Oligopolies in Trade and Transportation: Implications for the Gains from Trade

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Preliminary. Do not circulate.

Abstract

Transportation services are crucial for goods to move globally; however, given the concentration in the industry, the realized gains from trade are smaller due to the presence of market power. We study the interplay between oligopoly in the transportation industry and oligopsony power retained by non-atomistic importers. We leverage transaction-level data from Chilean customs to document several empirical facts: (i) market concentration in the transportation sector and among importers, and (ii) that transportation prices are highly dispersed and are the outcome of bilateral negotiations. We then develop a trade model that departs from the usual iceberg cost assumption and allows for two-sided market power in the transportation industry. We find that transport carriers charge large markups, but importers benefit from substantial bargaining power. Finally, we embed the bilateral bargaining framework into a quantitative trade model of importing. We show that market concentration reduces the pass-through of tariff shocks to gains from trade, and that the welfare implications of trade liberalization are different when accounting for the strategic interaction between the transportation sector and importers.

Keywords: Transportation, Transport Costs, Market Power, Gains From Trade.

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1 Introduction

Every year, over $20 trillion of international trade flows are carried around the globe by the transportation sector. Recent events such as the 2021 Suez Canal obstruction, the severe port congestion in 2021-2022, and the piracy and terrorist attacks in the Red Sea in 2023 and 2024 have demonstrated the crucial and indispensable role of the transportation sector for global trade and economic growth. Yet, little is known about the market structure of the transportation sector and how prices in the market for transportation services are determined.

In this paper, we study how imperfect competition and bilateral negotiations in the transportation sector impact the determination of transportation prices, and their effects on trade flows, gains from trade, and shock transmission. We document that the transportation sector is highly concentrated, and transportation prices are the outcome of bilateral negotiations between transportation carriers and importers. However, these features are usually absent from models in the trade literature. Most conventional quantitative trade frameworks assume the presence of iceberg trade costs, treating the price of transportation services as an exogenous multiplicative friction.

Conversely, in our study we depart from this simplifying assumption by introducing a model in which transportation prices are an endogenous outcome stemming from bargaining between importers and carriers. This extension allows us to understand quantitatively the importance of market power in the transportation sector as an additional friction to international trade. In particular, we show that the degree of concentration in firms and carriers matters for the pass-through of tariff shocks to trade and welfare.

We start our analysis by leveraging detailed customs data from Chile to document several key empirical facts about the market structure of the transportation sector and the determination of transportation service prices. For each international shipment, customs authorities collect detailed information on freight costs, the transportation mode, and the carrier performing the last leg of the shipment before clearing customs, along with standard information such as importer identity, product code (HS8), country of production and origin of the shipment, and the value and quantity shipped. These features of the data allow us to measure freight unit prices at the shipment level.

The customs transactions enable us to document a high degree of concentration in the transportation sector. We document that, from the same origin, multiple modes of transportation are used, but firms tend to rely on a single mode. However, each firm uses multiple carriers, and carriers serve multiple firms at the same time. This motivates us to define a market in which carriers compete as a combination of mode of transportation (sea, air, and road), country of origin, and HS4 sector. We then construct the Herfindahl-Hirschman Index (HHI) by computing the share of imports that each carrier operates within a given market. The average HHI index across markets is 0.55, far above the threshold value of 0.25 often used to define an industry as oligopolistic. This evidence suggests that carriers exerting some degree of market power might be relevant in international shipping.

We provide reduced-form evidence in line with carriers and importers negotiating bilaterally over the price of transportation services. The data reveal significant dispersion in the unit freight price that a carrier charges within the same market. We show that the coefficient of variation in unit freight cost within a carrier-market is, on average, 0.9 and not proportional to the value of the shipment, in contrast to the "iceberg" assumption. A statistical decomposition of unit freight price dispersion within a carrier-market-time combination further shows that 89% of the variation is specific to the carrier-importer relationship. Lastly, within a carrier-market pair, unit freight prices decrease with the importer's share of the carrier's total quantity and increase with the carrier's share of the importer's total imports. This is consistent with the presence of importer-carrier bilateral bargaining and buyer and seller market power.

Inspired by these facts, we develop a theory in which transportation carriers and importers bilaterally bargain over the price of transportation services, exerting both seller and buyer market power. Carriers exert seller market power as they compete in a standard oligopoly due to their non-atomistic nature, in line with the empirical evidence. Importers are also non-atomistic and exert buyer market power (oligopsony) as they internalize the upward-sloping supply curve of the carriers. We assume carriers and importers undertake Nash-in-Nash negotiations, and equilibrium unit freight prices reflect the relative bargaining power along with oligopoly and oligopsony incentives.

We bring the theory to the data to structurally estimate the relative bargaining power of carriers and importers. Following Alviarez et al. (2023), we leverage the network structure of the data to identify and estimate the key parameters via GMM. Using Hausman-type instrumental variables, we first estimate the within-market substitutability across carriers to be 3, indicating the presence of sizeable markups in the transportation sector. On average across markets, importers exert buyer market power due to a carriers' supply elasticity of 0.43, and they are estimated to have 2.5 times more bargaining power than carriers. We then show that both buyer market power and importers' bargaining power correlate positively (negatively) with the number of carriers (importers) operating in the market, validating our estimates.

We embed the bilateral bargaining framework into a quantitative trade model of importing to assess the effects of imperfect competition and bilateral negotiations in the transportation sector. The economy is populated by a finite number of heterogeneous domestic firms that produce and sell a differentiated product both domestically and internationally, in the presence of roundabout production (Caliendo and Parro, 2015). Firms have the option of importing a bundle of foreign intermediate inputs, subject to fixed costs of importing. Imported inputs increase firm productivity as they imperfectly substitute domestic inputs (Halpern et al., 2015; Blaum et al., 2018). Importers engage in Nash-in-Nash negotiations over the unit freight price in a transportation market populated by a finite number of heterogeneous carriers with an upward-sloping supply curve.

