ISLANDS AS ‘BAD GEOGRAPHY’.
INSULARITY, CONNECTEDNESS, TRADE COSTS AND TRADE

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September 3, 2014

Abstract

In this paper we explore the geographical dimension of insularity, measuring its effect on a comprehensive measure of trade costs (Novy 2012). Controlling for other geographical characteristics, connectedness (spatial proximity) and the role of historical events in shaping modern attitudes towards openness (measured through a quantification of routes descriptions in logbooks between 1750 and 1850), we give evidence that to be an island is not bad per se in terms of trade costs. Bad geography can be reversed by connectedness and open institutions.

Keywords: Islands, Geography, Connectedness, Trade, Gravity model.

JEL Classification: F10, F14.

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We are grateful to the “Cost of insularity,” Project of European Interest, funded by the regional government of Sardegna (Italy) for the financial sponsorship, under the CRP-27162. We profited from the several meetings of the research project in terms of ideas exchanged and advice received. The paper has been presented at ITSG Cagliari (July, 2014). We thank Massimiliano Bratti, Rosario Crinò, Giuseppe de Arcangelis, Giulia Felice, Emanuela Marrocù for the many comments received. We also thank Vania Licio for her research assistantship. The usual disclaimer applies.
1 Introduction

In this paper we take to the data the starting words of the 1624 Mediation XVII ode to humankind connectedness by the English poet John Donne. We focus on countries instead of individuals, and we study how much adverse geographical conditions, such as being an island, affect - literally - country’s isolation. Our objective is to evaluate the geographical condition of insularity - measured through a novel index - distinguishing it from other geographical conditions, such as e.g. limited country’s size in terms of territorial extension, that are as common for islands, and, especially, to explore the role of connectedness in influencing islands’ trade costs. In a potentially increasingly integrated world, absolute and relative connectedness costs, the latter ones determined by the contextual position of the country in the network of international economic flows, or in terms of our incipit, by the easiness of being or not “... a pece of the Continent, a part of the main ...,” matter, in general, as an important determinant of the pattern of bilateral trade and investment. Their amounts shape the geographical distribution of production, income per capita and economic growth. But space is not the only dimension of connectedness that matters.

Trade costs are influenced by the use of space that people master along history. The same use of space that shaped ancient and modern institutions and that encouraged the building of infrastructures, promotes in general terms, a culture of openness that foster connections and modify the original structure of geographical linkages. Along the lines of Nunn (2009), we give account of this culture of openness through the quantification of informations contained in logbook records of vessels traveling between European ports and the rest of the world, between 1750 and 1850. The documentary sources, mostly kept in a number of European archives in Spain, Britain,
Holland and France, allow to trace major navigation routes, the frequency of the different journeys, and, most of all, the anchorage and the in harbor stops of vessels in a selected number of islands. The strategic geographical position of some islands along sea lanes, with respect to other possible alternatives of harboring and obtaining sweet water and provisions, enhanced the probability of emergence of the culture of openness.

Our research hypothesis can be split in three subsequent parts: (1) trade costs are higher for islands, compared with countries of similar geographical characteristics; (2) connectedness reduces the cost of being an island, both within a country (country’s partial insularity is less costly than full insularity, in terms of trade costs with other countries) and between countries (accounting for spacial proximity using different adjacency matrices measuring different levels of geographical distance); (3) the development of a culture of openness, that we call institutional connectedness, due to repeated historical interactions with merchants from mainland reduces even more the cost of being an island.

The estimation of the effect of these three dimension of insularity (‘bad geography’, spatial connectedness, and institutional connectedness) requires some preliminary data work and the planning of an empirical strategy that minimizes the limits due to time-invariant geographical data, in terms of controlling for omitted variables and unobserved heterogeneity. We built a comprehensive measure of bilateral trade cost, based on theory-founded gravity model of international and domestic trade, as in Chen and Novy (2011) and Novy (2013), in the first place. Subsequently, after some descriptive analysis, we structure a multilevel empirical model, including both random and fixed effects to control for country-pair unobservables and country specific geographical characteristics. Finally, we include both dimension of connectedness, the spatial and the institutional one, in the analysis.

In the full structure of the paper, a short review of three streams of literature that are instrumental to the analysis is anticipating the bulk of the data description and the empirical setting, giving account of the role of geography in macro and international trade theory and empirics, of the specificity of islands as ‘bad geography’ entities, and on the recent literature that explore the role of historical events in shaping modern conditions in the economy of countries. Results come afterwards, following the tripartite structure previously mentioned. A final session on possible further explorations concludes the paper.
2 Building blocks: geography, islands and historical events

2.1 Geography and economic outcomes

The role of geography in economic development has recently filled the research agenda of development economists examining cross-country correlates of GDP per capita (Gallup et al., 1999), since very recently (Spolaore and Wacziarg, 2013). While there is little doubt that geographic factors are highly correlated with economic development, there is however little consensus on how this correlation should be interpreted. Geography as a key determinant of climate and temperature, natural resources, disease, ease of transport, and diffusion of technology, can directly affect productivity, human capital accumulation and the use of other factors resources.\(^1\) Hibbs and Olsson (2004), in search of an empirical validation of Diamond (1999),\(^2\) control for biogeographic endowments (i.e. initial biological conditions: the number of animals and plants suitable to domestication and cultivation at each location 12,000 years ago) in a cross-country regression of contemporary levels of development on geographic variables. They find supporting evidence of Diamond’s hypotheses, with geography being empirically more relevant than biology.

On the other hand, several authors claim that the influence of geography on economic development is merely indirect, through institutions and trade. The very influential evidence put forward by Acemoglu et al. (2001, 2002), showing that after controlling for the effects of institutions, geography did not matter for economic performance in their cross-sectional sample of countries, convincingly stress the primacy of institution over geography in causally determining the actual level of the wealth of nations. According to this view, geography plays an important secondary role, which in the specific

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1. Spolaore and Wacziarg (2013), in their beautiful survey on the ‘Deep determinants’ of economic growth, show how “...a small set of geographic variables (absolute latitude, the percentage of a country’s land area located in tropical climates, a landlocked country dummy, an island country dummy) can jointly account for 44% of contemporary variation in log per capita income, with quantitatively the largest effect coming from absolute latitude (excluding latitude causes the \(R^2\) to fall to 0.29). This result [documents] the strong correlation between geography and income per capita.”

2. Diamond (1999) traces the contemporary level of economic development of countries to biological and geographical characteristics of territories that their inhabitants were able to exploit during the Neolithic transition. See also Ashraf and Galor (2013) for a recent discussion of the issue.
case of Acemoglu et al. (2001) determines the burden of deceases on settlers, which in turn shaped the type of institutional experience of colonies, and, through this channel, influenced the type of modern institutions and the present fortunes of economies. The indirect role of geography has further been clarified by Rodrik et al. (2004), focusing on trade. Geography in fact is an important determinant of the extent to which a country can become integrated in world markets, regardless country’s own trade policies. A distant, remote, landlocked, isolated country faces greater costs of trade and therefore of integration.

The literature exploring the interplay between geography, institutions and trade is closer to the focus of our analysis, which is on islands. In this respect, the first geographical aspects that have to be considered are those ones related with higher distance from major international economic centers and corresponding higher transport costs.\(^3\) The recent literature on the gravity equation (Eaton and Kortum, 2002, Anderson and van Wincoop, 2003) has theoretically shown that the position of a country with respect to his partner has to be considered relatively to its position with respect to all its feasible alternatives (see also Chaney (2008) and Helpman et al. (2008) on the issue of selection on foreign markets), i.e. its multilateral resistance (MR) terms. In an intuitive way, the structural gravity model (Anderson and Yotov, 2010) includes geography in its monadic dimension - introducing controls for landlocked countries and islands - and in its dyadic dimension - introducing controls for border sharing - as components of MR. When those terms are estimated using export and import countries fixed effects the empirical strategy does not allow to separate geography from all other factors which contribute to MR.

\(^3\) On the relation between geographic bilateral distance and trade costs, it is possible to propose two non mutually exclusive interpretations. Once distance is controlled for (i.e. in gravity equations), the incidence of geography on trade costs (and therefore trade volumes) is either saying something more about distance (e.g. its non linear effect across different geographical conditions, such as being a coastal country or a landlocked one, or an island) or saying that distance is not capturing all about the economic cost of geography. In a recent report, the World Bank (2010) emphasized that landlocked economies are affected more by the high degree of unpredictability in transportation than by the high cost of freight services. In other words, the role of geography is primarily a question of the surrounding context. The need to transit from another country’s territory can become a condition of ‘bad geography’ because both exogenous and endogenous factors are likely to raise the total costs of logistics more than the isolated role of transport costs. In fact, some factors are out of a landlocked country’s control.
In this paper we take a different direction from the one of structural gravity models, aiming to isolate the effect on trade costs of extreme geographical conditions, such as the one of islands, from the one of spatial and institutional connectedness. The issue is of relevance since, despite the importance of trade costs as drivers of the geographical pattern of economic activity around the globe, most contributions to their understanding remain piecemeal (Arvis et al., 2013).

