Geography, Transport and the Composition of Trade

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PRELIMINARY DRAFT

Abstract

The particular transportation frictions to which landlocked and island countries are differentially exposed shape the composition of these regions' trade flows. Product characteristics associated with the method and cost of international transportation - together with an indicator of products' proximity to final demand - explain cross-country variation in revealed comparative advantage. Landlocked countries and small islands specialize in products with low weight-to-value ratios. Islands' exports and landlocked countries' imports are biased toward products typically shipped in containers. Final products make up a disproportionate share of islands' exports. We also find that cross-country differences in trade composition depend on countries' population, per-capita income, geographic remoteness, and WTO member status. The effects of transportation characteristics on trade composition are heterogeneous within the groups of landlocked countries and small islands, and depend on the other country characteristics we study.

Keywords: Landlocked countries, islands, revealed comparative advantage, transportation costs, upstreamness
JEL Codes: F10, F14

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1 Introduction

The growth of global supply chains over recent decades has created new opportunities for economic development through international trade (Baldwin, 2012). Rather than competing in a global market for finished products, developing countries are able to enter international markets by producing the particular stages of production for which they are well suited. Unfortunately, countries that are geographically separated from global production chains may be unable to take full advantage of these opportunities.

In this paper, we study the ways in which countries' landlocked or island status affects the composition of both their exports and imports.[1] Many studies using the gravity model of trade include dummy variables that identify one or both country types, so the consequences of geography for the level of trade in these countries is well studied, though not exhaustively so. We study the composition - rather than the level - of trade islands and landlocked countries, examining the ways in which certain product characteristics are over- or under-represented in their export and import bundles, when compared against the world as as whole. We use the concept of revealed comparative advantage (RCA) to summarize trade composition, and apply it to imports as well as exports. The product characteristics we study include several that relate to variation in the product's reliance on particular kinds of transport. We also separate products into sets of final and upstream products, in order to focus on the way in which industries' vertical position in global supply chains affects intersects with geography to determine revealed comparative advantage. The characteristics we study seem particularly relevant for understanding how geography affects countries' participation in global supply chains. Our results are also potentially useful for targeting sectors for investments aimed at sector-specific export growth (Reed (2024)). Sectors that face transport-related constraints on either exports or imported inputs may be poor choices for such investments in landlocked and small island countries.

Our intent is simply to document some new stylized facts, but we believe the insights may offer

[1] Alfaro and Chor (2023) focus more specifically on questions related to the global reallocation of supply chains, and survey related research on the topic. We focus on the degree to which island and landlocked status interact with product specific measures of exposure to particular transport frictions and production line position shape countries' participation in trade generally, with an eye to understanding their possibilities for participation in global supply chains.

lessons that are helpful to policymakers. Island countries likely face public financing decisions about the relative merits of capacity investments in sea ports vs. airports. Landlocked countries also face infrastructure choices regarding transport (e.g., increased air transport capacity versus greater coordination with neighbors with access to the sea). The empirical regularities we uncover speak to what is already true, on average, in countries of each type, but such lessons may be useful for informing the choices of individual country governments.

Our empirical methods are closely related to a literature that seeks to better understand the determinants of countries' comparative advantage. Romalis (2004) examines how factor proportions determine countries' production structure and trade composition. Nunn (2007), Levchenko (2007) and Debaere (2014) use the method to study the effects on comparative advantage of countries' contract enforcement, institutions more broadly, and water supplies, respectively. Like the above papers, we use RCA as an outcome variable in a regression framework that includes product- and country- fixed effects. Because we are interested in the role of transport costs we eschew language about uncovering the determinants of comparative advantage; for us RCA is simply a useful quantitative framework for summarizing differences in trade composition. Since we are interested in participation in global supply chains, we study the composition of imports as well as exports, the focus of the existing literature using RCA. Another difference with the existing comparative advantage literature is that we use a Poisson Pseudo Maximum Likelihood (PPML) estimator, an approach that has important advantages over the log-linear OLS tools that are more commonly employed in the RCA literature.

The paper that is useful for understanding our contribution is Venables and Limao (2002), which develops a theory about how countries' geographic position can determine the products that they export/import.[2] Our approach is empirical rather than theoretical, and our focus is on differential effects felt by landlocked and island countries, rather than the effects of geographic remoteness generally. As a by-product of our work, we also produce empirical estimates of the effects of geographic remoteness generally on trade composition, the questions that motivate Venables and

[2]In a different theoretical setting, Antràs and de Gortari (2020) show how geography defines specialization within particular supply chains. A key prediction is that final production stages are located in large/geographically central markets. The theory also highlights that the location of sequential production stages is a joint outcome. Since gravity model estimation takes the location of up- and down-stream production as given, it is not an ideal tool for our questions.

Limao (2002).[3]

The literature on the gravity model of trade provides a large number of estimates of the effect of landlocked and/or island status on the level of trade. Landlocked countries' trade appears to be more heavily affected by their particular geographies than island countries' trade, so landlocked countries have received a larger share of literature's attention. Limao and Venables (2001) demonstrate that landlocked countries pay an extremely large burden in terms of excess transport costs. They estimate that these higher transport costs (together with other implicit trade costs) produce an outcome in which the level of landlocked countries' trade is 60 percent lower than in otherwise equivalent countries with access to the sea. A recent estimate - using the most current empirical methods - estimates that landlocked status generates a 67 percent reduction in the level of trade (Gyawali, 2023). Both of these estimates of the landlocked penalty are broadly consistent with the findings in a number of other papers.[4] Several authors link the trade penalty associated with landlocked status to poor policy choices in the landlocked countries themselves, especially policies regarding transport.[5] All of the estimates in the papers above relate to the *level* of landlocked countries' trade, while we study the composition of trade using the lens of revealed comparative advantage.[6]

The effects of island status on trade are not as well studied as the effects of landlocked status, and are less clear-cut.[7] The most important paper regarding islands' trade is Langat et al. (2022), who conduct a metanalysis over 95 papers that report a total of 2,044 estimates of the effects of

[3] Anderson and Van Wincoop (2003) develop the implications of geographic remoteness for the level of trade. An influential literature focuses on the implications of remoteness for per capita income. See, for example, Redding and Venables (2004), Hanson (2005), Redding and Sturm (2008), Head and Mayer (2011) and Bosker and Garretsen (2012). Duranton et al. (2014) show the effects of US highways on both the level and composition of trade in US cities. Their result that cities with good highway access trade heavier goods is the most similar to our findings.

[4] See e.g., Radelet and Sachs (1998), Limao and Venables (2001), Raballand (2003), Faye et al. (2004), Arvis et al. (2010), Moore (2018), Paudel and Cooray (2018), and Pham and Sim (2020).

[5] See e.g., Macchi and Raballand (2009), Arvis et al. (2010), Hallaert et al. (2011), and Borchert et al. (2012).

[6] Felbermayr and Kohler (2006) study intensive and extensive (product) margins of trade, a step in the direction of the trade composition questions ask. They find less trade along both intensive and extensive margins of trade for both landlocked and island countries.

[7] One complicating factor we discover is that it can be difficult to define the sample of island countries. We find reasons to consider alternate definitions of island status. Several island countries (e.g., Japan, Philippines) are large enough to be of questionable relevance to our research question. Singapore is an island with land bridges that allow overland trade with Malaysia. Many countries that might come to mind as island nations actually share at least one land border with a neighbor (e.g., Haiti/Dominican Republic, UK/Ireland, Papua New Guinea/Indonesia/Timor Leste).

island status on the level of trade. Their estimates from the meta-analysis point to a positive and statistically significant effect of island status on the level of trade flows.[8] Our paper differs from those studied in Langat *et al.*, because we focus on the composition rather than the level of trade. We also study countries' total imports and exports, rather than bilateral trade flows usually studied in the gravity model of trade.[9]

A closely related paper is Hillberry and Jimenez (2022), which uses several of the same product characteristics to estimate an effect of U.S. cabotage restrictions on Puerto Rico's trade with the United States mainland. These authors find evidence that Puerto Rico's imports of final products are biased against US sources when they are sea-shipped, physically heavy and not commonly shipped in containers. Among upstream products, the authors find a strong bias against sea-shipped products, regardless of sourcing. In this paper we seek to understand whether products' transport characteristics and production line position affect islands (and landlocked countries) generally, rather than focusing on a specific island like Puerto Rico.

Our empirical study of cross-country variation in RCA shows that transport and geography play an important joint role in shaping the composition of countries' imports and exports. Looking first at our country control variables, we find that more geographically remote countries have trade bundles (exports, imports or both) that are biased against products that are more commonly air-shipped or shipped in containers. Geographically remoteness is also associated with physically lighter imports and physically heavier exports. Other country control variables (population, per capita income and World Trade Organization member status) also relate to trade composition in largely intuitive ways.