Why accounting for the market structure of the transport sector and bilateral bargaining is important for international trade? We emphasise their role through three counterfactual experiments. First, we compare the predictions of our benchmark model with those of an economy in which there is no market power in international transport. Second, we consider two different economies in which one side of the market has all the bargaining power. Third, we study its implications for the pass-through of trade shocks (increase in the price of imports) in the presence of dual market power and compare it to an economy where transportation prices are perfectly competitive.

Related Literature We contribute to the large literature in international trade focusing on the role of trade costs (Anderson and Van Wincoop, 2003; Eaton and Kortum, 2002). We contribute to this literature considering the features and the market structure of the transportation industry, endogeneizing transportation prices in a model of bilateral bargaining with both buyer and seller market power. Early work by Hummels et al. (2009) explores the role of market power and price discrimination in the shipping industry using aggregate data. More recently, with the availability of transaction level data,[1] Ignatenko (2020) shows firm size affects freight charges in a model of price discrimination through quantity discounts; Asturias (2020) explores how the number of shipping firms impacts transport prices and trade flows. In a model with market power in the upstream transportation sector, Ardelean and Lugovskyy (2023) introduce search and information frictions in the downstream importing sector. Brancaccio et al. (2020) also endogeneize transport costs in the presence of search frictions between exporters and transport firms. Wong (2022) endogeneizes transportation prices in a model with "round-trip" effect.[2]

Our paper contributes also to the limited literature on firm-to-firm trade. Novel empirical work is made possible by the recent availability of domestic and international firm-to-firm transaction data. Using domestic firm-to-firm transactions, Alfaro-Urena et al. (2022) focus on the effects of establishing a first linkage with a multinational buyer; Dhyne et al. (2022) develop a model of oligopolistic competition in firm-to-firm trade to rationalise the positive relationship between suppliers' markups and the supplier's share among their buyers. Using international firm-to-firm transactions, Alviarez et al. (2023) develop a pricing theory of firm-to-firm trade accounting for both oligopoly and oligopsony forces in the U.S. import data; Gopinath and Itskhoki (2011) and Grossman and Helpman (2020) develop theories of bargaining in firm-to-firm trade across borders and discuss the implications for exchange-rate pass-through and the organization of supply chains, respectively. Our contribution is new empirical evidence from the international transportation market and the focus on the implications for trade flows and the gains from trade.

Our quantitative analysis and counterfactual exercises contribute to the literature that measures how consumer welfare is affected by international trade (Arkolakis et al., 2012). Our quantitative framework is inspired by models of input trade with firm heterogeneity, e.g. Halpern et al. (2015) and Blaum et al. (2018). Relative to these works, we quantify the

[1] Ardelean et al. (2022) surveys the recent academic research on maritime shipping stemmed from the explosion of new micro data sets in shipping and international trade.

[2] Our work is also tangentially related to the literature on port infrastructure, network effects, and congestion (Heiland et al., 2019; Do et al., 2024; Ganapati et al., 2021).

welfare impact in the presence of endogenous trade costs arising from bilateral bargaining. Our work is also related to the literature investigating the determinants of shock transmission across borders. Several works have shown the importance of market structure for the pass-through rate of exchange rate fluctuations (Atkeson and Burstein, 2008; Amiti et al., 2019a) or tariffs (Alviarez et al., 2023; Amiti et al., 2019b). In this regard, we leverage our quantitative framework to study how endogenous transportation costs influence the transmission of tariff shocks.

The rest of the paper is structured as follows: Section 2 provides a set of stylized facts on the transportation industry and bilateral bargaining on unit freight prices. Section 3 presents and structurally estimates the model of bargaining over unit freight prices. Section 4 describes the quantitative model, its estimation, and the counterfactual exercises. Section 5 concludes. The Appendices contain additional tables and figures, derivations of key theoretical results, and additional data and estimation details.

2 Stylized Facts on Dual-Market Power

2.1 Data

We use transaction-level data on imports from Chilean Customs covering the period 2007-2022. The data includes information on the party conducting the transaction such as the importer, the exporter, the product, the mode of transport (sea, air, and road freight), the port of entry [3], and the country of origin. There is also information on the content of the transactions themselves such as the product code (HS8), the weight, the number of items, both the CIF and FOB values, and freight values. More importantly for this project, we also observe the name of the shipping company that took care of the transportation of the goods. A full list of the variables used can be found in Appendix C.

We collapse the data at the yearly level by importer-country of origin-carrier-product-transport mode. A key challenge in the data cleaning process is the identification of the carrier company. The data are not standardized, and the name of the carrier company is often misspelled or written in different ways. We use a combination of string matching and manual inspection to identify the carrier company. More details about the data cleaning process can be found in Appendix C.2.

We choose to focus our attention on imports for two reasons. First, Chilean exports are mostly driven by trade in commodities, with ores and metals accounting for almost 50% of the total value.[4] Second, and more important to our analysis, customs data contain information on the party responsible for arranging the shipping contract, the so-called INCOTERMS - the International Chamber of Commerce's International Commerce Terms. According to

[3]The Chilean custom refers as port of entry where custom declaration for the good is processed and can be either a maritime port, an airport or a border entry point.

[4]Source UNCTAD statistics on Chile year 2022.

INCOTERMS, any transaction is classified in two categories depending on whether it is the importer's or the exporter's responsibility to arrange the international shipping of the good. In line with previous literature (Ardelean and Lugovskyy, 2023; Teshome, 2018), we find that the majority of international shipments are arranged by the importing firm (Figure E.1 in Appendix E).

