trade for most sectors. The same occurs when both countries are landlocked with non-containerised trade, although with some exceptions (Ores and metal waste).

[Table 5 near here]

The significant estimates of the distance elasticity reported in Tables 4 and 5 lie within the normal range observed in gravity literature (Disdier and Head 2008). The results can be also compared with the sectoral estimates of Berthelon and Freund (2008), although their analysis does not specifically refer to seaborne trade. The increased sensitivity to distance of homogeneous and bulky goods found by these authors could in fact be more related to the possibilities of containerisation of cargo rather than the exact nature of goods, in the sense that the results in Table 5 show that the distance effect is lower for containerised cargo across sectors. Overall, the point estimates of the distance elasticity are similar to those obtained in other studies on seaborne trade. For instance, the results in Table 4 showing that aggregated seaborne trade is inversely proportional to distance can also be found in papers such as Bertho, Borchert, and Mattoo (2016). In other papers, the distance effect is somewhat lower (see, e.g., Martí and Puertas 2017) or higher (see, e.g., Dunford, Liu, and Xue 2020). It should be born in mind that trade flows actually carried by sea are not accurately measured but proxied with total trade in the majority of cases. The distance elasticities for agricultural products reported in Table 5 are comparable with those reported by Korinek and Sourdin (2010). The results are also in line with the conclusion of Guerrero, Grasland, and Ducruet (2016) that distance is less relevant for 'containerisable' trade flows, although the results reported in Tables 4 and 5 are based on accurate measures of containerised and uncontainerised maritime trade.

The estimation results across sectors also help when assessing the significance of the differences obtained for containerised and uncontainerised maritime trade. Arguably, the hypothesis that containerisation mitigates the distance effect is more relevant for general cargo, i.e. cargo that can be containerised or not, although previous evidence such as Berthelon and Freund (2008) also calls for considering bulk cargo. Sectoral estimates show that the reduction of the distance effect is clearer in manufacturing NSTR1 sectors (machinery, transport equipment and manufactured articles, chemicals, metal products and foodstuffs and animal fodder), i.e. industries that generate general cargo trade which can be carried by container ships, roll-on/roll-off vessels, general cargo vessels, ferries, etc. In this sense, the estimation results for the NSTR1 sector of machinery, transport equipment and manufactured articles (the most relevant by far, as can be shown in Table 3) are especially noteworthy. Arguably, bulk cargo in this sector would have a relatively minor role if any, so the difference in the distance elasticity estimates (–0.650 for containerised, –1.204 for non-containerised) is statistically and economically significant: compared with other break-bulk shipping, containerization reduces the negative effect of distance.

To sum up, the results documented in this paper are consistent with the idea that the containerisation of cargo in seaborne trade reduces or mitigates the deterrent effect of distance. The regression evidence is clear with both aggregated and sectoral data. The attenuation of the distance effect in maritime trade through containerisation appears to be important for manufacturing sectors.

5. Concluding discussion

Containerisation is one of the most decisive innovations in transport logistics, especially in maritime shipping. However, there is a lack of systematic analysis of its importance in maritime trade flows, mainly due to limitations in trade data sources. In this sense, a first major impediment has been the absence of information about the mode of transport in trade statistics. Even more problematic is knowledge about the use of containers, making evidence about the role of containerisation in maritime trade more sporadic and fragmented.

In this article, the Comext database regarding trade flows between EU countries and their partners has been utilised for analysing the patterns of EU maritime trade flows, focusing on the degree of containerisation. Over the study period of 2010 to 2019, 51% of the value of EU countries’ external trade and 78% of its tonnage was carried by sea. These basic figures confirm the crucial importance of maritime transport, especially in terms of weight. Looking at the importance of containerisation in EU maritime shipping, the picture changes: the share of containerisation is high in terms of value, around 40%, but much lower in volume terms, 15%. Furthermore, EU maritime exports show higher containerisation than imports. In general, these figures indicate a slightly less significant role for containerisation in maritime shipping than previous evidence suggested.