Relative to the set of reference countries, we find the following: 1) Products with low weight-to-value ratios are disproportionately represented in landlocked countries' imports and exports. 2) Landlocked countries also conduct relatively more trade in products transported in shipping containers, though this effect is only statistically significant for imports. 3) Small island countries'

[8] Prominent papers used in this meta-analysis include Estevadeordal et al. (2003), Ghosh and Yamarik (2004), Rose (2004), Klein and Shambaugh (2006), Tomz et al. (2007), Eicher and Henn (2011) and Grant and Boys (2012).

[9] A prominent approach used to estimate comparative advantage applies an EK framework, and estimates RCA conditional on the spatial distribution of demand.MORE HERE.

exports are biased towards products that are shipped in containers and towards final products. 4) Islands' imports are biased against containerized freight, and against air shipped products, outcomes that may reflect a disproportionate share of fuels and other bulk commodities in islands' imports. Finally, 5) the effects we observe for islands and landlocked countries are heterogeneous within categories, varying substantially (and in largely intuitive ways) with per capita income, population, geographic remoteness and WTO member status.

The remainder of the paper is organized as follows. Section 2 describes different theories of economic geography and trade, and relates them to predictions about the composition of exports and imports. Section 3 outlines the estimating framework. Section 4 describes our data. Section 5 report results. Section 6 concludes.

2 Predictive theories

The objective of this paper is to better understand how the composition of countries' exports and imports depends upon product characteristics that relate to transportation of the product, and to the product's positioning in vertical supply chains. There are a number of theories that are useful in informing these questions. Rather than specify a particular theory, we discuss several that seem the most relevant to our questions.

The most important ideas in what follows are the following: 1) there is important cross-product variation in the way that products are transported, and in the costs of transporting them; 2) observable transport-related outcomes are informative about cross-product differences in transportability; 3) the incidence of transport frictions varies across countries in ways that depend upon observable country-characteristics; 4) international supply chains are organized to minimize transport-related frictions.

The joint implication of these four ideas is that the interactions of product and country characteristics can explain cross-country differences in the composition of both imports and exports. Our empirical exercises seeks to evaluate the joint implications, and to evaluate their quantitative implicates for the composition of countries trade flows.

2.1 Cross-product variability in transportability

A central component of the gravity model of trade is the iceberg trade cost, which is taken to vary with distance and other geographic frictions, frictions that sometimes include island and landlocked status. As a stylized example, consider the following:

$$\tau_{ij} = f(dist_{ij}, ISL_j, LL_j, \overline{\theta}) \tag{1}$$

where τ_{ij} is the iceberg trade cost associated with selling a region i product in region j, $f()$ some function, $dist_{ij}$ the distance from i to j, ISL_j and LL_j indicators of countries island or landlocked status in destination country j, and $\overline{\theta}$ a vector of parameters that inform these relationships. One would normally include indicators of island and landlocked status for the origin country; we omit those indicators here for reasons of space.

The gravity literature has focused primarily on the implications of ij variation in trade costs for the level of bilateral trade. Instead we focus on are the implications of cross-product variation in the transport burden for the composition of countries' trade. Consider a vector of product characteristics $\overline{Z}^k$. We imagine a trade cost function that appears as follows:

$$\tau_{ij}^k = f(dist_{ij}, ISL_j, LL_j, \overline{Z}^k, \overline{\theta}) \tag{2}$$

where the $\overline{Z}^k$ vector is interacted with some or all of the remaining elements of τ_{ij}^k, especially our variables of interest, the island and landlocked dummy. The central idea is that each country type may have particular difficulties trading one or another type of product because of their particular geographic constraints, or because unmet demands for specific infrastructure necessary to overcome the effects of their geographies.

Our interest is in the way in which transport related frictions shape the composition of countries' trade. The implication is that cross-product differences in transport frictions generate cross-country differences in export supplies and import demands because the incidence of trade costs vary across countries. Rather than choose a particular theory to test, we describe several theories that seem relevant, and describe the implications of those theories for our estimates.

2.2 von Thünen specialization

Venables and Limao (2002) propose a factor proportions model of trade in which products have different trade costs, and countries differ in both their factor endowments and their proximity to the geographic core. The key lesson of the paper is that cross-product differences in trade costs can reverse the pattern of specialization among countries in the geographic periphery. Geographically remote countries will have difficulty exporting products that have high transportation costs, and may end up specializing in products that are not their comparative advantage.

The implications for our paper is that the transport characteristics we study might be expected to have predictive power for revealed comparative advantage. In particular we might expect to see geographically remote countries specializing in products with relatively low transport frictions. Landlocked and island countries might be differentially burdened by transport frictions, and so may be more likely to have their revealed comparative advantage determined by them. This particular model assumes constant returns to scale and homothetic preferences, so has no particular implications for the composition of imports, only exports.

2.3 Intermediate goods trade and agglomeration

Krugman and Venables (1995) propose a model with similar geographical relationships, in this case the 'North' takes the role of the geographic core, and the 'South' the role of periphery. There are two sectors of production: agriculture and manufactured goods. Manufactured goods face transport costs and agriculture does not. Manufactured goods also feature increasing returns to scale in production and trade in intermediate products. The model faces multiple equilibria, but at intermediate trade costs the manufacturing firms agglomerate in the North. Firms agglomerate to avoid the costs of trading intermediate goods. Krugman and Venables (1996) propose a closely related model in which the joint location of up- and down-stream leads two identical countries to specialize in one of two identical industries.

In this framework differences in industry specialization can emerge without cross-commodity differences in trade costs. Larger and more geographically central countries will tend to be the hosts of industry agglomerations. Such countries will tend to see the revealed comparative advantage shift in factor of the agglomerated sectors. Import composition will be biased towards intermediate inputs used in producing the output of the agglomerated sector.

If landlocked and island countries suffer additional trade costs on both imports and exports, we would expect their trade patterns to look like those of geographically remote countries in the Krugman and Venables (1995) framework. The primary implication is that both imports and exports will have a smaller role for products that are upstream of final consumption.

2.4 The spatial organization of supply chains

Antràs and de Gortari (2020) propose a theory of spatial supply chain organization. In this theory, supply chains process goods in multiple stages using a constant returns to scale technology. The model predicts that the final stages of production will occur near final demand, because the will be produced near final demand for the product.

In general this model predicts that large, geographically central markets will host later stage production. The implications are that they will export relatively more final products and import relatively more upstream products. Although there is important variation within the groups of landlocked and island countries, in general these economies are smaller and more remote than the typical country. This would imply a tendency towards exporting upstream products and importing final products among these sets of countries.

2.5 Home market effects

One implication of increasing returns to scale models are home market effects (see Krugman (1980)). In these models, idiosyncratically large demand in a country generates idiosyncratically large supply. While trade costs are an important component of such models, the differential trade costs that we propose are not necessarily predictive of RCA arising through home market effects. We do not test explicitly for non-homotheticities, but note only that non-homotheticies allow home market effects to occur across the income distribution.

In our context one might expect home market effects to cause relatively large population and geographically central countries to export final products (as with the supply chain models). If one allows for non-homotheticities in final demand, then home market effects in final goods may be scattered across the set of final products. Under the presumption that landlocked and island countries are smaller and less geographically central than the reference countries, they may be less likely to specialize in exporting products susceptible to home market effects.

2.6 Other considerations

Although they are not linked to particular trade theories, we offer here some other considerations likely affect our findings.

First, transportation possibilities depend on infrastructure investments, and may also depend on complementary investments by nearby trading partners. Larger and/or higher income countries may have the capacity to make larger investments in transport capacity. Countries with better market access may also make more of such investments, because their investments may be more complimentary with their nearby trading partners. Landlocked and island countries may require relatively more of specific kinds of transport investments. Investments in rail capacity may be particularly important for landlocked countries, but not important for island countries. The ability of landlocked countries and islands to make such investments may depend on characteristics such as their size, per capita income and geographic position.

Second, the supply of international transportation may be thicker in parts of the globe where more trade in goods occurs. There are likely to be network effects in certain kinds of transport. We conjecture that air transport and containerized shipping may be especially amenable to network effects of this kind.

Third, countries' general orientation towards trade policy may affect the composition of both their imports and exports. As a broad measure of trade policy orientation, we include countries' World Trade Organization (WTO) member status as a country characteristic. Drawing on the other theories, we may expect WTO member countries to participate more in supply chains, to make investments oriented towards international transportation. we might expect WTO member status to be endogenous to trading opportunities, so interactions with the WTO dummy should not be taken as causal.