2.2 Islands as ‘Bad Geography’

The role of geographical restrictions as determinants of economic integration and income have received an increasing attention in the literature. Milner and Zgovu (2003) and Hoekman and Nicita (2008) find them the primary reason that developing countries are unable to benefit from trade preferences. Moreover, as Hummels (2007) pointed out, “...as tariffs become a less important barrier to trade, the contribution of transportation to total trade costs ... is rising.” The same evidence is confirmed in Bertho et al. (2014), that state: “maritime transport costs (MTCs) today matter more than tariffs. Ad valorem MTCs of exports to the United States are on average more than three times higher than the average US tariff, and in New Zealand are more than twice as high.” It is not a case that New Zealand is an island.

The interest on extreme geography conditions shown by policy frameworks such as the Almaty Program of Action (2003) or the EU Posei Program (2010), suggests that more evidence on how geography imposes costs to the economies of countries is needed.

Insularity is not in general considered the worst condition in terms of ‘bad geography’. According to both empirical and theoretical literature, the most immediate case of extreme geographical condition is the lack of direct access to the sea. This is considered to be a fundamental cause of heterogeneity among countries. One out of four countries in the world is landlocked; in Africa, it is one out of three. On the contrary, having direct access to the sea is the geographical condition that has been found to be the most advantageous for the economy of a country: coastal countries are wealthier and experience 30% more trade than landlocked countries (see the references in Limao and Venables (2001). But the direct access to the see can generate extreme geographical conditions. Islands are completely surrounded by sea. This full land discontinuity raises costs by eliminating alternatives in the connection system of an island and by raising the level of uncertainty
for the remaining alternatives. The small and remote nature of island countries (Briguglio and Kaminarides, 1993, Briguglio, 1995, Mimura et al., 2007, Becker, 2012), should be considered in view of these characteristics, revealing the crucial physical difference between islands and coastal countries. But also not all islands are made the same.

In a recent work, Licio and Pinna (2012) constructing a new dataset, discuss about the dimensions which are better aimed at capturing the heterogeneity of the insular state. If the complete discontinuity of the land imposes a cost (i.e., limiting connectivity with other countries, as in the case of Madagascar), an increase in the number of islands to the level of an archipelagos (as in the case of Greece or Polinesia) can potentially raise that cost to the power. A second dimension that increases costs is distance from mainland. In fact, they find that the economic performance of island-states that are more isolated and remote is similar to that of landlocked countries. In a sense, if having direct access to the sea is a blessing, to be surrounded by too much is a curse. Furthermore, within the group of coastal countries, those whose territory is partially composed of islands perform better, in terms of income per capita or exports than countries with null or negligible degrees of insularity. In this taxonomy, countries can be divided in Landlocked countries (LL), Coastal countries (C), Negligible number of island (N) and Partial islands (that we will group tougher in our subsequent analysis), and Islands (I). In a sense, this taxonomy allows to define a brand new Index of Insularity in which all countries are islands along a continuum that goes from Insularity=0 (LL) to Insularity=1 (I).

The boxplots in figure 1 show the non-monotonicity of the Index of Insularity with respect to GDP per capita and Exports. As far as (LL), the Index reveals the burden of being landlocked, as emphasized many times in the literature (Limao and Venables, 2001, Bosker and Garretsen, 2012). At higher levels of the Index both income and exports increase, to abruptly decreasing for Islands (I). The general impression received confirms what stated before: not all islands are equal, and intermediate levels of Insularity seem better than the extremes.

This preliminary evidence requires some confirmation and more specific analysis on what makes islands so different one from the other.

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4 This is an exiguous group of countries. Their limited number is outweighed by a larger share in terms of income in the wide group of coastal countries. Our initial results suggest that this smaller sample of economies bolsters the fortunes of coastal countries.
2.3 The long lasting effects of historical events

Before entering the bulk of the analysis, we need to give account of a new stream of literature that is strongly related to our own analysis. As summarized by Nunn (2009), the primary goal of this literature is to examine “...whether historic events are important determinants of economic development today.” Acemoglu et al. (2001, 2002) and La Porta et al. (1997) paved the way to the analysis of the potential importance of an historic event, colonial rule in both cases, for long-term economic development. From the earliest subsequent studies, dealing essentially with the correlation of historically related variables with present-day economic outcome, the literature has developed in two directions. The first one goes towards the exploration of
new identification strategies of causal effects of history, the second one deals with the quantification of historical episodes, the digitalization of historical archives, the collection and compilation of new datasets based on historical data. The information content of such data has rapidly moved from sparse cross-sections to very detailed longitudinal structures.

Our contribution moves along this track, quantifying the information contained in a database drawing on British, Dutch, French and Spanish ships logbook records for the period 1750 to 1850. The data extracted from the original CLIWOC climatology database (a more detailed description of the database is included in section 3) allows to describe the main navigation routes in the XVIII and XIX Century, to keep records of the islands touched by that routes, and of the frequency of the different journeys, and, most of all, the anchorage and the in harbor stops of vessels in a selected number of islands. These two latter pieces of information are a true rarity in historical records of routes, roads and traveling. The possibility of weighting routes according to frequency of journeys, including the day of stopping, is per sè a great novelty in this field of research. Having this information at an international level is unique. We fully exploit the quality of the data in quantifying the emergence of a culture of openness in an international context, due to repeated institutional connectedness.

This is however not the first contribution on the role played by historical roads or communication routes in shaping the geographical distribution of contemporary economic outcomes. Dell (2010) in her seminal work on the persistent effect of Peru’s mining Mita shows that the geographical propagation of the negative effect of the forced labor system instituted by the Spanish government in Peru and Bolivia in 1573 is related to the road system, and today Mita districts still remain less integrated into road networks. Martincus et al. (2012) use the (distance to the) Inca road network as instrument to the present road network to address the potential endogeneity of transportation infrastructure to domestic and international trade. Similar analysis on transport infrastructure has been done by Fajgelbaum and Redding (2014) for Argentina, by Banerjee et al. (2012) and Faber (2014) for China, Donaldson (2014) for India, Jedwab et al. (2014) for Kenya and Donaldson and Hornbeck (2013) for the US. To the best of our knowledge there are no papers that take a multi-country approach to the issue.
3  Navigation routes between 1750 and 1850: The vessels logbooks database.

In the empirical analysis that follows we make extensive use of the data included in the CLIWOC database. The Climatological Database for the World’s Oceans 1750-1850 has been collected between 2000 and 2003 by several institutions, universities and research institutes, Europeans and non-Europeans under the EU funded EVK2-CT-2000-00090 project.

The goal of the project was to collect and digitalize meteorological information reported in British, Dutch, French and Spanish ships logbook records for the period 1750 to 1850, contained in national archives. The total number of logbooks included in the dataset is 1,624 giving rise to 273,269 daily observations. Logbooks included general information on the state of the vessel, the name of the captain, the port of origin and the destination of the journey; travel informations on the wind direction and wind force and vessel’s speed; logbooks also registered other aspects of the weather and precipitation, the state of the sea and sky, thunder, lightning, and eventually the proximity of mainland. For our purpose, every record in the logbooks includes the location of the vessel, in terms of longitude and latitude.

In figure 2 we describe, as an example, the navigation of one single vessel included in the records of the CLIWOC database. The vessel Seaford, leaving Plymouth the first day of February 1761 with destination Madras, in India. It anchored in Madras the 5th of July, 1761, after six month of travel. It then continued its journey until March 1775. The last record we have of the vessel corresponds to a logbook note written when leaving the Bermudas Islands.
During fourteen years of traveling the Seaford touched the ports of Cape Town, St. Marys Road in Madagascar, Point Galle at Ceylon (Sri Lanka), Jakarta (Indonesia) and Jamaica; it also stopped for few hours or many days in Tenerife in the Canarias Islands, in Capo Verde, in the Island of Trindade (Brazil), in the Island of Tristian De Cunha (UK), in the Mauritius, and in the Comore Islands. In figure 2 we marked the islands touched by the Seaford with a yellow spot, and ports with a red spot, while the latitude and longitude of sailing days is depicted by the red dotted line.

In the same way we are able to trace all routes travelled by all vessels in the database. In figure 3 we plot all available observations on the spatial position of vessels between 1750 and 1850. Major routes are immediately visible and it is also relatively simple to keep records of the islands touched by the different routes. We will take advantage of this information later on,
as well as of the one on the frequency of the different journeys, and, most of all, the anchorage and the in harbour stops of vessels in a selected number of islands.