Structure of Chilean Freight Market In line with aggregate statistics on international trade and international shipping [5], Figure E.1 in Appendix E shows that also in our sample, maritime transport is the most used mode of transport, with more than 50% of transactions conducted by sea. Air transport is the second most used mode, accounting for around 40% of the transactions in the sample. Road transport is seldom used given the geographical distance between Chile and its main trading partners. However, in terms of the total volume of trade, maritime transport is predominant both in terms of value and weight. The significant discrepancy between the share of transactions and the share of value and weight is attributable to the less frequent use of maritime transport compared to air transport.

Figure E.2 in Appendix E illustrates that firms tend to use a single mode of transport for the majority of their transactions.[6] Approximately 80% of importers use a single mode of transport for each origin-product pair. However, multiple modes are used for imports from specific countries. This pattern suggests that the choice of transport mode is not solely determined by a combination of the country of origin and the characteristics of the imported goods. This observation motivates our definition of a market as an origin-HS4-mode triplet.[7]

Despite using few modes of transportation, importers interact with multiple transportation companies. Table E.3 in Appendix E classifies all carrier-to-importer matches into four groups: one carrier to one importer, one carrier to multiple importers, multiple carriers to one importer, and multiple carriers to multiple importers. We show that both importers and carriers interact with other firms in most of the linkages, as the share of many-to-many imports is almost 60%. The remaining fraction of imports and linkages is classified as one-to-many, in which one carrier has relationships with many importers. Not surprisingly, one-to-one and many-to-one trades are marginal. These features of the network in the transportation market highlight how bilateral bargaining can play a key role in shaping the market equilibrium.

2.2 Stylized Facts on Market Power in Trade and Transportation

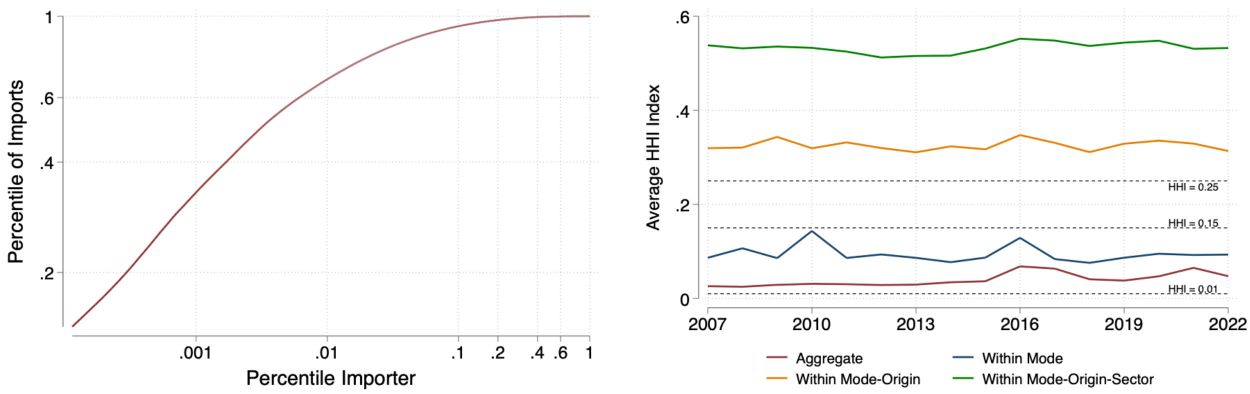
In the following section, we use transaction-level data to show that both imports and freight carriers are highly concentrated, and that transportation costs exhibit evidence consistent with bilateral bargaining and two-sided market power.

[5] Refer to Ardelean et al. (2022) for a recent survey.

[6] Appendix E.1.3 provides information on sectoral and sourcing composition of Chilean imports, both at the aggregate and at firm level (Figure E.2). Chilean firms tend to import from a limited number of countries (Figure E.3), in line with broad evidence from international trade.

[7] In figure E.4 in Appendix E we show that the median firm trade only with 2 product (HS4) in the sample.

Figure 1: Concentration among Importers and Freight Carriers



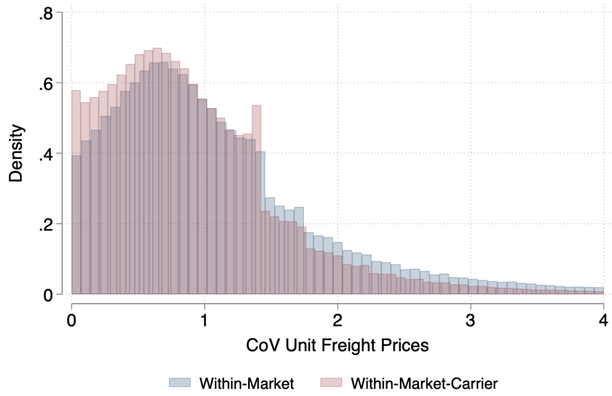
Notes: The left panel plots the cumulative distribution of importers for the year 2015. Importers are ranked according to their size from left to right on the horizontal axis. The vertical axis reports the cumulative contribution to aggregate imports. Axis are in log scale. The right panel plots the average HHI index across the different markets of the transportation sector over time. Markets are defined according different levels of granularity. The red line considers a unique aggregate transportation market. The blue line defines markets by their mode of transportation (i.e. sea vs air vs road freight). The orange and green lines defines markets as a combination of mode-origin and mode-origin-sector, respectively. A sector is defined as a HS4 category. Carriers' market share are computed in terms of value shipped.