Fourth, we offer a loose hypothesis that, all else equal, freight rates rise in products' weight-to-value ratio. A large literature studies within-product variation in value-to-weight ratios, and links such variation to variation in product quality. Here we study cross-product variation in weight-to-value ratios, and take our measure from U.S. data, so that the ratio does not respond to cross-country differences in supply demand and transport costs.[10] Hillberry and Jimenez (2022) link cross-product variation in Puerto Rico's preference for US over foreign products to product level estimates of the weight to value ratio in U.S. imports. They conjecture that the effects they observe emerge from a positive relationship between weight to value ratios and freight charges.[11]

Finally, we note that it is likely that the export bundles of island nations may be are disproportionately biased towards services, most notably tourism. This has two implications for our results: 1) we only study trade in goods, so islands RCA in any given product may be overstated by our measures, 2) much air freight is carried in the bellies of passenger planes, so air passenger traffic related to tourism may cross-subsidize trade in air-shipped products. Both these effects may be more common in geographically central islands, where air transport markets are relatively thicker.

3 Revealed comparative advantage and the PPML regression

Our analytical framework is that of RCA, first proposed by Balassa (1965). Country i's RCA in product k is the share of product k in country i's exports divided by the share of product k in world exports. Our notation is:

$$RCA_i^k = \frac{X_i^k}{\overline{X}_i} \bigg/ \frac{X_w^k}{\overline{X}_w} \tag{3}$$

where X_i^k is exports of product k from region i, $\overline{X}_i$ is the total value of exports of region i, and X_w^k and $\overline{X}_w$ are counterparts for the world. While the description of the index as a measure of "comparative advantage" is less appropriate in the case of imports, our interest in supply chains makes countries' differential purchases of imported products also a question of interest. We calculate a similar index for imports, replacing X_i^k with M_i^k, and so on.

[10] One would normally expect the mode of actual transport to depend on local conditions. For example, products that are usually shipped in containers may travel by plane when arriving in small island countries, given the relatively small market sizes and the cross-subsidy from passenger traffic. If local conditions make it relatively more difficult to trade goods that would normally travel in containers we want to observe the degree to which islands substitute away from the product, rather than observe the change in the method of transport.

[11] Two of the other transport characteristics we study - the share of the product shipped in containers and the share of the product shipped by air - are also related to products weight to value ratio, but these variables also capture other characteristics transport-related characteristics. We study the effect of weight-to-value ratios on trade, conditional on these other characteristics.

The literature on the determinants of comparative advantage typically seeks to understand variation in (3), by taking the log of the formulation, and explaining it with a linear combination of product- and country-fixed effects, together with the interaction of product country variables.

$$ln(RCA_i^k) = ln(X_i^k) - ln(\overline{X}_i) - ln(X_w^k) + ln(\overline{X}_w) = \alpha_i + \alpha^k + \mathbf{C}_i\mathbf{Z}^k\mathbf{\Gamma} + u_i^k \tag{4}$$

where α_i and α^k are country- and product- fixed effects, $\mathbf{C}_i$ a vector of country characteristics, $\mathbf{Z}^k$ a vector of product characteristics, $\mathbf{\Gamma}$ a vector of coefficients on the country-product interactions, and u_i^k a log-linear error term.

Our exercise is similar, though we argue that the properties of Poisson-Pseudo Maximum Likelihood (PPML) estimator is better suited to this kind of exercise. Our PPML specification is as follows:

$$X_i^k = exp\left[\alpha_i + \alpha^k + \mathbf{C}_i\mathbf{Z}^k\mathbf{\Gamma}\right] + \epsilon_i^k \tag{5}$$

where everything is as above, except that ϵ_i^k is a mean zero error term.

3.1 Country characteristics

The country characteristics we study include logged per capita gross domestic product and logged population (as in Hummels and Klenow (2005)). Since our focus is on landlocked and island countries the role of these characteristics is as control variables, rather than objects of interest. We include four more country characteristics in our regressions, two controls and our variables of interest. A key control variable of interest are logged market access variables, one of which is included in export and import regressions, respectively.[12] We also include, as a control, a dummy variable indicating membership in the World Trade Organization.

The country characteristics that are our primary interest are dummy variables indicating landlocked or small island status. We describe our approach to generating the indicators for these variables in the data section.

3.2 Product characteristics

The product characteristics $\mathbf{Z}^k$ are of two types. Three are associated with the methods and/or cost of transporting a product. A fourth characteristics is an indicator variable that measures

[12] We describe our calculations for constructing seller's market access (for studying exports) and buyer's market access (for studying imports) in Section 4.

production-line position. We take product characteristics from U.S. data, applying them to all trade flows.

The first transportation-related characteristic we consider is the share products' U.S. imports that arrive by air.[13] This is a continuous variable, but for most products it takes values near zero or near one. Since air shipment is expensive, products shipped primarily by air are typically those that require timely delivery. Given the cost, air-shipped products also tend to have relatively low weight-to-value ratios. Air-shipment is plausibly important for islands and landlocked countries, because it allows them to trade directly with many countries in the world; high income countries in particular. It may be easier for countries to participate in trade of air-shipped products when they are located near thick air transport markets. International tourism may cross-subsidize trade in air-shipped products, because a significant share of air freight travels in the bellies of passenger aircraft.

Although the air share of product k's shipment is a crude indicator of products' weight-to-value ratio, we expect product's weight-to-value ratio to generate independent variation in transport costs across products. It is likely that products that are physically heavier, relative to their value, pay transport costs that are higher as a share of the value of the product. (This may be especially true among air-shipped products.) All else equal, regions that are heavily exposed to trade costs might be expected to trade less in high weight-to-value products. One of our product k indicators is thus the products weight to value ratio, measured in U.S. import data.

The third transport-related indicator we consider is whether or not the product is usually shipped in containers. Most products can be shipped efficiently in containers, and so travel on container ships or railways, but a variety of products do not lend themselves to efficient transport in containers. Most significantly, many bulk commodities and fuels are usually shipped in bulk, tanker or liquid sea vessels, or by pipeline. Such products are rarely if ever containerized. At the other end of the

[13] Like Hummels and Schaur (2013), we study U.S. imports net of trade with Mexico and Canada. In these flows, firms are constrained to either ship by air or by sea. Since mode choice in small economies is likely endogenous to their specific geography and infrastructure choices, using a single-country's data is preferable. Since the US is large enough to import virtually every product in the HS schedule, and because transport choices in US imports are likely optimized because they are made in a highly competitive environment, the U.S. is a sensible choice from which to draw these characteristic data. The other shipment characteristics we study are also taken from U.S. data, following a similar logic.

spectrum, high value products that are not at all bulky tend not to be shipped in containers (e.g. watches, diamonds, newspapers). Completed motor vehicles are also rarely containerized, though their components may be. We use as our indicator, product k's share of container traffic in U.S. (air or sea) imports.

We expect that products that typically travel in containers are more easily traded than other products, over long distances than are other products. Containers may also facilitate mode switching, which may be important for landlocked countries' trading sea-shipped goods with distant trading partners.

Since we are interested in possibilities for participating in international supply chains, we also include an indicator of each product's production line position as a product characteristic measure. Specifically, we use the upstreamness measure of Antràs et al. (2012) to create a dummy variable that separates final and upstream goods. Antràs and de Gortari (2020) propose a theory suggesting that the final stages of production are more likely to be produced in large, geographically central markets. This theory has direct implications for the population and market access variables we study, because it predicts that final goods production should be less common in remote and/or small countries. Conditional on income and remoteness, we might expect to see islands and landlocked countries even less engaged in exporting final products. On the import side, a lack of participation in supply chains may result in a tendency to import final products, rather than upstream products that require further processing.

3.3 Variation within island and landlocked country status

Although we are primarily interested in how island and landlocked status affects the composition of trade, it seems likely that there is important variation within each category. The effects of island status on trade composition may be very different in the South Pacific and in the Caribbean. Landlocked countries in Europe likely have different trade bundles than landlocked countries in Africa, Latin America or Central Asia.

In order to explore these possibilities we add to our previous specifications triple interactions that are the product of a) the island or landlocked dummy, b) the product characteristics we study, and c) the other four country characteristics that we include as control variables. For example, one interaction used in the export regressions would be island status, air share of product shipments and the seller market access variable. The coefficient on this interaction would measure the degree to which variation in islands' exports of air shipped goods depends on their geographic position in the world. So for example, if Caribbean islands were better able to export air-shipped products than islands in the South Pacific, this coefficient would likely be positive.