Figure 3:
Trade routes: 1750-1850

All vessels routes (1750–1850)

Note: The figure depicts the navigation of the all vessels between 1750 and 1850. The latitude and longitude of sailing days is depicted by the red dotted line. Data comes from the CLIWOC database. Elaborations are our own. Further description of the data and of the data sources is included in the Appendix.

4 Measuring Trade Costs

It’s now time to focus on our dependent variable: trade costs.

To produce a comprehensive aggregate measure of bilateral trade costs\(^5\),

\(^5\) The World Bank has recently produced a sectoral measure of the same class of indices used in this analysis, using the Inverse Gravity Framework methodology (Novy, 2013). The Trade Costs Dataset (ESCAP and World Bank, 2013), which is the result of this computational effort, provides estimates of bilateral trade costs in agriculture, manufactured goods and total trade for the 1995-2010 period. It includes symmetric
that takes into account all possible costs associated with international trade, we built upon some insights from the structural gravity equation literature (Anderson and van Wincoop, 2003, Anderson and Yotov, 2010, 2012, Fally, 2014).

From Anderson and van Wincoop (2003) we know that the bilateral trade flow between country $i$ and country $j$ can be expressed as:

$$X_{ij} = \frac{Y_i}{\Pi_i^{1-\sigma}} \cdot D_{ij}^{1-\sigma} \cdot \frac{E_j}{P_j^{1-\sigma}}$$

(1)

where $Y_i$ is total output in country $i$, $E_j$ is total expenditure in country $j$, $D_{ij}$ is a measure of bilateral distance, and $\sigma > 1$ is the elasticity of substitution between varieties in a Dixit-Stiglitz utility function. The terms $\Pi_i^{1-\sigma}$ and $P_j^{1-\sigma}$ are the “inward” and “outward” multilateral resistance terms, capturing the interconnectedness among countries that is revealed through the price index in the importing market, $P_j^{1-\sigma}$, and through the price index $\Pi_i^{1-\sigma}$ capturing the degree of competition faced by the exporting country. Since Anderson and van Wincoop (2003), the multilateral resistance terms highlight the fundamental relevance of considering distance in relative terms, and not only in absolute terms, as expressed by $D_{ij}$.

Being $\sigma$ the elasticity of substitution among product varieties, the varieties considered in the expenditure function of consumers must necessarily include both domestic varieties and foreign varieties. Accordingly, the gravity equation (1) should consider not only foreign trade but also domestic trade, bilateral trade costs for 178 countries, computed for each country-pair using bilateral trade and gross national output. There is not a full overlap between the Trade Costs Dataset and our own, both in the time series and in the cross-sectional dimension. We will come back to the existing differences in the two datasets later on.

Even if the obtained measure is time-variant, for the sake of simplicity, we disregard the time subscript, $t$, from the notation. Moreover, the index can be applied to sectoral data without any substantial change.

As emphasized by Head and Mayer (2014), equation 1 can be derived from different trade models. In spite of being consistent with Armington (1969) preferences, the parameter $\sigma$ would indicate the constant elasticity of substitution between varieties in a monopolistic competition trade models á la Krugman. In Melitz (2003) and Chaney (2008) the same parameter refers to the exponent of the Pareto distribution of firms’ productivity (the higher $\sigma$ the less would be the productivity dispersion among firms). Finally, in Eaton and Kortum (2002) the parameter $\sigma$ would indicate the exponent of the Fréchet distribution defining the countries’ productivity across product varieties. See also De Benedictis and Taglioni (2011) on this point.
and $X_{jj}$. On that we follow Jacks et al. (2008), Chen and Novy (2012) and Novy (2013).

Being $N$ the total number of countries, for consistency we must have that:

$$Y_i \equiv \sum_{i \neq j}^{N-1} X_{ij} + X_{ii}; \quad (2)$$

$$E_j \equiv \sum_{i \neq j}^{N-1} X_{ij} + X_{jj}. \quad (3)$$

$X_{ii}$ and $X_{jj}$ are in general not observed and must be therefore estimated or - as in our case - can be calculated using equation (2) and (3).

Replacing the missing domestic trade with the calculated one, the trade matrix $X_{ij}$ will now be a $N \times N$ matrix with domestic trade along the main diagonal, instead of the usual case of a $N \times (N-1)$ matrix, as it is commonly used. When $X_{ii}$ and $X_{jj}$ are included in the trade matrix, Jacks et al. (2008) show that:

$$\tau_{ij} = \left(\frac{X_{ii}X_{jj}}{X_{ij}X_{ji}}\right)^{\frac{1}{\sigma - 1}} - 1 \quad (4)$$

Using this indirect approach of measuring trade costs, we obtain the comprehensive aggregate measure of bilateral trade costs $\tau_{ij}$. As shown by Chen and Novy (2011), this trade cost index is the geometric average of international trade costs between countries $i$ and $j$ relative to domestic trade costs within each country.\textsuperscript{9}

Intuitively, when countries trade more internationally than they do domestically that gets reflected in low trade costs, that will be high in the opposite case. The benchmark case, that is usually taken as a lower bound

\textsuperscript{8} The domestic trade component is usually disregarded in gravity models, making the model inconsistent with the data. Wei (1996) derives domestic trade in order to derive the notion of home bias from a microfounded gravity equation. According to his definition: “... a country's home bias ... [is the] imports from itself in excess of what it would have imported from an otherwise identical foreign country (with same size, distance and remoteness measure).” See also Wolf (2000) on that.

\textsuperscript{9} A similar measure of freeness of trade (or phi-ness) as been proposed by Head and Ries (2001) and Head and Mayer (2004), where $\phi_{ij}$ is an overall trade cost indirectly capturing the bundle of variables influencing trade cost, scaled by $\sigma$. See also Chen and Novy (2012) for some important details that make $\tau_{ij}$ different from $\phi_{ij}$. 

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for $\tau_{ij}$, is when in both countries total output is equally traded inside and outside the country. In that event $\tau_{ij} = 0$ for all level of $\sigma$.

As the ratio in equation 4 rises above one, with countries trading more domestically than internationally, international trade costs rise relative to domestic trade costs, and $\tau_{ij}$ takes positive values that reach the upper bound of the index, when countries do not trade internationally and $\tau_{ij} = +\infty$.

Since the index is a product of the two countries trade flows, the level of trade of one country influences the trade cost of the other country at the bilateral level. In this respect, $\tau_{ij}$ is a symmetric measure of bilateral trade costs.

### 4.1 Descriptives

Following the methodology proposed by Jacks et al. (2008), and further discussed in Chen and Novy (2011), Chen and Novy (2012) and Novy (2013), we calculate a comprehensive measure of bilateral trade cost, $\tau_{ij}$, as in equation 4, for 191 countries and 18145 country pairs. We used bilateral trade data from the Cepii revision of the Comtrade UN database to derive the aggregate measure of bilateral trade $x_{ij}$, and we calculate internal trade $x_{ii}$ using data on GDP reported in the World Bank WDI dataset. As far as $\sigma$ we use estimates from the literature on trade elasticity (Eaton and Kortum, 2002, Anderson and Yotov, 2012), mainly working with a $\sigma = 11$, but also lowering the level of $\sigma$ to 9 or 7 to check for the robustness of the results.

Even if it is possible to calculate such measure for every year between 1995 and 2010, we will exploit the time dimension of trade costs only in the descriptive analysis, while in the inferential part of the paper, since the geographic dimension of the data is time invariant, we will concentrate on the cross-country variability of $\tau_{ij}$.

#### 4.1.1 Trade and trade costs

In figure 4 we plot the chronological evolution of world exports between 1995 and 2010, measured in natural logarithms (left panel,) and the respective

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10 When in the hypothetical case the domestic trade of one of the two countries is null, the ratio $\frac{X_{ii}X_{jj}}{X_{ij}X_{ji}} > 1$, and for a given $\sigma$, $\tau_{ij} = -1$. The events in which this happens in the data used are none. The Appendix 8.3 contains descriptive statistics on the the distribution of $\tau_{ij}$ and on some limited cases of unusual behavior of the index.
trade costs, measured by $\tau_{ij}$. In the time span covered by the analysis, world exports evolve according to three phases: the first one of relatively moderate growth (1995-2002), the second one of acceleration (2003-2007), and the last phase of the Great Trade Collapse and its recovery (2008-2010).

During the first phase average international trade costs reduced sharply, moving from a proportion of 4.4:1 with domestic trade costs to a much moderated 3.75. In the subsequent phases the average $\tau_{ij}$ went up and down inside the band between 3.5 and 3.8. Even during the recent period of trade contraction, average trade cost increased, by no means, but not as dramatically as one could have imagined.