Concentration in Trade and Transportation Figure 1 shows that imports and freight carriers are characterized by the presence of large firms. The left panel shows that only a handful of firms drive aggregate imports, in line with previous literature (Bernard et al., 2007; Mayer and Ottaviano, 2008). The red curve plots the cumulative distribution of imports in 2015 after ranking importers from the left to the right, starting with the biggest. The top 0.1%, 1%, and 10% of importers account for 35%, 65%, and 95% of total imports, respectively. The right panel reports the average HHI index across different markets over time, showing that concentration is high across freight carriers. We construct the HHI index by computing the share of imports in value that each carrier ships within a given market. We define a market as a combination of mode of transportation (sea, air, and road) and country of origin or, alternatively, conditioning on the mode, country of origin, and HS4 sector, as we believe key competitive forces operate within routes (and are potentially product-specific). Using both definitions of market, the average HHI across markets is above the threshold value of 0.25 (approximately 0.3 and 0.55, respectively), indicating the presence of strong concentration among freight carriers.[8]

As robustness, Figure E.2 in Appendix E shows that concentration among carriers exhibits the same quantitative dynamics if market shares are measured in terms of quantity or weight (in kilograms) shipped. In addition, Figure E.1 plots the entire distribution of HHI indices when a market is defined as a mode, country of origin, and HS4 sector combination. Most of the markets exhibit moderate or high concentration, with indices above the 0.15 and 0.25 thresholds, with no differences between modes of transportation.

[8]We also consider more aggregate definition of markets, such as the aggregate set of imported goods or just conditioning on the mode of transportation. In these cases, Figure 1 shows that HHI indices are lower than the standard threshold used in defining a market as competitive. Moreover, despite multiple mergers and acquisition in the shipping industry, Figure 1 shows that concentration has not increased over the last 15 years.

Figure 2: Freight Price Dispersion



Notes: The figure plots the distribution of the coefficient of variation of unit freight prices within a market and within a market-carrier combination (and time). Markets are defined as a mode-origin-sector combination, where modes are sea, air, and road, and sectors are HS4 categories, respectively. Unit freight prices are computed by dividing total freight cost by the quantity transported.

Variation in Bilateral Freight Prices We show that freight prices vary substantially within market and within carrier, and the importer-carrier match-specific component explains a substantial portion of the variation in freight prices.

Figure 2 shows that unit freight prices are highly dispersed even within carriers, contrary to widespread modeling assumptions. For each market (sector-origin-mode-time combination), we compute the coefficient of variation (CoV) of unit freight prices, computed by dividing total freight cost by the quantity transported. The mean and median CoV across markets is approximately 0.9 and 0.8, respectively, indicating the presence of substantial dispersion in prices (Ignatenko, 2020; Ardelean and Lugovskyy, 2023).[9] We also find that carriers within the same market discriminate across importers, charging different unit freight prices, as most of the dispersion survives after conditioning also on carriers.

As robustness, Figure E.3 in Appendix E shows that the dispersion in unit freight prices is quantitatively similar when we measure unit freight prices in terms of unit of value shipped or per kilogram. Similarly, the distribution of coefficients of variation is similar across modes of transportation, suggesting that price discrimination is quantitatively similar in sea and air freight, and slightly lower in road freight. Lastly, Figure E.4 in Appendix E shows that unit freight prices are not directly proportional to the shipment value, indicating that the data reject the standard iceberg trade cost assumption.

Table 1 further shows that most of the dispersion in unit freight prices is explained by a carrier-importer match-specific component, indicating the presence of bilateral forces in determining freight prices. We follow Fontaine et al. (2020) and consider the following

[9] Fontaine et al. (2020) and DellaVigna and Gentzkow (2019) define uniform pricing a situation in which the coefficient of variation is below a threshold value of 0.01. Figure 2 shows that uniform pricing is rare in the transportation sector.

Table 1: Fixed-effect Decomposition of Freight Price Dispersion

	(1)	(2)
Panel A - Share of price dispersion explained by:		
Observables	.	-0.001
Buyer FE	0.065	0.065
Transport Company FE	0.032	0.033
Sector x Time x Origin x Mode	0.626	0.626
Match Residual	0.277	0.277
Panel B - Within Carrier-Sector-Origin-Time-Mode:		
Observables	.	0.000
Buyer FE	0.118	0.117
Match Residual	0.882	0.883

Notes: The table reports the results of a statistical decomposition exercise based on OLS regressions on the estimating specification in Equation (1). Unit freight prices are computed by dividing total freight cost by the quantity transported. Column (2) includes observable characteristics such as carrier's experience, age of relationship, size of transaction, while Column (1) includes only fixed effects. Markets are defined as a mode-origin-sector combination, where modes are sea, air and road, and sectors are HS4 categories.

statistical decomposition of unit freight price dispersion:[10]

$$\log p_{ijmt} = \mathrm{FE}_i + \mathrm{FE}_j + \mathrm{FE}_{mt} + \beta \mathbf{X}_{ijmt} + \varepsilon_{ijmt}, \tag{1}$$

where FE_i is an importer fixed effect, FE_j is a carrier fixed effect, FE_{mt} is a market-time fixed effect where a market is a product-origin-mode combination, and $\mathbf{X}_{ijmt}$ represents a set of control variables such as carrier's experience, age of relationship, size of transactions. Panel A of Table 1 reports the variation in prices explained by each component, indicating that firm-level fixed effects cannot capture the full dispersion in bilateral prices. Most of the dispersion is explained by market-time fixed effects (63%) and the match residual (28%). Product and market power heterogeneity across carriers and differences in buyer market power among importers account for a much smaller share of the variance, 3% and 6% respectively. Panel B of Table 1 focuses on the price dispersion within a carrier-market-year, and decomposes it into an importer fixed effect and a match residual component. We find that only 11% of the price dispersion can be explained by heterogeneity across importers. The bulk of the variation (89%) is in fact specific to the carrier-importer relationship within a market-year, consistent with the role of bilateral forces in determining bilateral prices.