The conventional wisdom in the literature is that containerisation reduces the negative impact of distance on seaborne trade. A motivation for this paper was the little empirical support for this hypothesis, mainly due to the unavailability of the data needed for obtaining quantitative estimates of the average effect of distance on containerised and uncontainerised maritime trade. Using Comext data, the findings of this paper show that containerisation mitigates the impact of distance on seaborne trade. Both with aggregated and sectoral data, the estimates of the elasticity of seaborne trade flows with respect to distance are larger in absolute terms for non-containerised flows than for containerised flows. The differential effect of distance appears to be especially noteworthy for certain manufacturing sectors.

There are interesting issues not addressed in the paper that offer fruitful directions for future research. For instance, it is worth exploring potential geographical differences that may exist in the reduction of the distance effect documented in this paper, such as differences between East-West and North-South trade. Similarly, the descriptive evidence about weight to value ratios is compelling and may be important for future applied work, for instance as a determinant of transport costs. The analysis of the distance effect for different types of bulk and general cargoes is another avenue for future research that the evidence shown in this paper encourage us to explore, although it would require nuanced data.

It would be naïve not to recognise that additional research will depend on data availability, because trade data with shipping details are sparse. In fact, it is difficult to understand why the use of containers, something so ‘revolutionary’ for world trade, has been measured so poorly in official statistics, when in many cases these details are present in the documents for customs clearance, as the EU case shows. Future availability of data with this type of information for a larger number of countries is badly needed. Furthermore, international institutions such as the UNCTAD should disseminate more nuanced data about the global container usage, with breakdown by sector and industry for example.

Finally, the empirical evidence shown in this paper supports the idea that containerisation reduces the constraints imposed by distance. Therefore, this evidence underlines the importance of containerisation for political initiatives aimed at fostering trade connectivity via trade-related infrastructure development, improvements in logistics performance and the promotion of better liner shipping connectivity (OECD/WTO 2017; Arvis et al. 2018; UNCTAD 2017). Being the key element in intermodal transportation, the container may bring closer remote and less developed countries to the central nodes of the world economy.

References

Anderson, James E., and Eric Van Wincoop. 2003. “Gravity with Gravitas: A Solution to the Border Puzzle.” *American Economic Review* 93 (1): 170–192. doi:10.1257/000282803321455214.

Arvis, Jean-François, Lauri Ojala, Christina Wiederer, Ben Shepherd, Anasuya Raj, Dairabayeva Karlygash, and Kiiski Tuomas. 2018. *Connecting to Compete 2018. Trade Logistics in the Global Economy*. Washington: The International Bank for Reconstruction and Development/The World Bank.

Baier, Scott L, Amanda Kerr, and Yoto V. Yotov. 2018. “Gravity, Distance, and International Trade.” In *Handbook of International Trade and Transportation*, edited by Bruce A. Blonigen and Wesley W. Wilson, 15–78. Cheltenham (UK): Edward Elgar.

Bernhofen, Daniel M., Zouheir El-Sahli, and Richard Kneller. 2016. “Estimating the Effects of the Container Revolution on World Trade.” *Journal of International Economics* 98: 36–50. doi:10.1016/j.jinteco.2015.09.001.

Berthelon, Matias, and Caroline Freund. 2008. “On the Conservation of Distance in International Trade.” *Journal of International Economics* 75 (2): 310–320. doi:10.1016/j.jinteco.2007.12.005.

Bertho, Fabien, Ingo Borchert, and Aaditya Mattoo. 2016. “The Trade Reducing Effects of Restrictions on Liner Shipping.” *Journal of Comparative Economics* 44 (2): 231–242. doi:10.1016/j.jce.2016.03.001.

Bertoli, Simone, Michaël Goujon, and Olivier Santoni. 2016. The CERDI-Seadistance Database. halshs-01288748.

Clark, Ximena, David Dollar, and Alejandro Micco. 2004. “Port Efficiency, Maritime Transport Costs, and Bilateral Trade.” *Journal of Development Economics* 75: 417–450. doi:10.1016/j.jdeveco.2004.06.005.