Figure 4:

Trade and trade costs: 1995-2010

![Graph showing trade and trade costs](image)

**Note:** The figure traces the time series of world exports (left panel, measured in natural logarithms) and trade costs (right panel,) as measured in equation 4 with $\sigma = 11$ and zero-trade flows replaced by $\tau_{ij} = 1$. Data comes from the BACI-CEPII database and the World Bank. Elaborations are our own. Further description of the data and of the data sources is included in the Appendix.

4.1.2 The distribution of trade costs

Figures 5 and 6 illustrate the frequency distributions of $\tau_{ij}$. The kernel densities clearly show a tri-modal empirical distribution with a different balance between the low, medium and high values of trade costs. Averages across the all period reveal a neat heterogeneity in trade costs when looking at countries all together. Even if the highest frequency refers to a calculated measure of 2, the graph demonstrates that trade costs can get higher, and even much higher, for a relevant number of trade partnerships. Already this evidence would encourage a deeper understanding of the world pattern of trade costs.
Figure 5:
Kernel density of trade costs: Country pairs averages 1995-2010

Note: Our elaborations on BACI-CEPII data and the World Bank WDI data. $\tau_{ij}$ is computed according to equation 4 with $\sigma = 11$, and zero-trade flows replaced by $x_{ij} = 1$. The smoothing parameter of the kernel function is set optimally.

Further elements become evident when comparing the empirical distribution of $\tau_{ij}$ in different years, as in figure 6: Declining trade costs along time correspond to a change in the shape of the frequency distribution.

Figure 6:
Kernel density of trade costs: Changes in time

Note: Our elaborations on BACI-CEPII data and the World Bank WDI data. $\tau_{ij}$ is computed according to equation 4 with $\sigma = 11$, and zero-trade flows replaced by $x_{ij} = 1$. The smoothing parameter of the kernel function is set optimally.
Figure 7: Kernel density of trade costs and the Insularity taxonomy

(a) Islands

(b) Landlocked countries

(c) Partial insularity

Note: Our elaborations on BACI-CEPII data and the World Bank WDI data. τ_{ij} is computed according to equation 4 with σ = 11, and zero-trade flows replaced by x_{ij} = 1. The smoothing parameter of the kernel function is set optimally.

The high mode of the distribution becomes less and less pronounced, progressively reducing its relative relevance with respect to the mid mode. The low mode, instead, becomes more and more pronounced and does not show any evident downsizing even during the Great Trade Collapse. International markets integration, the emergence of China and other BRICS on the trade scene, and the continuous evolution in transport technologies and in related infrastructure - what is generally called globalization - goes hand in hand with the reduction in the frequency of high trade costs values, bringing partners more alike in terms of the bilateral trade cost they have to bear.

But if the high mode of the distribution looses its weight in time, we now wonder how such change is related to the geography of the countries involved, in particular to the level of insularity of the country, which is the primarily interest of our analysis.

4.1.3 Trade Costs and Insularity

Figure 7 splits the distribution, illustrated in figure 6 for all world countries, according the insularity index (Licio and Pinna, 2013) illustrated above. Countries are divided in clusters whose taxonomy includes Islands (panel a), Landlocked countries (panel b), and Partial insularity countries, including countries with a negligible number of islands (Coastal countries are not
shown in figure 7). The range of trade costs values is quite similar to what shown in in figure 6 (the scale of the horizontal axis of the graph is fully comparable) but the figure reveals a clear difference between the three distributions of trade costs: Islands can be equally interested by smaller, middle and high levels of $\tau_{ij}$. As we said before, not all islands are made the same, some of them suffer from very high trade costs, others seem to be relatively immune from the cost of ‘bad geography.’ But what is puzzling is that recent trends in globalization, did not change the shape of the distribution of trade costs for islands. The reduction in the frequency of high trade costs revealed in figure 6 is more likely to have interested countries which are not islands.

Is the evidence for landlocked countries any different? Panel b of figure 7 shows a similar pattern for the other extreme geographic condition: high values of trade costs show a higher frequency when a country in the trade pair is landlocked. Moreover, changes in the last 20 years do not seem to have affected landlocked countries, in strong analogy with islands. The main difference between islands and landlocked countries is in the frequency around the low mode of the distribution: the share of landlocked countries with low $\tau_{ij}$ is higher than the one of islands (i.e. note the different scale of the vertical axis).

Panel c of figure 7 shows a totally different picture for partial insularity countries. The frequency of low trade costs is prominent and, more in line with the general case, trade costs have been declining along time.

4.1.4 Trade Costs and distance: Some European examples

Let’s now have a look at some specific country cases. We focus, as an example, on some European countries, with the twofold goal of illustrating how trade costs are related to distance to foreign markets but that they cannot be fully assimilated to distance, and that islands are different from other countries’ geographical conditions in terms of how distance is related to trade costs.

Figure 8 gives evidence of the relation between distance to European markets and 1995-2010 average trade costs for four European countries: Cyprus, France, Germany, and the UK.

In general, at least for the three continental countries a some how positive correlation between distance and trade costs exists. However, in all cases the highest bilateral trade costs are with Albania (ALB), even if for none of the
four countries Albania represents the European foreign market farther away. For France, Germany and the UK the trade partnership with Cyprus is the one that implies the longest distance, as far as intra-European trade.

**Figure 8:**

Trade Costs and distance: Some European cases

**Note:** The figure includes the scatterplots for Cyprus, France, Germany and the UK depicting the relation between distance to European markets (horizontal axis) and 1995-2010 average trade costs (vertical axis). Countries are identified by their ISO3 UN codes. Data comes from the CEPII database. Elaborations are our own. Further description of the data and of the data sources is included in the Appendix.

Two elements seems to characterize an island like Cyprus. First of all, trade costs reach higher levels with respect to the ones of the three continental countries. Secondly, the relationship between trade costs and distance doesn’t seem to follow a linear path, but shows an inverted-U shape. Intermediate levels of distance show higher trade costs, and Italy (ITA), which is around 2000 Kms away from Cyprus, and the Netherlands (NLD,) which is 3000 Kms away from Cyprus, show the same level of bilateral trade costs.

It is useful to summarize the evidence so far. Islands seem to be different from other countries in terms of trade costs. The spatial discontinuity with foreign countries add a further burden. On the other hand, islands are not all similar. What makes them different from each others?
4.1.5 Further geographical covariates

The first hypothesis is that islands are characterized by geographical specificities - apart being an island - that are different from the ones of other countries. The denomination of “island” could, therefore, hide some relevant geographical dimension that could explain why “islands” look so different in their trade costs.

The geographical dimensions that we consider and that we use as covariates in the empirical model described in section 5

Figure 9: Simple correlation among covariates

<table>
<thead>
<tr>
<th>Island-states</th>
<th>Rugged</th>
<th>Distance to coast</th>
<th>Tropical</th>
<th>Avg. temperature</th>
<th>Avg. precipitation</th>
<th>Distance from Equator</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rugged</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Distance to coast</td>
<td>0.1664*</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tropical</td>
<td>0.0158*</td>
<td>0.3521*</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Avg. temperature</td>
<td>-0.0034</td>
<td>-0.7283*</td>
<td>0.6019*</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Avg. precipitation</td>
<td>-0.0395*</td>
<td>-0.2717*</td>
<td>0.6242*</td>
<td>0.3601*</td>
<td>1</td>
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</tr>
<tr>
<td>Distance from Equator</td>
<td>-0.0548*</td>
<td>0.5471*</td>
<td>-0.7458*</td>
<td>0.8924*</td>
<td>-0.4757*</td>
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</table>

<table>
<thead>
<tr>
<th>Landlocked</th>
<th></th>
<th></th>
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<tbody>
<tr>
<td>Rugged</td>
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<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
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<td>Distance to coast</td>
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<tr>
<td>Tropical</td>
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<td>0.0216*</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Avg. temperature</td>
<td>-0.5466*</td>
<td>-0.0255*</td>
<td>0.6475*</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Avg. precipitation</td>
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<td>0.5029*</td>
<td>0.5383*</td>
<td>0.1451*</td>
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<tr>
<td>Distance from Equator</td>
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<td>0.0256*</td>
<td>-0.7777*</td>
<td>0.8984*</td>
<td>-0.3805*</td>
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</table>

<table>
<thead>
<tr>
<th>Partial-insularity</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Rugged</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Distance to coast</td>
<td>-0.2998*</td>
<td>0.1500*</td>
<td>1</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Tropical</td>
<td>-0.2862*</td>
<td>0.6513*</td>
<td>0.9666*</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Avg. temperature</td>
<td>0.0611*</td>
<td>0.2656*</td>
<td>0.7480*</td>
<td>0.5673*</td>
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<tr>
<td>Avg. precipitation</td>
<td>0.0869*</td>
<td>0.4027*</td>
<td>-0.7006*</td>
<td>0.8663*</td>
<td>-0.7405*</td>
<td>1</td>
</tr>
</tbody>
</table>

Note: The figure represents spatial connectedness between countries. Links connect countries that share a common border; light blue nodes are islands, yellow nodes are mainland countries. The nodes with a black thick circle around are landlocked counties, while nodes with a red circle are partial islands (PP) as defined in section 2.2. The position of each node depends on its relative connectedness as in the Kamada Kawai algorithm for network visualization. Islands are located near the closer country according to the intervals ≤300 Kms, and ≤500 Kms. Data comes from the CEPII database. Elaborations are our own. Further description of the data and of the data sources is included in the Appendix.