As robustness, Table E.1 in Appendix E shows that the decomposition of unit freight price dispersion is quantitatively similar when we measure unit freight prices in terms of unit of value shipped or per kilogram. Table E.2 shows that the decomposition delivers similar results when we consider only the transactions for which the importers explicitly arrange the shipment (according to Incoterms information). Table E.3 instead shows that the carrier-importer match-specific component accounts for 60% of the variation within a market-year when we consider road freight, slightly lower than the 85% and 90% in air and sea freight

[10] Refer to Appendix E.3 for additional details.

Table 2: Prices and Bilateral Concentration

	(1) OLS	(2) OLS	(3) OLS	(4) IV
Log Carrier Share s_{ij}	0.089***	0.089***	0.601***	0.505***
	(0.003)	(0.003)	(0.004)	(0.023)
Log Importer Share x_{ij}	-0.262***	-0.262***	-0.715***	-0.608***
	(0.002)	(0.002)	(0.003)	(0.020)
adj. R^2	0.808	0.808	0.915	0.384
Controls	No	Yes	Yes	Yes
$FE_j + FE_i + FE_{mt}$	Yes	Yes	No	No
$FE_{jmt} + FE_{imt}$	No	No	Yes	Yes
N	2938028	2938028	2294616	2199484

Notes: The table reports the estimates from the specification in Equation (2). Columns (1) and (2) include carrier, importer, and market fixed effects. Columns (3) and (4) include carrier-market and importer-market fixed effects. Columns (2) to (4) include controls such as carrier's experience and the age of the bilateral relationship. Columns (1) to (3) report OLS estimates; Column (4) reports IV estimates. We exclude all importer-market-time and carrier-market-time singletons from the estimation. Standard errors are clustered at the importer level.

respectively.

Evidence of Bilateral Bargaining We provide reduced-form evidence in line with the presence of importer-carrier bilateral bargaining. In the presence of bilateral bargaining, equilibrium prices reflect at the same time both buyer and seller market power (Alviarez et al., 2023; Antràs and Staiger, 2012). We test whether bilateral prices increase in seller market power, proxied by carrier j's share in importer i's total purchases s_{ij}, and decrease in buyer market power, proxied by the importer i's share in carrier j's total sales x_{ij}. The economic intuition of the mechanism is as follows: the importance of the importer to the carrier correlates with the markup the carrier can exert. Conversely, the importance of the carrier to the importer correlates with the markdown the carrier can impose. Formally, we consider the following empirical specification:

$$\log p_{ijmt} = \beta_s \log s_{ijmt} + \beta_x \log x_{ijmt} + \beta \mathbf{X_{ijmt}} + FE + \epsilon_{ijmt}, \tag{2}$$

Where p_{ijmt} is the unit freight price paid by importer i to carrier j in market m at time t, measured as transport costs per unit shipped; $\mathbf{X_{ijmt}}$ is a set of control variables such as carrier's experience and the age of the bilateral relationship; and FE represents a set of fixed effects. We define a market as an origin-sector-mode combination, where sectors are HS4 categories. We construct instruments for bilateral shares to address their endogeneity with respect to bilateral prices following Alviarez et al. (2023) and exploiting the network structure of the market. More specifically, we instrument the carrier's seller share s_{ijmt} using the (log) sales of i's other carriers to importers other than i in the specific market m. For the importer's buyer share x_{ijmt}, we use as an instrument the purchases of j's other importers from carriers other than i in the specific market m.

In line with economic intuition, Table 2 shows that buyer market power reduces unit freight prices (β_x), and carrier market power increases unit freight prices (β_s). The quantitative effect of buyer and seller market power is similar. In Column (1), which includes importer, carrier, and market fixed effects, a one percent increase in the carrier's share increases unit freight cost by 0.089 pp, and a one percent increase in the importer's share decreases unit freight cost by 0.26 pp. Including additional controls does not impact quantitatively the effects of buyer and seller market power (Column (2)). Including importer-market and carrier-market fixed effects increase the effect of buyer and seller market power to -0.7 pp and 0.6 pp, respectively (specification in Column(3)). Lastly, instrumenting bilateral shares does not substantially impact the effects of buyer and seller market power (Column (4)).

Table E.4 in Appendix E that the qualitative and quantitative results are robust to several alternative specifications. Columns (1) to (3) show that the buyer and seller market power have quantitatively similar effects on unit freight costs independently of whether we consider sea, air, or road freight. Columns (4) and (5) show that quantitatively similar results hold when measuring unit freight prices per kilogram shipped or using the subsample of transactions for which the importers explicitly arrange the shipment (according to Incoterms information).

3 Estimating Bargaining Power in Transportation Sector

This section develops and estimates a partial equilibrium theory of bilateral bargaining in the international shipping market. We focus on the determination of shipping prices through a Nash-in-Nash bargaining problem between importers and carriers. The model allows us to estimate key parameters such as the relative bargaining power between importers and carriers, the substitutability across carriers, and the returns to scale of the carriers' production function. The tractability of the framework allows us to embed the key mechanism into a more general model in Section 4.

3.1 Theory

The market consists of a finite number of importers, denoted by i, and a finite number of carriers, denoted by j. We denote the set of carriers to an importer as J_i, and the set of importers to a carrier as Z_j. We abstract away from endogenous network formation and entry/exit forces, and consider these sets as given.

Importers Each importer i produces one good and sells it domestically facing an isoelastic demand function with elasticity $\sigma > 1$. Importers' output is produced by combining an imported intermediate input, q_{iF}, with a domestic input, q_D, using a constant-return-to-scale production function with unit substitution elasticity between foreign and domestic inputs. Therefore, the share of imported inputs in total cost and the output elasticity of the imported input are constant, and both are denoted by γ.[11]

As the stylized facts in Section 2 suggest, importers organize the shipment and purchase transportation services. We assume that each unit of imported input requires one unit of transportation services to be delivered to the importers. Thus, the imported input q_F used in production can be written as the output of the following Leontief production function:

$$q_{iF} = \min\{\,\overline{q_{iF}}, t_i\}, \tag{3}$$

where $\overline{q_{iF}}$ is the physical imported input, and t_i is the transportation service purchased by the importer.