Correia, Sergio. 2015. “Singletons, Cluster-Robust Standard Errors and Fixed Effects: A Bad Mix.” Unpublished Working Paper, November 2015: 1–5. Available at http://scorreia.com/research/singletons.pdf .

Coşar, A. Kerem, and Banu Demir. 2018. “Shipping inside the Box: Containerization and Trade.” *Journal of International Economics* 114: 331–345. doi:10.1016/j.jinteco.2018.07.008.

Del Rosal, Ignacio, and Ticiana Grecco Zanon Moura. 2022. “The Effect of Shipping Connectivity on Seaborne Containerised Export Flows.” *Transport Policy* 118: 143–151. doi.org/10.1016/j.tranpol.2022.01.020.

Disdier, Anne Célia, and Keith Head. 2008. “The Puzzling Persistence of the Distance Effect on Bilateral Trade.” *Review of Economics and Statistics* 90 (1): 37–48. doi:10.1162/rest.90.1.37.

Ducruet, César. 2020. “The Geography of Maritime Networks: A Critical Review.” *Journal of Transport Geography* 88 (June). doi:10.1016/j.jtrangeo.2020.102824.

Ducruet, César, and Theo Notteboom. 2012. “The Worldwide Maritime Network of Container Shipping: Spatial Structure and Regional Dynamics.” *Global Networks* 12 (3): 395–423. doi:10.1111/j.1471-0374.2011.00355.x.

Dunford, Michael, Zhigao Liu, and Jiashun Xue. 2020. “Chinese Overseas Ports: Market Potential, Supply Capacity and Access to Imports.” *Journal of Geographical Sciences* 30 (10): 1681–1701. doi:10.1007/s11442-020-1807-7.

Egger, Peter H., and Filip Tarlea. 2015. "Multi-Way Clustering Estimation of Standard Errors in Gravity Models." *Economics Letters* 134: 144–147. doi:10.1016/j.econlet.2015.06.023.

Fugazza, Marco, and Jan Hoffmann. 2017. "Liner Shipping Connectivity as Determinant of Trade." *Journal of Shipping and Trade* 2 (1): 1–18. doi:10.1186/s41072-017-0019-5.

Guerrero, David, Claude Grasland, and César Ducruet. 2016. "Explaining International Trade Flows with Shipping-Based Distances." In *Maritime Networks: Spatial Structures and Time Dynamics*, edited by Cesar Ducruet, 302–320. New York: Routledge.

Hoffmann, Jan, Naima Saeed, and Sigbjørn Sødal. 2020. "Liner Shipping Bilateral Connectivity and Its Impact on South Africa's Bilateral Trade Flows." *Maritime Economics and Logistics* 22 (3): 473–499. doi:10.1057/s41278-019-00124-8.

Korinek, Jane, and Patricia Sourdin. 2010. "Clarifying Trade Costs: Maritime Transport and Its Effect on Agricultural Trade." *Applied Economic Perspectives and Policy* 32 (3): 417–435. doi:10.1093/aepp/ppq007.

Levinson, Marc. 2016. *The Box: How the Shipping Container Made the World Smaller and the World Economy Bigger*. 2nd Ed. Princeton and Oxford: Princeton University Press.

Martí, Luisa, and Rosa Puertas. 2017. "The Importance of Export Logistics and Trade Costs in Emerging Economies" *Maritime Economics and Logistics* 19 (2): 315–333. doi:10.1057/mel.2015.31.

Notteboom, Theo, Athanasios Palli, and Jean-Paul Rodrigue. 2022. *Port Economics, Management and Policy*. New York: Routledge.

OECD/WTO. 2017. Aid for Trade at a Glance 2017. *International Journal of Development Issues*. Geneva and Paris: WTO/OECD Publishing.

Rodrigue, Jean-Paul. 2020. *The Geography of Transport Systems*. 5th ed. New York: Routledge.