Our triple interaction specifications (for exports) appear as

$$X_i^k = exp\left[\alpha_i + \alpha^k + \mathbf{C}_i\mathbf{Z}^k\mathbf{\Gamma} + \overline{\mathbf{C}}_i\mathbf{Z}^k LL_i\mathbf{\Omega_{LL}} + \overline{\mathbf{C}}_i\mathbf{Z}^k ISL_i\mathbf{\Omega_{ISL}}\right] + \epsilon_i^k \tag{6}$$

where $\overline{\mathbf{C}}_i$ is the subset of control variables that excludes the landlocked and island dummies, $\mathbf{\Omega}_{LL}$ and $\mathbf{\Omega}_{ISL}$ are the coefficients to be estimated on triple interactions involving landlocked countries and islands, respectively.

3.4 Advantages of the PPML specification

The PPML specification, which is commonly used to estimate the gravity model of trade, has a number of advantages over other specifications used in studies of RCA, especially the log-linear form. The advantages of PPML are widely recognized in the empirical gravity literature. These advantages also apply to estimation of RCA indices. We briefly discuss the advantages here.

First, the PPML specification allows the inclusion of zero values of trade in the estimation. Most studies in the literature on the determinants of comparative advantage estimate with log-linear specifications like that in (4). These specifications drop products that are not exported from a given country, an outcome that likely generates selection bias.

Second, fixed effects in the PPML specification have important adding up conditions; these conditions are quite useful in the specific context of estimating RCA indices. Fally (2015) shows that, in PPML estimation, fixed effects attached to dummy variables take values such that the sum of the fitted values associated with the dummy variable equal the sum of the data associated with the dummy variable. In the context of (5) this means that the the α_i terms take values such that $\sum_k \widehat{X}_i^k = \overline{X}_i$, and the α_k terms take values such that $\sum_i \widehat{X}_i^k = \overline{X}_w^k$. In the context of a cross country RCA estimation, these adding up conditions imply that each country's α_i term effectively controls for country i's total participation in exporting $\overline{X}_i$ (or importing $\overline{M}_i$), while each product's

α_k efficiently controls for it's role in world exports X_w^k (or imports M_w^k). In this way, the explained variation in the trade flows $\left(exp\left[\mathbf{C}_i\mathbf{Z}^k\mathbf{\Gamma}\right]\right)$ matches the variation in the RCA index, since the variation due to $\overline{X}_i$ and X_w^k have been exactly purged by estimation that satisfies adding up. These adding-up conditions of the PPML specification do not obtain for log-linear regression, because of Jensen's inequality.

A (related) property of PPML specifications recognized in Fally (2015) is that they act (implicitly) as weighted regressions, with weights proportional to the dollar values of $\widehat{X}_i^k$. Fally explains that log-linear regressions apply weights of $\widehat{ln(X)}_i^k$ in this context. Log-linear specifications overweight small trade flows (relative to their contribution to world trade), and underweight large flows. While any weighting scheme has it's plusses and minuses, weights that are proportional to trade value are particularly useful in our exercise, since our specifications consider both within-product (cross-country) variation and within-country (cross-product) variation. Consistent US-dollar weighting insures cross-country size variation and cross-product size variation are treated consistently in the estimation.[14]

4 Data and Summary Statistics

In order to estimate our empirical models, we use a sample of global trade flows of 200 countries. Our sample also includes data from four country control variables and three product characteristics related to transportation costs. This database also includes the classification of every country as an island or as a landlocked territory. Below, we describe in detail all these data. We then examine some summary statistics of these data.

4.1 Data

4.1.1 Trade Data

BACI database - sourced from the Centre d'Etudes Prospectives et d'Informations Internationales (CEPII) - is the source for all import and export flows we use in all estimates.[15] This database reports the value (in USD) and weight (in kg.) for all trade flows worldwide at the combination level: year, HS6 digit product code, exporter and importer country. We thus use this database

[14] This will weight Switzerland's trade more heavily than Bolivia's in determining the effect of landlocked status on trade, a potential drawback. But by the same logic PPML will weight more heavily those products that are larger in Bolivia's trade than those that are smaller, a quite beneficial property in this context.

[15] We specifically downloaded this database from http://www.cepii.fr/CEPII/en/bdd_modele/bdd_modele_item.asp?id=37

to calculate the demand for imports and supply of exports in all countries for every product; the LHS variable in all our models. However, we specifically do so for a subsample of 200 countries for which we observed all their trade flows and we have information on all country controls and products detailed below.[16] We also use these data only for the year 2017. The composition of products a country produces and trades is expected to be stable from one year to another, for which we believe that most variation occurs at the product-country level. We thus exploit this variation of the data for estimating our models.

4.1.2 Product Characteristics

The U.S. imports data (net of imports from Mexico and Canada) - sourced from the U.S. Census – is the source to calculate all product characteristics related to transportation costs. Each record in this database reports the value (in USD) and weight (in kg) of every US import flow at the combination year, HS10 digit product code, origin country and district of entry. We thus use it as benchmark data to calculate these product characteristics. As in Hillberry and Jimenez (2022) we aggregate these data at HS6 digit product level, that is the level at which BACI reports the trade flow information. We then use these data to calculate three variables: a) the value share of every imported product shipped by air; b) the share of (air and sea) shipments that are containerized of every product; and 3) the log weight-to-value ratio of the product.[17] Additionally, we include in this vector of product characteristics the "upstreamness" index of Antràs et al. (2012) to characterize the role of every product throughout global value chains. This index helps us to determine whether islands and landlocked countries mainly focus on exporting and/or importing final goods or intermediate goods.

4.1.3 Landlocked and Island Countries

Our model includes the interaction of these product characteristics with a dummy variable equal to 1 for all landlocked countries and a dummy variable equal to 1 for all island countries. This means it is critical how we define a landlocked country and an island country. We thus denote a landlocked country as a country without access to the sea. CEPII defines these countries likewise

[16]We identify 18 countries in the BACI database for which the reported trade flows are incomplete. We specifically find that although some of their trade flows are reported, trade flow information with close partners is missing such as is the case of the trade between Guam and the US. We thus unfortunately do not observe the overall composition of products that these countries produce and trade. Along with this problem, we identify 8 countries for which data on product and country controls is not available. Hence, we cannot include them in our sample to estimate our models.

[17]All US import data are retrieved from Peter Shott's website: https://sompks4.github.io/sub_data.html.

for which we use the dummy variable that they produce to classify all countries.[18] This variable takes the value of 1 for all landlocked countries and 0 otherwise.

Now turning to our definition of an island, we came across the surprise that there is not a consensus in the literature. Although it seems trivial to define what is an island country, a discussion exists in the literature regarding what is the most appropriate way to do it.[19] One definition denotes an island country every country surrounded by water (such as in De Benedictis and Pinna (2015)). However, three dimensions conflate for defining an island: 1) smallness, 2) remoteness, and 3) vulnerability (Deidda, 2016). So, this definition includes countries such as Japan, the United Kingdom and Australia as island countries which certainly do not satisfy any of these dimensions. It also considers - as islands - countries that are not very isolated from others by sharing at least a land border with a neighbor (e.g., Haiti/Dominican Republic, UK/Ireland). An alternative definition thus consists of denoting an island country as every country located on an island not sharing a land border with another (such as in Hillberry and Zurita (2022)). This definition permits ensuring that island countries are remote and, in addition, filtering out large island countries from the sample that certainly do not satisfy any of the island's conditions such as UK and Singapore. However, this definition still leaves in the sample large countries such as Japan and Australia. We thus define an island country in this paper as all countries surrounded by water with small economies and not sharing a border with any other. In practice, we begin by identifying all countries surrounded by water. We then keep in the sample only the countries with a GDP less than US$200 billion dollars.[20] Finally, we exclude those island countries that have at least one land border.

4.1.4 Country Controls

4.1.4.1 GDP per capita and Population

We use the GDP per capita (in current USD) and population reported by CEPII at the country level in all our estimates. In all cases these variables are missing when we merge them into our trade flows database, we supplement these variables using data from the World Development Indicators,

[18] We classify by hand all countries in our sample for which CEPII does not provide a classification as a landlocked country looking at the geographical location of every country in Google Maps.

[19] Deidda (2016), for instance, indicates that the EU legislation classifies all European islands in three categories. The first category pools all islands that are whole or a part of overseas countries (e.g., Greenland and Bermuda). The second corresponds to those islands commonly known as so remote regions (e.g., French Polynesia). Finally, the third includes all continental EU islands.

[20] This exercise specifically removes from our list of islands the following countries: Australia, Indonesia, Ireland, Japan, New Zealand, Philippines, Singapore, Taiwan and UK.

IMF or UN. We also use these variables for 2015 in order to avoid any presumable simultaneous endogeneity between these variables and every country's trade flows. This allows us to ensure that there is a unique direction in the causal relationship between these variables. So, the GDP per capita effect thus can be interpreted as the effect of the presence of non-labor factors of production as well as an indicator of export sophistication. Likewise, the effect of population can be read as a measure of market size.