We assume that importer i's transportation service, t_i, represents a composite bundle of carrier-specific varieties. In other words, each importer i purchases a variety of the transportation service from each carrier $j \in J_i$, combining them with a CES technology.[12] Specifically, we write:

$$t_i = \left(\sum_{j\in J_i} t_{ij}^{\frac{\rho-1}{\rho}}\right)^{\frac{\rho}{\rho-1}} \qquad \text{and } \tau_i = \left(\sum_{j\in J_i} \tau_{ij}^{1-\rho}\right)^{\frac{1}{1-\rho}}, \tag{4}$$

where t_{ij} is the quantity of transportation services that importer i purchases from carrier j, τ_{ij} the corresponding bilateral price, and $\rho > 1$ the substitutability across carriers.

It follows that, ultimately, the unit price of imported inputs is $p_{iF} = \overline{p_{iF}} + \tau_i$, where $\overline{p_{iF}}$ is the (possibly i-specific) factory-gate price and τ_i the price index of the bundle of transportation services. We abstract away from any bilateral bargaining between importer and exporter, assuming that the importer is a price taker in the imported input market, taking as given the factory-gate $\overline{p_{iF}}$.

Carriers On the carrier side, we follow Alviarez et al. (2023) and define the production technology in a parsimonious way. Each carrier sells a unique variety of transportation services to all importers in Z_j. We assume that the total costs of production are a function of the total output produced by the carrier, denoted by t_j: $TC(t_j) = \zeta_j t_j^{\frac{1}{\theta}}$, where ζ_j is a constant capturing productivity differences across carriers, and $\theta \in (0, 1)$ controls the returns to scale of carriers' production.

Importantly, carriers exhibit an upward-sloped supply curve with marginal cost c_j increasing in quantity, i.e. $\frac{\partial \log c_j}{\partial \log t_j} = \frac{1-\theta}{\theta} > 0$. The presence of decreasing returns to scale in carriers' production guarantees the existence of importers' market power given that the inverse carrier supply elasticity is positive.[13]

[11]In other words, $\frac{\partial \log u_i}{\partial \log p_{iF}} = \frac{q_{iF} p_{iF}}{p_i q_i} = \gamma$, where u_i is the marginal cost of importer i, while p_i and q_i are the price and the output of importer i, respectively.

[12]We show in Appendix B.1 that we can microfound the CES composite bundle of transportation services *via* a discrete choice model in which the importer chooses one single carrier subject to idiosyncratic taste shock distributed according to a Gumbel distribution. This more realistic framework delivers the same implications as our composite bundle of carrier-specific varieties assumption.

[13]In Appendix B.2, we follow Boehm and Pandalai-Nayar (2022) and show that we can obtain a similar specification for the supply curve and total costs assuming that each carrier has fixed capacity, a reasonable assumption for the international shipping market.

Bargaining over shipment prices We assume that the bilateral price of transportation services is determined *via* a static, Nash-in-Nash bargaining process (Collard-Wexler et al., 2019; Alviarez et al., 2023). The bilateral price, τ_{ij}, is the outcome of the following maximization taking as given the agreements by all other pairs:

$$\max_{\tau_{ij}} \left(\pi_i(\tau_{ij}) - \widetilde{\pi_{i(-j)}}\right)^{\phi} \left(\pi_j(\tau_{ij}) - \widetilde{\pi_{j(-i)}}\right)^{1-\phi}, \tag{5}$$

where ϕ controls the relative bargaining power, and the first (second) term inside parentheses is the gains from trade of importer i (carrier j), defined as the payoff from trading with all counterparts in J_i (Z_j) minus the payoff from trading with all counterparts except for j (i). Specifically, for importer i, the gains from trade represent the saving from lower per-unit transportation costs, minus the cost of purchasing services from carrier j. Similarly, for carrier j, the gains from trade represent the extra revenues from serving importer i, net of the additional production costs.

Solving for the first-order condition of the problem in Equation (5), we can write the optimal bilateral price, τ_{ij}, as follows:

$$\tau_{ij} = c_j \mu_{ij} = c_j \left(\omega_{ij} \widehat{\mu_{ij}} + (1 - \omega_{ij}) \overline{\overline{\mu_{ij}}}\right), \tag{6}$$

where $\overline{\overline{\mu_{ij}}}$ is the oligopoly markup, $\widehat{\mu_{ij}}$ is the oligopsony markdown, and ω_{ij} the effective importers' bargaining power.[14]

The optimal bilateral markup, μ_{ij}, is a weighted average of the markups that arise in the case one side of the market exerts all the bargaining power. Specifically, $\overline{\overline{\mu_{ij}}} = \frac{\epsilon_{ij}}{\epsilon_{ij}-1}$ is the oligopoly markup where ϵ_{ij} is the perceived demand elasticity of carrier j. The elasticity ϵ_{ij} depends inversely on the share of carrier j in total transportation costs of importer i, $s_{ij} = \frac{\tau_{ij} t_{ij}}{\sum_{z \in J_i} \tau_{iz} t_{iz}}$, so that the carrier charges higher markups the larger is their relevance for the importers' business.[15] Similarly, $\widehat{\mu_{ij}} = \theta \frac{1-(1-x_{ij})^{\frac{1}{\theta}}}{x_{ij}}$ is the oligopsony markdown, which depends negatively on the share of total sales of j purchased by importer i, $x_{ij} = \frac{t_{ij}}{\sum_{z \in Z_j} t_{zj}}$. In this case, the larger the relevance of an importer in the business of a specific carrier, the higher the markdown they exert.