4.1.6 Connectedness

It’s now time to go back to John Donne Meditation. Islands are not always severely isolated, sometimes for some of them is easier to be “... a piece of the Continent, a part of the main ...” Geographical proximity with the mainland is probably the first candidate to explore in order to evaluate how connectedness with foreign countries can reduce the onus of islands bilateral trade costs.
To measure and visualize countries' connectedness we use a proximity index that takes a value of ... TO BE CONTINUED

Figure 10:
A network visualization of countries’ spatial connectedness

Note: The figure represents spatial connectedness between countries. Links connect countries that share a common border; light blue nodes are islands, yellow nodes are mainland countries. The nodes with a black thick circle around are landlocked counties, while nodes with a red circle are partial islands (PP) as defined in section 2.2. The position of each node depends on its relative connectedness as in the Kamada Kawai algorithm for network visualization. Islands are located near the closer country according to the intervals ≤300 Kms, and ≤500 Kms. Data comes from the CEPII database. Elaborations are our own. Further description of the data and of the data sources is included in the Appendix.

5 The Empirical Model

While the recent literature on calculated trade costs measures (Chen and Novy (2011) and Novy (2013)) has been motivated to delve trade costs over time along with factors which have been driving their evolution, the starting model equation is the standard trade costs function as in Anderson and Yotov (2012):
\[ \tau_{ijt} = \exp(\alpha D_{ij} + X_{ijt}\gamma) + \epsilon_{ijt} \]  

(5)

where the dependent variable is calculated as in 4; \( D_{ij} \) is the standard measure of distance and \( X_{ijt} \) is the matrix of geographical covariates, discussed in section 4.1.5.

In this paper we use the same methodology of Novy (2013) to investigate the variance of trade costs in space, i.e. across countries, instead of its time variation. We modify the estimated equation accordingly, in order to adapt it to our variance analysis where correlates are time invariant. Therefore in our model the dependent variable is an average of \( \tau_{ij} \) across the years (1995-2010) regressed against measures of the geography of a country either in its exporter of importer position (\( i \) or \( j \)). Controls for the heterogeneity of the pairs are captured by a random effect term, \( \theta_{ij} \), and the multilevel random effect modelling allows us to estimate coefficients for the time invariant terms we are interested in, including a control for the variance in trade costs across pairs. Our simple model looks like:

\[
\ln \tau_{ij} = \beta_1 I_{ij} + \beta_2 Iboth_{ij} + \beta_3 LL_{ij} + \beta_4 LLboth_{ij} + \beta_5 P_{ij} + \beta_6 Pboth_{ij} + \\
+ \alpha \ln D_{ij} + \ln X_{ij}\gamma + \theta_{ij} + \epsilon_{ij}
\]

(6)

where \( \theta_{ij} \) is the random component of the error term, with \( E(\theta = 0) \) and variance constant for the pair; and \( \epsilon_{ij} \) is a standard idiosyncratic error, clustered at the country-pair level. Using the same symbol as in the Insularity taxonomy, \( I \) is a dummy equal to 1 if one of the two countries in the pair is an island state; we also control for the case of both countries in the pair being islands, \( Iboth_{ij} \). Similarly we include controls for landlocked countries, \( LL_{ij} \) and \( LLboth_{ij} \), and for countries of partial insularity, \( P_{ij} \) and \( Pboth_{ij} \).

In the following sub-section we illustrate results from running a maximum likelihood random effect model in logs as in equation 6 where the average \( \ln \tau_{ij} \) is regressed on several geographic measures. Our main interest is on estimates of \( \beta_1 \), \( \beta_3 \) and \( \beta_5 \). In order to conduct a first robustness checks we also augment the model with other geographical characteristics at the country level and information on their main colonial experience, \( X_{ij} \).\textsuperscript{11}

\textsuperscript{11} Results do not change when the model is estimated allowing the time dimension of the dependent variable and introducing a trend term along with the above covariates.
<table>
<thead>
<tr>
<th>VARIABLES</th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
<th>(6)</th>
<th>(7)</th>
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<td>0.481***</td>
<td>0.429***</td>
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<td>0.367***</td>
<td>0.328***</td>
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<td>(0.012)</td>
<td>(0.012)</td>
<td>(0.012)</td>
<td>(0.013)</td>
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<td>(0.015)</td>
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<td>(0.023)</td>
<td>(0.023)</td>
<td>(0.022)</td>
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<td>(0.024)</td>
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<td>(0.013)</td>
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<td>(0.013)</td>
<td>(0.018)</td>
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<td>-0.192***</td>
<td>-0.0341*</td>
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<td>(0.016)</td>
<td>(0.015)</td>
<td>(0.015)</td>
<td>(0.015)</td>
<td>(0.017)</td>
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<td>-0.0990</td>
<td>0.0966</td>
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<td>(0.058)</td>
<td>(0.059)</td>
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<td>Land Area (1000 squared km)</td>
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<td>-0.0903***</td>
<td>-0.0516***</td>
<td>-0.113***</td>
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<td>(0.002)</td>
<td>(0.003)</td>
<td>(0.002)</td>
<td>(0.004)</td>
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<td>Terrain Ruggedness Index</td>
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<td>0.0131***</td>
<td>0.00539</td>
<td></td>
<td></td>
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<tr>
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<td>(0.004)</td>
<td>(0.005)</td>
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<tr>
<td>Percentage Tropical Territory</td>
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<td>0.265***</td>
<td>0.170***</td>
<td></td>
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<td></td>
<td>(0.019)</td>
<td>(0.019)</td>
<td>(0.021)</td>
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<td>Annual average temperature country</td>
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<td>(0.001)</td>
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<td>(0.009)</td>
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<td>Distance country from equator (La Porta 1999)</td>
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<td>-0.107</td>
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<tr>
<td>Distance to nearest ice-free coast (1000 km.)</td>
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<td></td>
<td>0.280***</td>
<td></td>
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<td></td>
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</tr>
<tr>
<td>Controls for colonial links</td>
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<td>NO</td>
<td>NO</td>
<td>NO</td>
<td>NO</td>
<td>YES</td>
<td></td>
</tr>
<tr>
<td>Constant</td>
<td>0.837***</td>
<td>0.672***</td>
<td>0.777***</td>
<td>0.899***</td>
<td>0.758***</td>
<td>1.997***</td>
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<td>(0.008)</td>
<td>(0.010)</td>
<td>(0.011)</td>
<td>(0.011)</td>
<td>(0.011)</td>
<td>(0.093)</td>
<td>(0.118)</td>
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</tbody>
</table>

Clustered $ij$ standard errors in parentheses. *** $p<0.01$, ** $p<0.05$, * $p<0.1$.
Dependent variable is Trade Costs measured as in equation 4, with $\sigma = 11$ and replacement for zeros.
Reference category for Islands, Landlocked and Partially Insular countries are Coastal countries.
5.1 Trade Costs, Geography Measures and Colonial Links

Our first focus on geography is linked to better understanding the position of islands with respect to countries with a different geography. Columns (1) to (3) in table 1 include only controls for separating those country pairs where when one partner (and both) are islands (1); are islands or landlocked countries (2); are islands, landlocked or have only a portion of territory which is insular, what we call partial insularity (3). Results clearly indicate that islands, in the $ij$ pair, are associated with higher trade costs. The insularity effect in trade costs is quite large: islands have costs which are higher between 150% and 160% with respect to the base group of coastal countries (countries which do not have islands except for a negligible part of their territory). As expected the condition is shared by landlocked countries, where the smaller coefficient indicates that the differential in trade costs for countries without access to the sea is less severe. Column (3) offers a further element for interpreting results of higher trade costs for islands: the insular condition is mitigated when islands are administratively connected with the mainland (which in the majority of cases this implies a geographical proximity). Countries which have a portion of territory as islands seem to be characterized by lower trade costs with their partners, also with respect to the base group of coastline economies. All coefficients are significantly different from zero at 1%.

The term which captures those limited cases of both countries in the pair in the same geographical condition (both islands, both landlocked or both partial insular) suggest that having a two-sided (symmetric) geographical condition is more relevant for landlocked countries and also for those ones which are partially insular.