Saeed, Naima, Kevin Cullinane, and Sigbjørn Sødal. 2021. "Exploring the Relationships between Maritime Connectivity, International Trade and Domestic Production." *Maritime Policy & Management* 48 (4): 497–511. doi:10.1080/03088839.2020.1802783.

Santos Silva, J .M.C., and Silvana Tenreyro. 2006. "The Log of Gravity." *The Review of Economics and Statistics* 88 (4): 641–658.

Stopford, Martin. 2009. *Maritime Economics*. 3rd ed. New York: Routledge.

UNCTAD. 2016. *Review of Maritime Transport*. Geneva: United Nations Publication.

UNCTAD. 2017. *Review of Maritime Transport*. Geneva: United Nations Publication.

UNCTAD. 2019. *Review of Maritime Transport*. Geneva: United Nations Publication.

Valentine, Vincent F., Hassiba Benamara, and Jan Hoffmann. 2013. "Maritime Transport and International Seaborne Trade." *Maritime Policy & Management* 40 (3): 226–242. doi:10.1080/03088839.2013.782964.

Wilmsmeier, Gordon, Jan Hoffmann, and Ricardo J. Sanchez. 2006. "The Impact of Port Characteristics on International Maritime Transport Costs." *Research in Transportation Economics* 16 (06): 117–140. doi:10.1016/S0739-8859(06)16006-0.

Wilmsmeier, Gordon, and Inmaculada Martínez-Zarzoso. 2010. "Determinants of Maritime Transport Costs - A Panel Data Analysis for Latin American Trade."

Transportation Planning and Technology 33 (1): 105–121.

doi:10.1080/03081060903429447.

Table 1. Transport mode distribution of EU import and export flows with ROW countries (2010-2019) (%).

	Value		Volume	
Mode of transport	**EU Imports**	**EU Exports**	**EU Imports**	**EU Exports**
Sea	54.66	47.52	77.41	80.00
Air	21.14	28.18	0.27	0.81
Road	13.89	19.38	4.12	14.34
Rail	1.25	1.33	4.35	3.12
Other:	9.06	3.59	13.85	1.74
Fixed transport installations	4.11	0.22	11.22	0.40
Own propulsion	1.17	2.92	0.13	0.16
Inland waterways	0.18	0.19	0.55	1.14
Postal consignment	0.10	0.06	0.00	0.00
Unknown/Not applicable	3.52	0.20	1.95	0.04

Source: Comext

Table 2. Containerisation in EU seaborne trade by sector (2010-2019) (%).

	Value		Volume	
Industry	**EU Imports**	**EU Exports**	**EU Imports**	**EU Exports**
Agricultural products and live animals	53.29	47.49	25.78	26.43
Foodstuffs and animal fodder	42.16	76.95	17.08	71.00
Solid mineral fuels	0.50	22.11	0.41	23.76
Petroleum products	0.49	3.58	0.33	1.25
Ores and metal waste	22.61	41.03	3.04	11.90
Metal products	26.33	38.52	14.48	22.72
Crude and manufactured minerals, building materials	54.25	75.28	16.75	34.43
Fertilizers	4.12	38.09	1.70	21.85
Chemicals	51.73	63.22	27.57	53.03
Machinery, transport equipment, manufactured articles	56.47	41.40	58.23	55.72

Source: Comext.

Table 3. Value, volume and value/weight ratio in EU seaborne trade by sector (2010-2019).

	Total Value 2010-2019 (Billion euros)		Total volume 2010-2019 (Million tons)		Average value/weight (Euros/ton)	
Industry	**Non-containerised**	**Containerised**	**Non-containerised**	**Containerised**	**Non-containerised**	**Containerised**
Agricultural products and live animals	243.49	259.69	760.22	272.63	320	953
Foodstuffs and animal fodder	583.18	866.58	775.63	417.02	752	2,078
Solid mineral fuels	142.52	2.13	1,507.19	15.09	95	141
Petroleum products	3,345.01	38.14	7,064.19	35.62	474	1,071
Ores and metal waste	256.98	108.98	1,362.58	73.53	189	1,482
Metal products	551.78	266.97	567.36	126.76	973	2,106
Crude and manufactured minerals, building materials	49.78	104.91	682.19	234.80	73	447
Fertilizers	49.81	10.55	226.19	20.70	220	510
Chemicals	733.95	1,098.42	644.75	468.02	1,138	2,347
Machinery, transport equipment, manufactured articles	4,364.58	4,154.43	607.86	828.88	7,180	5,012

Source: Comext.