We interpret the weight $\omega_{ij} = \frac{\bar{\phi}\lambda_{ij}}{1+\bar{\phi}\lambda_{ij}}$ as the effective importer's bargaining power, that depends positively on the Nash bargaining power parameter, $\bar{\phi} = \frac{\phi}{1-\phi}$, and negatively on the importers' gains from trade term Ω_{ij} through the term $\lambda_{ij} = \frac{\sigma-1}{\epsilon_{ij}-1} \frac{\gamma s_{i\tau} s_{ij}}{\Omega_{ij}}$.[16] Intuitively, the bilateral price is closer to the oligopolistic case the lower the bargaining power of the

[14] Appendix A.1 provides additional details on the derivations of the key equations, together with analytical expressions for the gains from trade in Equation (5). A richer and more comprehensive analysis of all the special cases embedded in this framework can be found in Alviarez et al. (2023).

[15] It can be shown that the ϵ_{ij} has the following function form: $\epsilon_{ij} = (1 - s_{ij}) \cdot \rho + s_{ij} \cdot (s_{i\tau} \cdot (1 - \gamma + \sigma \cdot \gamma))$. Further details in Appendix A.1.

[16] We have defined the gains from trade for the importer as $\Omega_{ij} = \left[1 - (1 + s_{i\tau}\Delta\tau)^{\gamma(1-\sigma)}\right]$, where $s_{i\tau} = \frac{\tau_i}{p_{iF}} = \frac{\tau_i}{p_{iF}+\tau_i}$ is the share of transportation costs in the price of imported goods, and $\Delta\tau = (1 - s_{ij})^{\frac{1}{1-\rho}} - 1$ is the change in the unit cost of transportation services.

importer and/or the larger the gains from trade for the importers.

3.2 Estimation

The goal of this section is to estimate the key parameters of our theory: ϕ, that controls the relative bargaining power between importers and carriers, ρ, that governs the substitutability across carriers, and θ, that controls the return to scale of carriers' production function. We use a two-step empirical strategy. We first estimate substitutability across carriers employing a standard IV strategy and the log-log relationship between prices and shares implied by our framework. Then, given the estimated ρ, we estimate the remaining parameters leveraging the identification assumption in Alviarez et al. (2023). We use the estimated parameters in Section 4 to perform counterfactual exercises.

Identification - ρ The identification of the substitutability across carriers, ρ, relies on the demand equation for transportation services. The specification of the model in Equation (4) reveals that, for each importer in a specific market m, the observed log of the share of carrier j in total transportation costs of importer i, s_{ijt}^m, depends linearly on the log of the bilateral price, τ_{ijt}^m:

$$\log s_{ijt}^m = -(\rho - 1)\left(\log \tau_{ijt}^m - \log \tau_{it}^m\right) + \nu_{ijt}^m, \tag{7}$$

where the superscript m refers to a specific market (i.e. product-route pair), τ_{it}^m is the price index at the importer level, and ν_{ijt}^m is an idiosyncratic demand shock of importer i for carrier j in market m, typically assumed to be i.i.d. across (i, j, m, t) with (conditional) mean zero. Equation (7) translates into the following empirical specification assuming that ρ is constant across all markets and importers:

$$\log s_{ijt}^m = \beta \log \tau_{ijt}^m + \alpha_{it}^m + \nu_{ijt}^m, \tag{8}$$

where α's is a set of importer-market-time fixed effects, and β is the coefficient of interest. To address the standard endogeneity bias associated with OLS regressions of prices on market shares, we instrument transportation prices using Hausman-type and BLP-type instruments. Specifically, exploiting the presence of multiple markets, we consider the price charged by the same carrier j to *other* importers in *other* markets (Hausman et al., 1994). The instrument is exploiting common carrier-level cost shocks across markets for identification. The key assumption is that importers' demand shocks are not correlated across markets, $cov(\nu_{ijt}^m, \nu_{i'jt}^{m'}) = 0$. This assumption would be violated in the presence of carriers' (unobserved) promotional or advertising campaigns across markets. We do not view this as a compelling scenario, given the nature of the international shipping market.[17]

We estimate the specification in Equation (7) differencing out the importer's price index,

[17] Companies operating in international shipping make use of targeted B2B marketing campaigns rather than more common, widespread B2C ads. This is in line with the fact that prices are bargained, as shown in the previous section. **more formal info**

τ_{it}^m, which is common across all carriers j for a given importer i in a given market m (Broda and Weinstein, 2006; Feenstra, 1994). Specifically, we take the difference of the bilateral share and price of importer i and carrier j and the bilateral share and price of importer i with a different carrier j' in the same market m. Formally, defining $\Delta \log x_{ijj't}^m \equiv \log x_{ijt}^m - \log x_{ij't}^m$, we can rewrite Equation (7) as: $\Delta \log s_{ijj't}^m = -(\rho - 1)\Delta \log \tau_{ijj't}^m + \Delta \nu_{ijj't}^m$. This allows us to estimate the specification in Equation (8) abstracting away from importers-market-time fixed effects. In our preferred specification, we include carrier, time, and market fixed effects, thereby limiting potential endogeneity issues to time-varying pair-specific shocks.

We perform several robustness exercises using different specifications, aggregation levels, and set of instruments. We estimate the main specification in difference including the number of carriers and importers competing in each market as additional instruments. In this case, instruments carry information on the market structure and the identification relies on the standard assumption that the entry of carriers and importers takes place before the realization of the shocks (Berry et al., 1995; Gandhi and Nevo, 2021). In addition, we directly estimate the specification in Equation (8) including importer-market-time and carrier fixed effects, both at yearly and quarterly frequency. Lastly, we estimate a reduced form log-log demand aggregating the market share at the carrier (seller) level and dropping information on the importer (buyer) side (Berry et al., 1995).