4.1.4.2 Market Access Measures

Our approach for constructing our buyer and seller market access measures is conventional in the literature. Denoting these measures as variables measuring the size and closeness of a seller to a buyer and vice-versa, we calculate these variables by first estimating a conventional PPML gravity model as follows:

$$V_{ij} = \exp\left(\omega_i + \omega_j + \phi \ln(Dist_{ij})\right) + \epsilon \tag{7}$$

where V_{ij} is the (aggregate) value of bilateral trade between origin i and destination j, ω_i and ω_j are origin and destination fixed effects capturing the scale of region i's exports and region j's, respectively, ϕ is the distance elasticity of trade, $Dist_{ij}$ is the distance between i and j, and ϵ is a mean zero error term. This exercise predicts a distance elasticity $\widehat{\phi}$ equals to -0.775 when we estimate it using the BACI data for 2017 and including exporter i and importer j fixed effects in the estimation.

$ln(Dist_{ij})$	N	Pseudo R2
-0.775***	32,267	0.919
(0.0309)		

We then calculate Sellers' (i.e. exporters) Market Access (SMA) of country i's as a weighted average distance to global import demand V_j. We specifically calculate it as follows:

$$SMA_i = \sum_j V_j \left(Dist_{ij}\right)^{-0.775}. \tag{8}$$

Similarly, we calculate Buyers' (i.e. importers) Market Access (BMA) of country j's as a weighted average distance to global export supply. We specifically calculate it as follows:

$$BMA_j = \sum_i V_i \left(Dist_{ij}\right)^{-0.775}. \tag{9}$$

4.1.4.3 WTO Country Membership

Finally, we use the WTO dummy from CEPII's database to capture WTO membership. This variable equals 1 when a country appears as a WTO member in a year and 0 otherwise. However, we notice this variable is equal to 0 for territories that are not completely independent from active WTO members (such as Greenland from Denmark). We update the value of this WTO variable to 1 in such cases.[21]

4.2 Summary Statistics

The final sample we use to estimate all our models includes information from a universe of 5,044 HS6-digit products. This sample also includes information from a total of 200 countries. 38 are landlocked countries (19 percent of the sample) and 39 are island countries (20 percent). In this section, we examine the summary statistics of the product transportation characteristics in our sample. We also study the characteristics of the countries.

4.2.1 Product Characteristics

Beginning with the transportation characteristics of the products in our sample, we observe that a small share of the products' traded value is shipped by air. On average, only 22 percent of the value traded of a product is moved by air (See Table 1). We also find that this share is even lower when we look at the median product. The share of the traded value shipped by air of this product only reaches 7 percent. Thus, most products in our sample are mainly shipped by sea.

This high dependency on maritime shipping clearly explains why most products in our sample are typically shipped in a container. We estimate that 70 percent of the traded value of a product in our sample is moved in a container on average. This share also reaches 83 percent for the median product. Additionally, we find that 84 percent of the products are upstream goods.

In order to examine whether there exists a relationship between these product transportation characteristics in our sample, we estimate the simple correlation among these variables(See Table 2). This exercise predicts a negative correlation between the air share of products' trade value containerized share (-0.79), and products' weight-to-value ratio (-0.72). It also reports a negative correlation between the products' weight-to-value ratio and the dummy variable identifying final

[21] We provide in Table B a detailed table with the list of all territories for which we update the WTO variable released by CEPII.

goods (-0.21), and a positive correlation of this ratio with the products' containerized share (0.46). Thus, our main conclusion from this exercise is most products shipped by air in our sample are non-containerized goods, and are light and final goods. Conversely, products shipped by vessel are typically containerized goods, heavy and upstream goods.

4.2.2 Country Controls

Turning now to the characteristics of the countries in our sample, we estimate that there exists an important variability across all countries' income levels. On average the log(GDP per capita) of the countries in our sample is 8.58 (approximately US$5,305) (See Table 3.). However, it varies from 7.42 (US$1.668) for the 25^{th} country in our sample to 9.69 (US$16,117) for the 75^{th} country. Along with this, we also estimate that there exists a marked difference between the income levels in island and landlocked countries. On average, the log(GDP per capita) in island countries is 8.9 (US$7,341), while in landlocked countries is 7.79 (US$2,422).

Now looking at the population level of all countries in our sample, we observed an even greater variability across all of them. The log(population) of the average country is 15.51 (approximately 5.4 million people) and of the median country is 15.87 (approximately 7.8 million people). However, the population level is 14.26 (US$1.6 million people) for the 25^{th} country in our sample and 17.08 (26.1 million) for the 75^{th} country. We also observe that island countries are low densely populated territories, while landlocked countries are completely the opposite. On average, the population level in island countries is 12.45 (255 thousand people), whereas in landlocked countries it is 15.94 (8.3 million people).

This summary statistics exercise also shows that both market access measures share similar distributions. On average the natural log of the seller and buyer marker access averages 23.8. They also range between 23.2 and 23.6 for the 25^{th} and 75^th country of the distribution, respectively. Countries thus with higher seller market access also experience higher levels of buyer market access and vice-versa. Additionally, this exercise reveals that island countries exhibit lower levels of market access (about 23.4), while landlocked countries hold similar levels to the overall world (at around 23.8).

Finally, most of the countries in our sample are WTO members. We calculate that about 84 percent of the total (167 countries) are active members. We also estimate that this percentage of countries reaches 77 percent among island countries (30 countries) and 84 percent among landlocked countries (31 countries).

In order to characterize the landlocked and island countries in our sample, we also estimate the correlation among all country controls including a dummy variable for landlocked countries and another for island countries (See Table 4). This exercise reaffirms most of the conclusions noted above. Island countries in our sample are countries with high GDP per capita, lower population and relatively lower levels of market access. Conversely, landlocked countries are territories with lower levels of GDP per capita, highly populated and with average market access levels.

5 Results

5.1 Transportation, production line position and RCA

Our estimation models in (5) and (6) contain a large number of coefficient estimates, which poses a challenge for reporting results. The estimates have different purposes: some as controls and some as objets of interest. Since the interactions of product characteristics with the country characteristics is novel (and also of interest to the general topic), we find it useful to report these as well. The large number of interactions involving landlocked and island dummies also poses a challenge, since it is useful to include the triple interactions for islands with the initial results for islands. We there fore take the unusual step of reporting estimates of single specifications of (5) and (6) across multiple tables, grouping separately results for control variables, islands and landlocked countries.

5.1.1 Product characteristics and country controls

Before turning to the effects of island and landlocked status on the composition of trade, we first consider interactions of our country controls and our transport characteristics. We report these results in Table 5. The regressions reported here also include interactions with the island and landlocked dummy, but we report those results in separate tables. 5 contains only the results for the control variables themselves. None of the estimates reported here include the triple interactions in specification 6.

We estimate the same specifications of (5) for exports and imports, respectively. For both imports and exports we estimate on two different sets of controls separately, and then estimate a pooled sample. The results with the pooled controls are largely similar to those with with subsets of the controls so we focus our discussion on those results, columns 3 for exports and 6 for imports.

The first four rows of Table 5 consider interactions of the product characteristics with per capita income. Column 3 shows that higher income countries' exports are less often shipped in containers, physically lighter, and less likely to be final goods than are exports of lower income countries. High income countries' imports are physically lighter and more likely to be final goods than are low income countries' imports. The coefficient on the air share of shipments is negative for both exports and imports, though not statistically significant in either case. (Punchlines...)

The next four rows of Table 5 consider interactions of product characteristics with countries' population size. Since we are controlling elsewhere for per capita income, we might expect countries with larger populations to be capable of making larger infrastructure investments. On the export side we find evidence supporting this argument as we find that large population countries' RCAs are biased towards products that are shipped by air or in containers. Following the intuition of Antras and Chor, we might expect the final stages of production chains to be located in large markets for such products. Countries with large populations have large domestic markets, and Column 3 evidence points to their RCAs in exporting to be biased towards final goods. Presumably this is a sort of home-market effect coming from their tendency to produce the final stages of production. We do not find strong evidence of any bias in large population countries imports, though the air shipment coefficient is significant at the ten percent level, and of the same sign as the coefficient on exports.

We next turn to market access variables, using sellers' market access variable in the exports regressions and buyers' market access in the import regressions. We might expect more geographically central countries to be more engaged in international trade, and therefore to make greater investments in trade-related infrastructure. We might also expect On the export side, more geographically central countries are much more likely to export products that are often containerized, physically lighter, and final products. The sign patterns on the sellers market access interactions match those of the interactions with population, consistent once again with the intuition of Antràs and de Gortari (2020). On the import side, more geographically central regions import more air-shipped products, more containerized products and physically physically heavier products. It seems likely that infrastructure investments necessary to support air freight and containerized shipments are more useful for geographically central regions. The tendency of more central regions to export final products is consistent with Antràs and de Gortari (2020). The import of somewhat heavier products and export of lighter products may also suggest that value is being added as production stages are organized to move goods from remote to more central regions.