Table 4. PPML gravity estimates with aggregated seaborne trade.

	Sea	**Containerised**	**Non-containerised**
lnDistance$_{ij}$	-1.015***	-0.639***	-1.151***
	(0.0941)	(0.179)	(0.120)
Contiguity$_{ij}$	0.213	-0.698*	0.285
	(0.421)	(0.417)	(0.447)
Island$_{ij}$	0.0603	0.164**	-0.0265
	(0.0439)	(0.0711)	(0.0522)
Landlocked$_{ij}$	-0.862	-0.0546	-0.911**
	(0.588)	(0.383)	(0.459)
Colony$_{ij}$	0.337**	0.387**	0.310*
	(0.152)	(0.184)	(0.172)
Language$_{ij}$	0.141**	0.123	0.153**
	(0.0554)	(0.0984)	(0.0645)
Observations	96624	95786	95788
Pseudo R^2	0.941	0.964	0.914

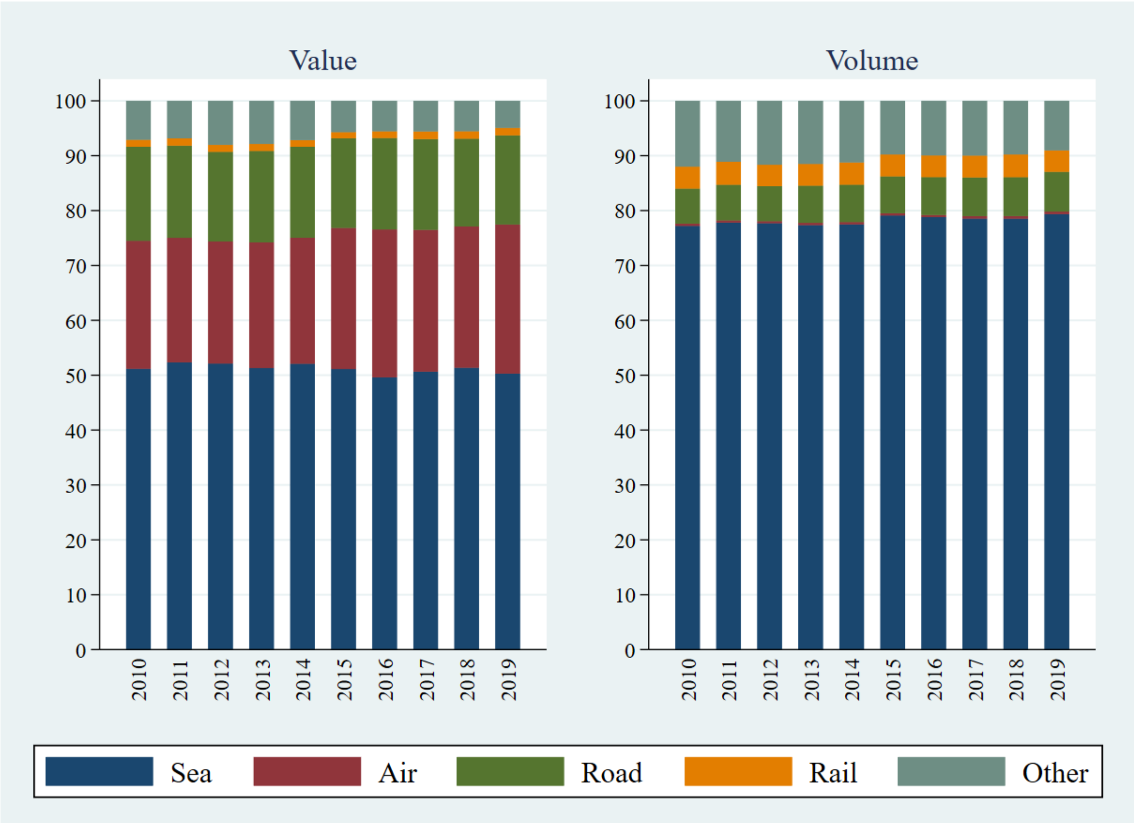
Notes: The regressand in column (1) is the nominal seaborne export flow from country *i* to country *j* in year *t*; the regressand in column (2) is the nominal containerised seaborne export flow from country *i* to country *j* in year *t*; the regressand in column (3) is the nominal non-containerised seaborne export flow from country *i* to country *j* in year *t*. All regressions include exporter-year and importer-year fixed effects. Standard errors clustered in three dimensions (exporter, importer and year) are in parenthesis. * Significant at the 10% level; ** significant at the 5% level; *** significant at the 1% level.