In columns (4) to (7) of table 1 we include further controls for testing the robustness of our significant and positive higher trade costs when an island or a landlocked country is in the pair. First of all the size of a country. The fact of being small is a geographic characteristics which repeatedly the literature has reported as a disadvantage condition (the main point being

---

Islands have been always separated from other countries with specific controls in the intuitive standard gravity exercise (Limao and Venables, 2001). But also in the empirical models from the structural equations when fixed effects controls are included for the pair, extreme geographical condition as being an island or a landlocked economy captures come back in place.
the limited possibility of exploiting diversification economies and to tap into economies of scale). The fact of being a small island is the crucial condition reported in the literature of development (see references as Easterly and Kraay (2000)). Therefore it is our interest to dissect whether the effect we are capturing can be attributed to the fact of being small.\(^{13}\) Results in column (4) suggest that size matters (smaller countries show higher trade costs) but the effect does not drain size or significance from our coefficients of interest. In columns (5) and (6) of table 1 measures of geography reported as robust correlates with income and trade are included: Nunn and Puga (2012) Puga’s ruggedness index, standard variables reporting different climate zones in the planet (percentage of tropical territory, precipitation, distance from equator, as in La Porta et al. (1997)) and the standard distance from coast. Results on our augmented models are consistent with expectation of bad geography conditions to be associated to higher trade costs. We do not report changes in the coefficients linked to the insular condition but, notably, we report on the information that the variable distance from coast add to our previous results: the measure shows a perfect capture of the nature of being landlocked. When we take it out (column 6) results come back to what previously stated.

In column 7 we also reported the effects of including colonial ties controls referred to several national-state empires.\(^ {14}\) Results on our variables of interest do not change: insularity is associated with higher trade costs; the case is replicated for landlocked countries, with a smaller size of the effect: landlocked countries have trade costs 120% higher than coastal countries; the effect increases to 136% when islands states are in the pair. Higher trade costs linked to the insular condition highlight a crucial element of the islands’ geography: precluding the possibility of sharing the infrastructure of contiguous neighbours which are possibly better connected to the international markets.

We focus on contiguity and connectedness in the following sub-section.

\(^{13}\) We included a geographical measure of size, land extension in km squared so that to avoid elements of endogeneity with trade costs. Of course we do not control in this way for any density effect, size in land does not implies size in population or income thought this case is more evident for some countries with extensive land.

\(^{14}\) Australian, Austrian, Belgian, German, Danish, Spanish, French, English, Italian, Japanese, Dutch, New Zealander, Portuguese, Russian, Turkish, American and Yugoslavian
5.2 Trade Costs, Bad Geography and Connectedness

What makes islands different from other territories? Islands are surrounded by sea, which is the opposite of the crucial characteristic which makes the geography of landlocked countries highly difficult. But sharing a border brings advantages. Adjacency favours exchanges through different channels most of time built thought historical passages (what results in what we call and measure as cultural openness). In this part of the analysis we try to capture some of this reasoning by interacting our insularity measure with measures of contiguity which are adjusted for the spatial discontinuity generated by the sea.

\[
\ln \tau_{ij} = (\beta_1 I_{ij} + \beta_2 I_{both_{ij}} + \beta_3 LL_{ij} + \beta_4 LL_{both_{ij}} + \beta_5 P_{ij} + \beta_6 P_{both_{ij}}) \times (\sigma SC_{ij} + \omega HC_{ij}) + \alpha \ln D_{ij} + \ln X_{ij} \gamma + \theta_{ij} + \epsilon_{ij}
\]

(7)

All equations in table 2 include controls for other geographical characteristics as in 1. We show therefore results when islands have been separated between those ones positioned near another economy within a distance of 300km (500km in equations 3 and 4) and those ones which can be called ‘more isolated’. When islands trade with countries which are nearby they show much smaller trade costs, even smaller than the averages obtained for coastal countries. The result indicates how the crucial part of being an island is its position with respect its possible trade partners. A fact which pertains to countries in general but that for islands becomes crucial.\(^{15}\)

6 Results

How is connectedness build? In the previous section we show that an important part is played by the geographical position of a country with respect to

\(^{15}\)What we are saying is directly related to what the taxonomy of the gravity model calls multilateral trade resistance. The point refers directly not only to having or not a proximate trade partner but also to the number of such alternatives. The more the better. The more the higher the level of connectedness. This is the case for countries which have access to the sea but also share several borders with other countries which in turn share multiple borders.
Table 2: Trade costs correlates

<table>
<thead>
<tr>
<th>VARIABLES</th>
<th>(1) ln $\tau_{ij}$</th>
<th>(2) ln $\tau_{ij}$</th>
<th>(3) ln $\tau_{ij}$</th>
<th>(4) ln $\tau_{ij}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>ISLAND =0 × AND distance below 300 Kms=1</td>
<td>-0.279</td>
<td>-0.244</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ISLAND =1 × 1 AND distance below 300 Kms=0</td>
<td>0.302***</td>
<td>0.304***</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ISLAND =1 × AND distance below 300 Kms=1</td>
<td>-1.207***</td>
<td>-1.317**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BOTH ISLAND =0 × AND distance below 300 Kms=1</td>
<td>-0.677*</td>
<td>-0.706*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BOTH ISLAND =1 × AND distance below 300 Kms=0</td>
<td>-0.00922</td>
<td>-0.00774</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LANDLOCKED</td>
<td>0.293***</td>
<td>0.291***</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BOTH LANDLOCKED</td>
<td>0.181***</td>
<td>0.182***</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PARTIAL INSULARITY</td>
<td>-0.196***</td>
<td>-0.199***</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BOTH PARTIAL INSULARITY</td>
<td>-0.0995</td>
<td>-0.0963</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ISLAND =0 × AND distance below 500 Kms=1</td>
<td>-1.068***</td>
<td>-0.939*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ISLAND =1 × AND distance below 500 Kms=0</td>
<td>0.301***</td>
<td>0.302***</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ISLAND =1 × AND distance below 500 Kms=1</td>
<td>-1.192***</td>
<td>-1.195**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BOTH ISLAND =0 × AND distance below 500 Kms=1</td>
<td>0.127</td>
<td>0.0956</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BOTH ISLAND =1 × AND distance below 500 Kms=0</td>
<td>0.000665</td>
<td>0.00214</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LANDLOCKED =0 × AND distance below 300 Kms=1</td>
<td>-0.000721</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LANDLOCKED =1 × AND distance below 300 Kms=0</td>
<td>0.295***</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LANDLOCKED =0 × AND distance below 300 Kms=1</td>
<td>-0.290*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LANDLOCKED =1 × AND distance below 300 Kms=0</td>
<td>0.182***</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PARTIAL INSULARITY =0 × AND distance below 300 Kms=1</td>
<td>0.149</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PARTIAL INSULARITY =1 × AND distance below 300 Kms=0</td>
<td>-0.197***</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>PARTIAL INSULARITY =0 × AND distance below 300 Kms=1</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BOTH PARTIAL INSULARITY =1 × AND distance below 300 Kms=0</td>
<td>-0.0966</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LANDLOCKED =0 × AND distance below 500 Kms=1</td>
<td>-0.0135</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LANDLOCKED =1 × AND distance below 500 Kms=0</td>
<td>0.296***</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BOTH LANDLOCKED =0 × AND distance below 500 Kms=1</td>
<td>-0.281*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BOTH LANDLOCKED =1 × AND distance below 500 Kms=0</td>
<td>0.183***</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PARTIAL INSULARITY =0 × AND distance below 500 Kms=1</td>
<td>0.106</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PARTIAL INSULARITY =1 × AND distance below 500 Kms=0</td>
<td>-0.200***</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BOTH PARTIAL INSULARITY =0 × AND distance below 500 Kms=1</td>
<td>0.194</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BOTH PARTIAL INSULARITY =1 × 1 AND distance below 500 Kms=0</td>
<td>-0.0954</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Geo Controls</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td></td>
</tr>
<tr>
<td>Constant</td>
<td>2.014*** (0.091)</td>
<td>1.998*** (0.091)</td>
<td>2.013*** (0.091)</td>
<td>1.997*** (0.091)</td>
</tr>
<tr>
<td>Observations</td>
<td>31132</td>
<td>31132</td>
<td>31132</td>
<td>31132</td>
</tr>
</tbody>
</table>

Clustered (ij) standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1
Dependent variable is Trade Costs measured as in equation 4, with $\sigma = 11$ and replacement for zeros.
Reference category for Island, Landlocked and Partially Insular countries are Coastal countries.
all its potential partners. In this part of our paper we explore the possibility that connectedness builds on a process that has to be retrieved in history, in the way trade connections have been created in time.

CLIWOC database allows us to identify territories which have been touched by historical trade routes.