The interactions with the WTO dummy show that WTO members trade is quite different than that of non-members. WTO members exports are much more likely to move by air, to be containerized, to be physically light, and to be final products. The magnitudes of these effects are quite large. On the import side, we find air shipment much more common among WTO members. Infrastructure investments and or policy may support larger share of air shipments. WTO members imports are less final than those of non-WTO members, suggesting net trade between the two sets of countries, with non-members selling upstream products to members in return for final products.

5.1.2 Main results

While these results are interesting (and novel), they are not the primary focus of our estimates. We turn next to results of interactions of the product characteristics with landlocked and island status. Although the results in both tables are taken from the same specification, we report them in separate tables. We report results for landlocked countries' in Table 6 and islands in Table 7.Columns 1-4 of both tables are from 5, while columns 5-6 include the triple interactions described in 6.

We first consider results for landlocked countries. In columns 1 (for exports) and 3 (for imports) we report results for a specification of 5 that includes only transport characteristics. In columns 2 and 4 we also include dummy variable indicating that the product is a final product.

Among landlocked countries, we find that the sign pattern on interactions involving the transport characteristics is consistent across both exports and imports. Although not all coefficients are statistically significant, the sign pattern suggests that landlocked countries' trade is less likely to travel by air, more likely to be containerized, and less physically heavy than trade of reference countries, though not all coefficients are significant. Coefficients on the weight-to-value ratio are negative and statistically significant for both exports and imports. Landlocked countries imports are more likely to be containerized. Imports of products that are fully containerized are approximately 40 percent higher than products that are not typically containerized. The fact that both imports and exports of light products are relatively more burdened in landlocked countries, suggests compositional insight into the literature surrounding landlocked countries trade. The importance of containerization for imports suggests that physical infrastructure to support such freight might be important in those settings.

Inclusion of the final products dummy does not change the sign or significance of the transport variables. We find no statistically significant effect of products production line position on the composition landlocked countries' trade.

When we turn to island countries we find that their exports are more likely to be containerized than in the reference country, and more likely to be final products. The coefficient on the interaction with products' air share of shipments and weight to value are negative, though not statistically significant.[22] This sign pattern for both variables is negative, but not in a statistically significant. We note that the same sign pattern for these variables exists on the import side.

On the import side, the coefficients on air share and container share in columns 3 and 4 are large, negative and statistically significant. It seems that islands' purchase a disproportionate amount of sea-shipped, non-containerized freight. A large share of these imports are likely to be fuels, which islands are unable to purchase via other modes of transport. After controlling for air shipment and containerized products, we find no statistically significant effects of product weight or production line position on islands imports. The key lesson for islands seems to be that sea freight is relatively more important than air freight, and that port facilities for both containerized and non-containerized freight are needed.

The negative coefficients on interactions with the air share for both imports and exports points to the outsize importance of sea-shipping for islands' trade. On the export side, it seems that islands have a strong tendency to specialize in products that can be shipped in containers. The coefficient

[22]The coefficient on the interaction with weight-to-value is significant when we don't include the final product dummy, but becomes insignificant when we include the dummy

of 0.910 in column 2 implies that islands' RCA in that product is nearly 2.5 times larger than that of product not shipped at all in containers. The coefficient on the final goods dummy also indicates a strong tendency towards island specializing in final products. The coefficient of 0.607 implies that islands exports of final products are approximately 83 percent higher than those of upstream goods, after controlling for product and country size effects. On the import side, the large and statistically significant coefficients imply a bias against air-shipped imports of 88 percent, and a bias against containerized imports of 61 percent.

Inclusion of the final products dummy does not change the sign or significance of the transport variables. We find no statistically significant effect of products production line position on the composition landlocked countries' trade.

5.1.3 Triple interactions

We next turn to triple interactions that consider the joint effect of two country coefficients and one product characteristic. We interact the island and landlocked dummies, respectively with the a cross between product characteristics we consider and the other country characteristics (per capita income, population, etc.) The purpose of this exercise is to consider variation in the composition of trade that occurs within the island and landlocked country groups respectively. Of particular importance are the interactions with the market access variables, for these describe how geographic position can exacerbate/offset countries status. We will also focus on the effects of WTO status within groupings, since this is a policy choice.

Considering the other country characteristics, we find that islands with either high populations or high incomes tend to export heavier products. Large population islands are also more likely to export final goods. We do not have a preferred interpretation of these results, though perhaps they describe the effects of an extensive margin of trade that operates with country size. We find that larger population islands import relatively more air-shipped, containerized, and heavy products. This would be consistent with larger population having better infrastructure for trade than lower population islands.

Looking at triple interactions that include per capita income and population, we find relatively variables that reveal differences across landlocked countries. Higher income landlocked countries exports contain quite a bit more airshipped products than their low income counterparts. This may reflect either home market effects, infrastucture or both. It seems that low population landlocked countries are more specialized in final products. On the import side, higher poluation landlocked countries import more airshipped products. The sign on the same interaction is positive for exports (though slightly less significant), pointing to airport infrastructure as a likely cause of these effects.

Turning to interactions with the market access variable, we find that geographically central islands are much less likely to export final products. It may be that geographically central islands are better able to participate in global supply chains than are remote islands. On the import sign there is only weak evidence that the effects of island status vary with market access.

Geographically central landlocked countries are much more likely to export containerized products, and final products, than are less central landlocked countries. Infrastructure for containerized freight may be important in the first instance. Proximate access to geographically central consumers may be most important in the latter case. On the import side, we find relatively little variation in the characteristics of trade within landlocked countries, except that geographically central countries import relatively less final products.

Turning to interactions with WTO status, we find that islands that are WTO members purchase much less containerized freight, and are more likely to purchase upstream products. On the import side, islands that are WTO members purchase more air-shipped products, more containerized freight, heavier products and more final products than non-member islands.

Among landlocked countries, we find that WTO members exports are less airshipped, less containerized and less final than non-members' exports. On the import side, WTO members purchase more containerized freight and more final products.

6 Conclusion

We estimate the relationship between countries' geographic location and the product composition of their exports and imports. Our hypothesis is that landlocked countries and small islands are burdened by unique transport frictions, and we ask if the revealed comparative advantage of exports and imports in these countries is related to cross-product variation in product characteristics related to transportation constraints on individual products. Since countries that face unusually high transport costs are disadvantaged in a world of multi-stage production, we also investigate the question of whether landlocked countries and islands trade less in upstream products than do other countries.

We find that both the imports and exports of landlocked countries are biased against products with low weight-to-value ratios. Products normally shipped in containers over-represented in landlocked countries' imports. Small island countries revealed comparative advantage of exports is biased in the direction of containerized freight and in the direction of final products. These countries imports are biased against air-shipped and containerized freight, an outcome consistent with islands disproportionate reliance on imported fuels. The effects of transport-related characteristics on the composition of imports and exports is are heterogeneous with landlocked countries and within small islands. There is substantial variation within each country group that can be explained by countries' per capita income, population, geographic location, and WTO member status.

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7 Tables

Table 1: Summary Statistics - Product Transportation Characteristics

	# Obs.	Mean	Std. Dev	Min	Perc. 25	Median	Perc. 75	Max
Air share^k	5,044	0.22	0.29	0.00	0.01	0.07	0.31	1.00
Ctnr share	5,044	0.70	0.32	0.00	0.49	0.83	0.96	1.00
$\ln(WV^k)$	5,044	-1.98	1.73	-14.50	-2.87	-1.93	-0.93	4.29
Dummy Final^k	5,044	0.16	0.37	0	0	0	0	1

Note: Air share^k is the share of every product k shipped by air. *Ctnr share* is the share of every product k shipped in a container. $\ln(WV^k)$ is the natural log of the weight-to-value ratio of every product k. Dummy Final^k is a dummy variable equal to 1, if a product k is a final good, and to 0 if it is an upstream product.

Table 2: Correlation - Product Transportation Characteristics

	Air share^k	*Ctnr share*	$\ln(WV^k)$	Dummy Final^k
Air share^k	1.00			
Ctnr share	-0.79	1.00		
$\ln(WV^k)$	-0.72	0.46	1.00	
Dummy Final^k	0.06	-0.01	-0.21	1.00

Note: Air share^k is the share of every product k shipped by air. *Ctnr share* is the share of every product k shipped in a container. $\ln(WV^k)$ is the natural log of the weight-to-value ratio of every product k. Dummy Final^k is a dummy variable equal to 1, if a product k is a final good, and to 0 if it is an upstream product.