Table 5. PPML gravity estimates by NSTR1 sector.

	Panel A: Seaborne containerised trade flows							
	$lnDistance_{ij}$	**$Contiguity_{ij}$**	**$Island_{ij}$**	**$Landlooked_{ij}$**	**$Colony_{ij}$**	**$Language_{ij}$**	**Observations**	**Pseudo R^2**
Agricultural products and live animals	-0.955***	0.117	-0.320	-0.576	0.430*	0.018	83976	0.885
Foodstuffs and animal fodder	-0.217	-1.322***	0.218	-0.478	0.539**	0.187*	90764	0.910
Solid mineral fuels	-0.034	1.253	-0.578	0.000	0.281	0.564	23941	0.769
Petroleum products	-0.566*	-1.795**	0.155	0.059	0.355	0.158	56966	0.852
Ores and metal waste	-0.658*	-0.436	-0.495**	1.182**	0.197	-0.089	53055	0.866
Metal products	-0.864***	-1.891***	0.473***	-2.433***	0.350**	0.330**	72383	0.886
Crude and manufactured minerals, building materials	-0.002	-0.412	-0.005	-0.113	0.228	-0.084	74216	0.934
Fertilizers	-0.401***	-1.250***	-0.475	0.164	0.866***	0.200	44713	0.806
Chemicals	-0.836***	-0.321	0.093	-0.452	0.187	0.047	83382	0.952
Machinery, transport equipment, manufactured articles	-0.650***	-0.576	0.090	0.284	0.460**	0.093	94977	0.966
	Panel B: Seaborne non-containerised trade flows							
	$lnDistance_{ij}$	**$Contiguity_{ij}$**	**$Island_{ij}$**	**$Landlooked_{ij}$**	**$Colony_{ij}$**	**$Language_{ij}$**	**Observations**	**Pseudo R^2**
Agricultural products and live animals	-1.158***	-1.160**	-0.932*	-0.859***	0.592**	0.240*	81729	0.818
Foodstuffs and animal fodder	-1.242***	-0.450	0.460***	-0.754*	0.552***	-0.202*	90097	0.891
Solid mineral fuels	-0.704	1.047*	0.100	-6.858***	-0.117	-0.528**	19540	0.921
Petroleum products	-1.105***	0.789**	-0.419	0.198	0.284	0.257*	66715	0.889
Ores and metal waste	-0.657**	-1.121*	-0.090	2.433***	0.935***	0.041	48483	0.858
Metal products	-1.146***	0.029	1.078***	-1.494***	0.408**	-0.256	75030	0.879
Crude and manufactured minerals, building materials	-1.206***	-0.317	0.276	-0.163	0.370*	0.235	72783	0.825
Fertilizers	-0.590***	0.652**	-0.371	0.200	0.308	-0.123	39582	0.795
Chemicals	-1.181***	-1.341	-0.060	-0.609	0.267	0.183	82916	0.905
Machinery, transport equipment, manufactured articles	-1.204***	0.273	-0.042	-0.582	0.369	0.038	94583	0.939