A first direct way is to use the information from one specific variable which informs on whether during the route the ship stopped in a specific port or island. At this stage of the work we also use the information of weather the island has been the starting point of a route. In this way we can add some complexity to the information given by the database on trade routes as the one we are using: counting the number of times an island is the starting port of a route we trace the possibility and capability of constructing a position favourable to trade by a country in time.

\[
\tau_{ij} = \alpha \exp((DIssl)(Ddist_{ij})\beta_1)\exp((DIsslboth)(Ddist_{ij})\beta_2) \\
exp((DLandlocked)(Ddist_{ij})\delta_1)\exp((DLandboth)(Ddist_{ij})\delta_2) \\
exp((DPartInsul)(Ddist_{ij})\gamma_1)\exp((DPartInsulboth)(Ddist_{ij})\gamma_2) \\
\exp((GEO_iGEO_j)\beta_4) + \gamma_{ij} + \epsilon_{ij}
\]

6.1 Trade Costs, Bad Geography and History

In table 3 we report on results when islands which have been approached during a route are identified.\textsuperscript{16} In the last two models we construct a continuous variable since we count the number of times an island has been involved in an historical route. Equation 2 and 4 include also controls for the geographical position as in 2. Results in all equations show that for islands trade costs are still higher, but the differential attached to this geographical position is strongly reduced when countries are shown to be involved in a route. The reduction is clear already when a simple measure of being a stop over of the ship voyage to the final destination is used (first two models). The evidence is confirmed when our count variable is included: islands which have been more times the origin of routes are more likely to have now lower trade costs.

\textsuperscript{16}at this stage a only a limited number of islands are separated from the full sample of island states. work in progres
Table 3: Trade costs correlates

<table>
<thead>
<tr>
<th>VARIABLES</th>
<th>(1) ln $T_{ij}$</th>
<th>(2) ln $T_{ij}$</th>
<th>(3) ln $T_{ij}$</th>
<th>(4) ln $T_{ij}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>ISLAND =1 × IN ROUTE =0</td>
<td>0.448***</td>
<td>0.687***</td>
<td>(0.014)</td>
<td>(0.091)</td>
</tr>
<tr>
<td>ISLAND =1 × IN ROUTE =1</td>
<td>0.162***</td>
<td>0.369***</td>
<td>(0.037)</td>
<td>(0.093)</td>
</tr>
<tr>
<td>ISLAND =1 × IN ROUTE BOTH =1</td>
<td>-0.183*</td>
<td>0</td>
<td>(0.089)</td>
<td>(.)</td>
</tr>
<tr>
<td>BOTH ISLAND =0 × IN ROUTE =1</td>
<td>-0.167***</td>
<td>-0.138**</td>
<td>(0.039)</td>
<td>(0.047)</td>
</tr>
<tr>
<td>BOTH ISLAND =1 × IN ROUTE =0</td>
<td>0.0195</td>
<td>0</td>
<td>(0.030)</td>
<td>(.)</td>
</tr>
<tr>
<td>ISLAND =0 × AND distance below 300 Kms=1</td>
<td>-0.191</td>
<td>-0.139</td>
<td>(0.058)</td>
<td>(0.059)</td>
</tr>
<tr>
<td>ISLAND =1 × AND distance below 300 Kms=0</td>
<td>-0.262**</td>
<td>-0.00546</td>
<td>(0.030)</td>
<td>(0.047)</td>
</tr>
<tr>
<td>ISLAND =1 × AND distance below 300 Kms=1</td>
<td>-1.851***</td>
<td>-1.547***</td>
<td>(0.301)</td>
<td>(0.301)</td>
</tr>
<tr>
<td>ISLAND =0 × AND distance below 300 Kms=1</td>
<td>-0.737*</td>
<td>-0.818*</td>
<td>(0.119)</td>
<td>(0.147)</td>
</tr>
<tr>
<td>ISLAND =1 × AND distance below 300 Kms=0</td>
<td>0.0504</td>
<td>0.0605*</td>
<td>(0.00370)</td>
<td>(0.00519)</td>
</tr>
<tr>
<td>LNDLOCKED =0 × AND distance below 300 Kms=1</td>
<td>0.299***</td>
<td>0.301***</td>
<td>(0.0262)</td>
<td>(0.032)</td>
</tr>
<tr>
<td>LNDLOCKED =1 × AND distance below 300 Kms=0</td>
<td>-0.302*</td>
<td>-0.287*</td>
<td>(0.181***</td>
<td>(0.185***</td>
</tr>
<tr>
<td>LNDLOCKED =0 × AND distance below 300 Kms=1</td>
<td>-0.302*</td>
<td>-0.287*</td>
<td>(0.181***</td>
<td>(0.185***</td>
</tr>
<tr>
<td>PARTIAL INSULARITY =0 × AND distance below 300 Kms=1</td>
<td>0.119</td>
<td>0.147</td>
<td>(0.119)</td>
<td>(0.147)</td>
</tr>
<tr>
<td>PARTIAL INSULARITY =1 × AND distance below 300 Kms=0</td>
<td>-0.188***</td>
<td>-0.198***</td>
<td>(0.188***</td>
<td>(0.198***</td>
</tr>
<tr>
<td>BOTH PARTIAL INSULARITY =0 × AND distance below 300 Kms=1</td>
<td>0.260</td>
<td>0.264</td>
<td>(0.00237)</td>
<td>(0.00237)</td>
</tr>
<tr>
<td>BOTH PARTIAL INSULARITY =1 × AND distance below 300 Kms=0</td>
<td>-0.0872</td>
<td>-0.0980</td>
<td>(0.0872)</td>
<td>(0.0980)</td>
</tr>
<tr>
<td>ISLAND =1 × ORIGIN OF ROUTE =0</td>
<td>0.408***</td>
<td>0.386***</td>
<td>(0.014)</td>
<td>(0.072)</td>
</tr>
<tr>
<td>ISLAND =1 × ORIGIN OF ROUTE =1</td>
<td>0.238***</td>
<td>0.147*</td>
<td>(0.035)</td>
<td>(0.072)</td>
</tr>
<tr>
<td>ISLAND =1 × BOTH ORIGIN OF ROUTE =1</td>
<td>0.0460</td>
<td>0</td>
<td>(0.071)</td>
<td>(.)</td>
</tr>
<tr>
<td>BOTH ISLAND =0 × ORIGIN OF ROUTE =1</td>
<td>-0.0799*</td>
<td>0</td>
<td>(0.036)</td>
<td>(.)</td>
</tr>
<tr>
<td>BOTH ISLAND =1 × ORIGIN OF ROUTE =0</td>
<td>0.00237</td>
<td>0</td>
<td>(0.033)</td>
<td>(.)</td>
</tr>
<tr>
<td>GEO CONTROLS</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>Constant</td>
<td>1.990***</td>
<td>2.005***</td>
<td>1.982***</td>
<td>1.998***</td>
</tr>
<tr>
<td>Observations</td>
<td>31132</td>
<td>31132</td>
<td>31132</td>
<td>31132</td>
</tr>
</tbody>
</table>

Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1
Dependent variable is Trade Costs measured as in equation XXX, with $\sigma = 11$ and replacement for zeros.
Reference category for Island is Coastal country.
7 Concluding Remarks

We investigated on the role of the role of geography in determining differences across space in trade costs. We used a measure derived from the structural gravity model of trade as in Novy (2013), in order to consider costs of moving goods behind borders with respect to moving them domestically. Our multilevel empirical model, includes random effects controls for country-pair unobservables and in the meanwhile it treats country specific geographical characteristics as fixed effects. In this set up we register a systematic difference in a ‘indirect’ measure of trade across associated to geographical characteristics. The point we raised in the paper relates to a simple but fundamental question: how should we interpret this result? Our try to answering this question gains insight from the analysis of a particular geographical status: insularity, the condition of having 100% spacial discontinuity with other countries. Our scrutiny on islands has been run side by side with the opposite status of being completed surrounded by other countries. Islands have been always separated from other countries with specific controls in the intuitive standard gravity exercise (Limao and Venables, 2001). Landlocked countries are another geographical condition which received even more attention in the literature. What’s the major point of being landlocked? A recent report by the World Bank (2010) advance a clear evidence that landlocked economies are affected more by the high degree of unpredictability in transportation than by the high cost of freight services per se. Once distance is controlled for, as in the gravity equation, the incidence of geography on trade costs (and therefore trade volumes) is either saying something more about distance (e.g. its non linear effect across different geographical conditions, such as being a coastal country or a landlocked one, or an island) or saying that distance is not capturing all about the economic cost of geography. In our work we provide some evidence that geography plays a role when looking at trade facts (such as trade costs) when it constraints the capability that a country has to relate, to properly connect to other economies. More on this, connectivity is not a dimension that can be reduced neither to a bilateral dimension (instead it refers to the position of a country with respect to all possible alternatives, i.e. it is multilateral) nor to a simple distance measure (it has to be referred to the repetition of facts in time which in first place may have given different weights to similar geographical distances, i.e. the process of building trading relations).
The starting point of our empirical exercise moves from the recent literature motivated to delve trade costs over time along with factors which have been driving their evolution. A simple analysis on the variance of ‘indirect’ measure of trade costs, as in Chen and Novy (2012) across subgroups such as islands, landlocked countries and countries which have a portion of territory in islands, indicates that costs are higher firstly for islands-states. They display costs which are 140% higher with respect to the reference group, coastal countries. Also landlocked economies show higher costs but the coefficient’s magnitude for this group is smaller. Islands are surrounded by sea, which is the opposite of the crucial characteristic which makes the geography of landlocked countries highly difficult. But sharing a border brings advantages such as sharing the infrastructure of contiguous neighbours which are possibly better connected to the international markets. Also, if this element introduces elements of unpredictability, since a landlocked country has to bargain conditions for passing another country’s land, relying therefore on factors which are out of their direct control, islands are excluded from such a possibility. Another element adds some understanding on the insular condition. Insularity is mitigated when islands are administratively connected with the mainland (which in the majority of cases this implies a geographical proximity). Countries which have a portion of territory as islands seem to be characterized by lower trade costs in their trade relationships, also with respect to the base group of coastline economies.