Table 3: Summary Statistics - Country Control Variables

	# Obs.	Mean	Std. Dev	Min	Perc. 25	Median	Perc. 75	Max
LL_i	200	0.19	0.39	0	0	0	0	1
ISL_i	200	0.20	0.40	0	0	0	0	1
$\ln(\text{GDP pc})_i$	200	8.58	1.44	5.72	7.42	8.54	9.69	11.53
$\ln(\text{Pop})_i$	200	15.51	2.25	9.21	14.26	15.87	17.08	21.04
$\ln(\text{SMA})_i$	200	23.80	0.43	22.85	23.49	23.68	24.07	24.85
$\ln(\text{BMA})_j$	200	23.81	0.42	22.89	23.51	23.70	24.07	24.84
WTO_i	200	0.84	0.37	0	1	1	1	1

Note: LL_i is a dummy variable equal to 1, if a country i is landlocked, and to 0 otherwise. ISL_i is a dummy variable equal to 1, if a country i is an island, and to 0 otherwise. $\ln(\text{GDPpc})_i$ is the natural log of the country's i GDP percapita. $\ln(\text{Pop})_i$ is the natural log country's i population. SMA stands for Seller Market Access and BMA for Buyer Market Access of country i. WTO_i is a dummy variable equal to 1, if a country i is a WTO member nation, and to 0 otherwise.

Table 4: Correlation - Country Control Variables

	LL_i	ISL_i	$\ln(\text{GDP pc})_i$	$\ln(\text{Pop})_i$	$\ln(\text{SMA})_i$	$\ln(\text{BMA})_j$	WTO_i
LL_i	1.00						
ISL_i	-0.24	1.00					
$\ln(\text{GDP pc})_i$	-0.26	0.11	1.00				
$\ln(\text{Pop})_i$	0.09	-0.67	-0.19	1.00			
$\ln(\text{SMA})_i$	0.07	-0.42	0.43	0.28	1.00		
$\ln(\text{BMA})_j$	0.08	-0.41	0.41	0.27	0.98	1.00	
WTO_i	-0.03	-0.09	0.14	0.21	0.06	0.03	1.00

Note: LL_i is a dummy variable equal to 1, if a country i is landlocked, and to 0 otherwise. ISL_i is a dummy variable equal to 1, if a country i is an island, and to 0 otherwise. $\ln(\text{GDPpc})_i$ is the natural log of the country's i GDP percapita. $\ln(\text{Pop})_i$ is the natural log country's i population. SMA stands for Seller Market Access and BMA for Buyer Market Access of country i. WTO_i is a dummy variable equal to 1, if a country i is a WTO member nation, and to 0 otherwise.

Table 5: Composition of Export Supply and Import Demand

	X_i^k			M_i^k		
VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
Air share^k $\times$ ln(GDPpc)$_i$	-0.00656		-0.0579	-0.0281		-0.0885
	(0.138)		(0.147)	(0.119)		(0.125)
Ctnr share $\times$ ln(GDPpc)$_i$	-0.0391		-0.223***	-0.00323		-0.0127
	(0.0776)		(0.0761)	(0.0554)		(0.0590)
ln(WV^k) $\times$ ln(GDPpc)$_i$	-0.0667***		-0.0448**	-0.0429**		-0.0486**
	(0.0217)		(0.0225)	(0.0188)		(0.0202)
Dummy Final^k $\times$ ln(GDPpc)$_i$	-0.120***		-0.169***	0.218***		0.235***
	(0.0456)		(0.0530)	(0.0313)		(0.0325)
Air share^k $\times$ ln(Pop)$_i$	0.222***		0.210**	0.0862		0.122*
	(0.0850)		(0.0904)	(0.0730)		(0.0694)
Ctnr share $\times$ ln(Pop)$_i$	0.245***		0.264***	-0.0517		-0.0327
	(0.0491)		(0.0487)	(0.0417)		(0.0418)
ln(WV^k) $\times$ ln(Pop)$_i$	-0.0156		-0.0219*	0.0145		0.0197*
	(0.0113)		(0.0127)	(0.0113)		(0.0116)
Dummy Final^k $\times$ ln(Pop)$_i$	0.0940***		0.103***	-0.0143		-0.0182
	(0.0363)		(0.0382)	(0.0267)		(0.0275)
Air share^k $\times$ ln(MA)$_i$		-0.166	0.155		0.519**	0.687***
		(0.362)	(0.414)		(0.222)	(0.218)
Ctnr share $\times$ ln(MA)$_i$		0.640***	1.088***		0.312**	0.262**
		(0.182)	(0.198)		(0.124)	(0.134)
ln(WV^k) $\times$ ln(MA)$_i$		-0.166***	-0.157***		0.0410	0.0857***
		(0.0515)	(0.0607)		(0.0287)	(0.0315)
Dummy Final^k $\times$ ln(MA)$_i$		0.0772	0.370**		0.00622	-0.110
		(0.125)	(0.160)		(0.0725)	(0.0773)
Air share^k $\times$ WTO$_i$		1.860***	1.727***		1.007***	0.968***
		(0.634)	(0.650)		(0.369)	(0.366)
Ctnr share $\times$ WTO$_i$		1.544***	1.627***		-0.167	-0.0927
		(0.421)	(0.456)		(0.166)	(0.178)
ln(WV^k) $\times$ WTO$_i$		-0.365***	-0.289***		0.00989	0.0563
		(0.0748)	(0.0729)		(0.0446)	(0.0474)
Dummy Final^k $\times$ WTO$_i$		0.826***	0.949***		-0.0132	-0.367***
		(0.298)	(0.313)		(0.113)	(0.118)
Constant	14.74***	1.761	-10.51***	19.33***	15.01***	16.99***
	(0.998)	(3.376)	(3.740)	(0.581)	(1.960)	(2.285)
Observations	1,008,800	1,008,800	1,008,800	1,008,800	1,008,800	1,008,800
Pseudo R2	0.774	0.774	0.781	0.868	0.865	0.869

Note: Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Models (1)-(3) have as LHS variable the exports X_i^k of country i and HS6 digit product k. Models (4)-(6) have as LHS variable the imports M_i^k of country i and HS6 digit product k. *Ctnr share* in the containerized share of product k. (WV^k) is the ratio (Weight/Value)^k of product k. ln(GDPpc)$_i$ is the natural log of the country's i GDP percapita. ln(Pop)$_i$ is the natural log country's i population. $(MA)_i$ is the Market Access measure of country i. All models are estimated with country and year fixed effects using the PPML estimator over a database of import and export flows respectively in 2017 at the country-product level.

Table 6: Composition of Export Supply and Import Demand of Landlocked Countries

VARIABLES	X_i^k (1)	(2)	M_i^k (3)	(4)	X_i^k (5)	M_i^k (6)
Air share$^k \times LL_i$	-0.0971	-0.230	-0.203	-0.139	-48.46	1.240
	(0.416)	(0.426)	(0.248)	(0.229)	(37.48)	(14.95)
Ctnr share $\times LL_i$	0.315	0.276	0.316***	0.330***	-32.29*	-11.65*
	(0.259)	(0.268)	(0.122)	(0.123)	(18.22)	(6.599)
$\ln(WV^k) \times LL_i$	-0.121**	-0.137**	-0.0683**	-0.0595*	-9.479	0.811
	(0.0518)	(0.0545)	(0.0320)	(0.0329)	(8.008)	(2.652)
Dummy Final$^k \times LL_i$		-0.147		0.0605	-34.23***	16.82***
		(0.161)		(0.0913)	(10.28)	(3.869)
Air share$^k \times LL_i \times \ln(\text{GDPpc})_i$					1.281***	0.223
					(0.413)	(0.207)
Ctnr share $\times LL_i \times \ln(\text{GDPpc})_i$					-0.260	-0.161*
					(0.226)	(0.0956)
$\ln(WV^k) \times LL_i \times \ln(\text{GDPpc})_i$					0.0490	-0.0107
					(0.0495)	(0.0260)
Dummy Final$^k \times LL_i \times \ln(\text{GDPpc})_i$					-0.291	-0.0437
					(0.201)	(0.0857)
Air share$^k \times LL_i \times \ln(\text{Pop})_i$					0.712*	0.517**
					(0.407)	(0.231)
Ctnr share $\times LL_i \times \ln(\text{Pop})_i$					-0.429	0.147
					(0.314)	(0.108)
$\ln(WV^k) \times LL_i \times \ln(\text{Pop})_i$					0.139*	0.0218
					(0.0839)	(0.0387)
Dummy Final$^k \times LL_i \times \ln(\text{Pop})_i$					-0.270**	0.0257
					(0.132)	(0.0738)
Air share$^k \times LL_i \times \ln(\text{MA})_i$					1.138	-0.479
					(1.517)	(0.588)
Ctnr share $\times LL_i \times \ln(\text{MA})_i$					1.781**	0.432
					(0.856)	(0.271)
$\ln(WV^k) \times LL_i \times \ln(\text{MA})_i$					0.279	-0.0462
					(0.291)	(0.0953)
Dummy Final$^k \times LL_i \times \ln(\text{MA})_i$					1.741***	-0.709***
					(0.477)	(0.180)
Air share$^k \times LL_i \times \text{WTO}_i$					-4.346***	-0.156
					(1.162)	(0.452)
Ctnr share $\times LL_i \times \text{WTO}_i$					-1.744**	0.682***
					(0.781)	(0.264)
$\ln(WV^k) \times LL_i \times \text{WTO}_i$					-0.237	0.0218
					(0.174)	(0.0592)
Dummy Final$^k \times LL_i \times \text{WTO}_i$					-1.507***	0.654***
					(0.492)	(0.157)
Constant	-7.688**	-10.38***	18.15***	18.47***	-9.784**	18.71***
	(3.672)	(3.830)	(2.395)	(2.371)	(3.982)	(2.482)
Observations	1,008,800	1,008,800	1,008,800	1,008,800	1,008,800	1,008,800
Pseudo R2	0.780	0.781	0.869	0.870	0.783	0.870