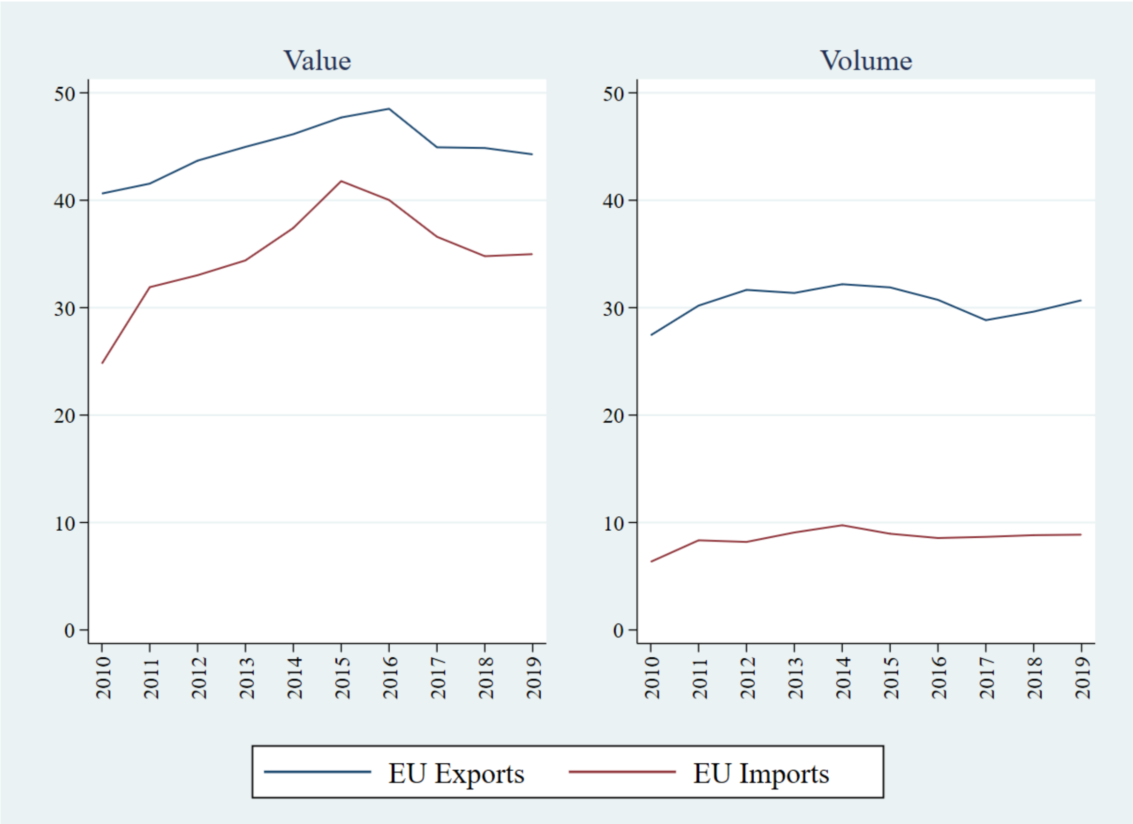
Notes: The regressand in Panel A is the nominal containerised seaborne export flow from country *i* to country *j* of NSTR1 sector *k* in year *t*; the regressand in Panel B is the nominal non-containerised seaborne export flow from country *i* to country *j* of NSTR1 sector *k* in year *t*. All regressions include exporter-year and importer-year fixed effects. The statistical inference is based on multiway cluster-robust standard errors (clustered in three dimensions, exporter, importer and year), not shown to save space. * Significant at the 10% level; ** significant at the 5% level; *** significant at the 1% level.

Figure 1. Transport mode distribution of EU trade flows with ROW countries.



Source: Comext.

Figure 2. Containerisation in EU seaborne trade (2010-2019) (%).



Source: Comext.