We dig up on this first evidence by interacting our insularity measure with measures of contiguity which are adjusted for the spatial discontinuity generated by the sea. When islands trade with countries which are nearby they show much smaller trade costs, even smaller than the averages obtained for coastal countries. The result indicates how the crucial part of being an island is its position with respect its possible trade partners. A fact which pertains to countries in general but that for islands becomes even more crucial. Here is what we call connectedness, spacial connectedness.

The question which follows is straightforward. Once physical distance is taken as given, what other factors help to build connectedness? In the second part of our paper we explore the possibility that connectedness builds on a process that has to be retrieved in history, in the way trade connections have been created in time. In order to test for this hypothesis, we rely on the Climatological Database for the World’s Oceans 1750-1850 (CLIWOC) which reports on British, Dutch, French and Spanish ships logbook records for the
period 1750 to 1850. Logbooks included general information on the state of
the vessel, first of all the port of origin and the destination of the journey
and along with other climatological information eventually the proximity of
mainland. For our purpose, every record in the logbooks includes the location
of the vessel, in terms of longitude and latitude. CLIWOC database allows
us to identify territories which have been touched by historical trade routes.
A first direct way is to use the information from one specific variable which
informs on whether during the route the ship stopped in a specific port or
island. At this stage of the work we also use the information of weather the
island has been the starting point of a route. In this way we can add some
complexity to the information given by the database on trade routes as the
one we are using: counting the number of times an island is the starting port
of a route we trace the possibility and capability of constructing a position
favourable to trade by a country in time. First results from this analysis
show that for islands trade costs are still higher, but the differential attached
to this geographical position is strongly reduced when countries are shown to
be involved in a route. The reduction is clear already when a simple measure
of being a stop over of the ship voyage to the final destination is used. The
evidence is confirmed when a count variable is included: islands which have
been more times the origin of routes are more likely to have lower trade costs.

This first evidence from the use of historical data would suggest that along
geographical distance, history has helped to shape the geography of the ac-
tual world. The process of building trade relations had a role in creating
something which is likely to work also after centuries: a culture to open-
ness, an aspect which is fundamental if a country aims to better position its
economy in the international market. The mechanics underlying this process
may work through a country’s institutions’ and/or infrastructure building
process. Our results would suggest that these dimension are worth further
research.

Our work in progress: use the information of the database in a way which
is likely to provide information on how the involvement in the historical trade
route is likely to provide information on the present quality of trade infras-
structure of a territory. Within the same route we are able to identify stops
during the journey. Short stops are likely to be due to the quick provision
of goods necessary for the continuation of the journey. Longer stops, which
can be attributed to several reasons (weather conditions, damages of the ves-
sel, other technical problems during the voyage, or merely the fact of having
reached an important trading post) are likely to be the ones which helped a country to create that culture of connectedness still important when dealing with trade today.

8 Appendix

8.1 Data Info

The data matrix dimensions are $191 \times 190 \times 11$, including 191 countries, listed below, from 1995 to 2010.

1. Bilateral trade data are sourced from the CEPII-BACI version of the COMTRADE UN Database.

2. Trade Costs: 1995-2010, calculated using the CEPII-BACI database from COMTRADE UN Database and for GDP data the WDI database of the World Bank;

3. Insularity measure: dummies for full Insularity (1 if the country is an island-state); Landlocked: 1 if the country is landlocked; Partial insularity: 1 if the country has at least 2% of its all territory on islands; Coastal: 1 if the country has access to the sea and the percentage of insular territory is below 2%. The source for this measures is Licio and Pinna (2013) insularity dataset;


5. Distance from equator. Source: La Porta et al. (1997).

6. Tropical climate (%); percentage of the land surface area of each country that has any of the four Kappen-Geiger tropical climates. Source: (Nunn and Puga, 2012).
7. **Other geographical characteristics**: Distance from coast; Average temperature; Precipitation (SEDAC, 2009).

### 8.2 CLIWOC data

Table 4: Number of CLIWOC data per ocean, country and period.

<table>
<thead>
<tr>
<th></th>
<th>North Atlantic</th>
<th>South Atlantic</th>
<th>Indian</th>
<th>Pacific</th>
<th>All</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spain</td>
<td>≤1800</td>
<td>28236</td>
<td>11622</td>
<td>319</td>
<td>1614</td>
</tr>
<tr>
<td></td>
<td>&gt;1800</td>
<td>399</td>
<td>190</td>
<td>301</td>
<td>89</td>
</tr>
<tr>
<td>UK</td>
<td>≤1800</td>
<td>31603</td>
<td>12530</td>
<td>16104</td>
<td>1281</td>
</tr>
<tr>
<td></td>
<td>&gt;1800</td>
<td>9270</td>
<td>5202</td>
<td>7002</td>
<td>200</td>
</tr>
<tr>
<td>Netherlands</td>
<td>≤1800</td>
<td>20045</td>
<td>5109</td>
<td>5142</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>&gt;1800</td>
<td>31932</td>
<td>18348</td>
<td>26617</td>
<td>1481</td>
</tr>
<tr>
<td>France</td>
<td>≤1800</td>
<td>3898</td>
<td>158</td>
<td>159</td>
<td>896</td>
</tr>
<tr>
<td></td>
<td>&gt;1800</td>
<td>32</td>
<td>28</td>
<td>46</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>125415</td>
<td>53187</td>
<td>55690</td>
<td>5561</td>
</tr>
</tbody>
</table>

### 8.3 $\tau_{ij}$ characteristics

In some cases the index $\tau_{ij}$ takes a negative value. This happens when $\frac{X_{ii} - X_{jj}}{X_{ij}X_{ji}} > 1$ but the square root of the term is less than 1. These cases pertain always to the same county pair: Malaysia and Singapore for the period 1997, 1999, 2000, 2002 and 2007.

Particular cases are those ones where the value of internal trade is negative because of the high value of re-exports. Observations which satisfy this condition are pertinent for some years to Antigua and Barbuda; Belize; Guyana; Liberia; Malaysia; Marshall Islands and Singapore. In this case the value of the index is undefined, except for those cases where both countries in the pair report a negative value of the internal trade term.

After the change in trade values from 0 to 1 (144934 cases of pair’s trade in both or either direction equal to zero), the value of the ratio is undefined when either:

1. trade in either or both directions between the $ij$ couple is missing; this happens in the matrix without repetition 8147 times (5217 joint
missing; 1517 and 1413 asymmetric missing values in trade). All these observations pertain to 2011, but this year is excluded from the analysis.

2. GDP is missing for either or both countries (in 847 cases the value of GDP is missing for both countries in the pair; and 15056 and 16118 asymmetric cases);

3. when the values for internal trade are negative (4652 and 6216 cases where one of the countries has exports greater than GDP; in 75 cases the value in the square root term of $\tau_{ij}$ is still positive: both countries have a negative internal trade therefore the index can be computed; in 1 case, where internal trade is negative for both countries, the index is missing since also case 1 is satisfied.)

8.4 Georeferenced connectedness

To measure and visualize countries connectedness we use a proximity index that takes a value of 1 if countries share a common border, and zero otherwise. Nodes are positioned according to the latitude and longitude of capital cities.
Figure 11:

A network visualization of countries’ connectedness

Note: Nodes are positioned according to the latitude and longitude of capital cities. Links are present when countries share a common border.

Data comes from the CEPII database.

References