Note: Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Models (1),(2) and (5) have as LHS variable the exports X_i^k of country i and HS6 digit product k. Models (3), (4) and(6) have as LHS variable the imports M_i^k of country i and HS6 digit product k. *Ctnr share* is the containerized share of product k. (WV^k) is the ratio (Weight/Value)^k of product k. ln(GDPpc)$_i$ is the natural log of the country's i GDP percapita. ln(Pop)$_i$ is the natural log country's i population. $(MA)_i$ is the Market Access measure of country i. LL$_i$ is a dummy variable equal to 1, if a country i is landlocked, and to 0 otherwise. All models are estimated with country and HS6 product fixed effects using the PPML estimator over a database of import and export flows respectively in 2017 at the country-product level. All variables from Table 5 are also included, as well as the same double and triple interacted variables listed above for island countries.

Table 7: Composition of Export Supply and Import Demand of Island Countries

	X_i^k		M_i^k		X_i^k	M_i^k
VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
Air share$^k \times ISL_i$	-1.276	-0.654	-2.005***	-2.100***	-73.34	50.55
	(0.818)	(0.810)	(0.561)	(0.706)	(47.46)	(38.62)
$Ctnr\ share \times ISL_i$	0.878**	1.027***	-0.920***	-0.941***	40.32*	33.04**
	(0.357)	(0.363)	(0.243)	(0.277)	(20.82)	(14.54)
$\ln(WV^k) \times ISL_i$	-0.261**	-0.171	-0.0682	-0.0814	-2.529	7.132
	(0.121)	(0.122)	(0.0723)	(0.0935)	(5.645)	(4.888)
Dummy Final$^k \times ISL_i$		0.606***		-0.0683	24.26*	6.353
		(0.230)		(0.281)	(13.92)	(13.17)
Air share$^k \times ISL_i \times$ ln(GDPpc)$_i$					-0.0345	1.139*
					(0.775)	(0.613)
$Ctnr\ share \times ISL_i \times$ ln(GDPpc)$_i$					-0.232	0.138
					(0.371)	(0.215)
$\ln(WV^k) \times ISL_i \times$ ln(GDPpc)$_i$					0.288***	0.151**
					(0.0990)	(0.0739)
Dummy Final$^k \times ISL_i \times$ ln(GDPpc)$_i$					0.151	-0.276
					(0.243)	(0.308)
Air share$^k \times ISL_i \times$ ln(Pop)$_i$					0.947	1.021***
					(0.711)	(0.389)
$Ctnr\ share \times ISL_i \times$ ln(Pop)$_i$					0.0790	0.377***
					(0.250)	(0.138)
$\ln(WV^k) \times ISL_i \times$ ln(Pop)$_i$					0.235***	0.108**
					(0.0833)	(0.0458)
Dummy Final$^k \times ISL_i \times$ ln(Pop)$_i$					0.244	-0.0731
					(0.150)	(0.168)
Air share$^k \times ISL_i \times$ ln(MA)$_i$					2.594	-3.474*
					(1.837)	(1.784)
$Ctnr\ share \times ISL_i \times$ ln(MA)$_i$					-1.529	-1.784***
					(0.952)	(0.672)
$\ln(WV^k) \times ISL_i \times$ ln(MA)$_i$					-0.162	-0.445**
					(0.234)	(0.226)
Dummy Final$^k \times ISL_i \times$ ln(MA)$_i$					-1.113*	-0.202
					(0.648)	(0.651)
Air share$^k \times ISL_i \times$ WTO$_i$					-2.598	5.910***
					(3.021)	(2.240)
$Ctnr\ share \times ISL_i \times$ WTO$_i$					-1.940*	2.181***
					(1.030)	(0.772)
$\ln(WV^k) \times ISL_i \times$ WTO$_i$					0.137	0.561**
					(0.332)	(0.237)
Dummy Final$^k \times ISL_i \times$ WTO$_i$					-2.255***	2.264**
					(0.718)	(1.031)
Constant	-7.688**	-10.38***	18.15***	18.47***	-9.784**	18.71***
	(3.672)	(3.830)	(2.395)	(2.371)	(3.982)	(2.482)
Observations	1,008,800	1,008,800	1,008,800	1,008,800	1,008,800	1,008,800
Pseudo R2	0.780	0.781	0.869	0.870	0.783	0.870

Note: Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Models (1),(2) and (5) have as LHS variable the exports X_i^k of country i and HS6 digit product k. Models (3), (4) and(6) have as LHS variable the imports M_i^k of country i and HS6 digit product k. *Ctnr share* is the containerized share of product k. (WV^k) is the ratio (Weight/Value)^k of product k. ln(GDPpc)$_i$ is the natural log of the country's i GDP percapita. ln(Pop)$_i$ is the natural log country's i population. $(MA)_i$ is the Market Access measure of country i. ISL$_i$ is a dummy variable equal to 1, if a country i is an island, and to 0 otherwise. All models are estimated with country and product fixed effects using the PPML estimator over a database of import and export flows respectively in 2017 at the country-product level. All variables from Table 5 are also included, as well as the same double and triple interacted variables listed above for landlocked countries.

Appendixes

A Summary Statistics

Table A1: Country Controls for Island and Landlocked Countries

Panel A. Island Countries								
	# Obs.	Mean	Std. Dev	Min	Perc. 25	Median	Perc. 75	Max
$\ln(\text{GDPpc})_i$	39	8.90	1.08	6.00	8.13	9.00	9.73	10.83
$\ln(\text{Pop})_i$	39	12.45	1.87	9.21	11.44	12.49	13.56	17.00
$\ln(\text{SMA})_i$	39	23.43	0.33	22.85	23.17	23.43	23.59	24.30
$\ln(\text{BMA})_j$	39	23.46	0.32	22.89	23.21	23.51	23.62	24.22
WTO_i	39	0.77	0.43	0	1	1	1	1

Panel B: Landlocked Countries								
	# Obs.	Mean	Std. Dev	Min	Perc. 25	Median	Perc. 75	Max
$\ln(\text{GDPpc})_i$	38	7.79	1.51	5.72	6.59	7.67	8.61	11.53
$\ln(\text{Pop})_i$	38	15.94	1.08	13.25	15.51	16.09	16.68	18.42
$\ln(\text{SMA})_i$	38	23.86	0.45	23.22	23.48	23.77	23.99	24.85
$\ln(\text{BMA})_j$	38	23.88	0.45	23.28	23.53	23.79	24.00	24.84
WTO_i	38	0.82	0.39	0	1	1	1	1

Note: $\ln(\text{GDPpc})_i$ is the natural log of country's i GDP percapita. $\ln(\text{Pop})_i$ is the natural log country's i population. SMA stands for Seller Market Access and BMA for Buyer Market Access. WTO_i is a dummy variable equal to 1, if a country i is a WTO member nation, and to 0 otherwise.

B Adjusted non-WTO Countries' Membership from the CEPII Database

Adjusted WTO Country Membership from CEPII	Related WTO Country Member
COK	NZL
GRL	DNK
NCL	FRA
PYF	FRA
SHN	GBR

Note: All codes correspond to the ISO country codes. Column Adjusted WTO Country Membership lists all countries not completely independent from a WTO member classified in the CEPII database as a non-WTO member. Column Related WTO Country Member reports the WTO membership to which every country in column Adjusted WTO Country Membership is related.