Identification - ϕ and θ We follow Alviarez et al. (2023) and Dhyne et al. (2022) for the identification of the bargaining power parameter, ϕ, and the carriers' scale parameter, θ.

From Equation (6), we can write the log bilateral price of transportation services between carrier j and importer i at time t as the sum of the log bilateral markup and the log marginal cost of carrier j:

$$\log \tau_{ijt} = \log \mu_{ijt} + \log c_{jt} + \nu_{ijt},$$

where ν_{ijt} is mean-zero i.i.d. and captures (unobserved) cost differences across the importers of a given carrier driven by, for instance, quality differentiation or customization. Taking the difference between the price carrier j charges to any two distinct importers, i and k, we can abstract away from the marginal cost of the carrier and write the following moment condition for every (i, k, j, t):

$$g(\phi, \theta, \Lambda_{jikt}) \equiv \mathbb{E}_u[\nu_{jit} - \nu_{jkt} | \Lambda_{jikt}] \equiv \mathbb{E}_u[\log \tau_{ijt} - \log \mu_{ijt} - (\log \tau_{kjt} - \log \mu_{kjt}) | \Lambda_{jikt}] = 0 \quad \forall i, k, j, t, \tag{9}$$

where Λ_{jikt} is the relevant information set. The identification of the parameters of interest is guaranteed by the strict monotonicity and invertibility of the moment condition in ϕ and θ, and by the non-linearity in the elements of the information set, specifically the bilateral shares s_{ijt} and x_{ijt} (Alviarez et al., 2023).[18]

[18] The same moment condition is not strictly monotonic in ρ, thus it does not ensure its identification.

We estimate the moment condition in Equation (9) using an IV GMM:

$$\min_{\phi,\theta} G(\phi,\theta)Z'WZG(\phi,\theta)', \tag{10}$$

where $G(\phi,\theta)$ collects all moment condition across all $i-k-j-t$, W the optimal weighting matrix, and Z the vector of instruments. The moment condition implies that the expected difference in carrier j's marginal cost across importers i and k is zero. However, difference in the marginal could be correlated with observables such as bilateral shares, creating endogeneity issues. We rely on Hausman-type instruments in constructing Z: we include the number of importers and carriers in each market, and the mean (median) bilateral share in the market excluding the involved pairs $i-j$ and $k-j$ (Hausman et al., 1994; Alviarez et al., 2023). As robustness, we also demean at the market, time, and importer level so that the endogeneity concerns are limited to time-varying pair-specific shocks.

3.3 Results

Data construction Using a structural model, we estimate the parameters of interest using the whole dataset from 2007 to 2022. We define a market m as an HS2 - country of origin - mode of transportation triplet. We collapse all transaction data at the importer-carrier-market-quarter level and construct the key variables of interest s^m_{ijt}, x^m_{ijt}, $s_{i\tau}$ and τ^m_{ijt}.[19]

In addition to the cleaning described in Section 2.1, we use the following criteria for sample selection. First, we drop observations with zero shares or unit transport price and trim unit transport price at the 5% level within each route and at the 1% level in the whole sample.

For the structural estimation of ρ, we further exclude i) markets with only one carrier operating (no variation in s^m_{ijt}); ii) carriers operating in only one market or selling only to one importer because we cannot construct the Hausman-type instrument.[20] When estimating ρ in difference, we also exclude importers that purchase transportation services from only one carrier within a market.

For the structural estimation of θ and ϕ, we only keep markets in which at least three carriers operate and importers transacting with at least two carriers to ensure enough variation within each market. Moreover, we exclude carriers transacting with only one importer within each market because the moment condition is not defined.

We drop all importer-carrier-market triplets that imply a carrier's perceived demand elasticity ϵ^m_{ijt} lower than one, which is inconsistent with our model.[21] Because of this restriction,

[19] We aggregate all transactions at the importer-market-time level and construct the share of transportation services in the price of imports, $s_{i\tau}$, as $\frac{\sum_{jm}\tau^m_{ijt}t^m_{ijt}}{\sum_{jm}(\overline{p}^m_{iFt}+\tau^m_{ijt}t^m_{ijt})} = \frac{\sum_{jm}\text{Freight Cost}^m_{ijt}}{\sum_{jm}(FOB^m_{ijt}+\text{Freight Cost}^m_{ijt})}$.

[20] We construct the Hausman instrument as:

$$\text{IV}^m_{ij} = \frac{\sum_{m'}\sum_{i'}\tau^{m'}_{i'j} - \sum_{i'}\tau^m_{i'j} - \sum_{m'}\tau^{m'}_{ij}}{\sum_{m'}\sum_{i'} - \sum_{i'} - \sum_{m'}},$$

[21] See Footnote 15.

Table 3: Summary Statistics

	Mean	Std.
Log τ_{ijt}^m	0.467	1.928
Importer's Share s_{ijt}^m	0.236	0.204
Carrier's Share x_{ijt}^m	0.072	0.178
Transport Share s_{itm}^τ	0.114	0.115
Number of Carriers per Market	5.292	4.485
Number of Importers per Market	22.074	87.710
Number of Carriers per Importer	2.988	0.845
Number of Importers per Carrier	15.020	41.807

Notes: The table shows the mean and standard deviation for key variables. τ_{ijt}^m is the unit freight price paid by importer i to carrier j in market m at time t, where unit freight price is computed by dividing total freight cost by the quantity transported; s_{ijt}^m is the share of carrier j on importer i's total imports from market m at time t; x_{ijt}^m is the share of importer i in j's total quantity transported in market m at time t. s_{imt}^τ is the share of transportation services in the price of imports at the importer-market-time level. A market is defined as a mode-origin-sector combination, where modes are sea, air and road, and sectors are HS2 categories. Appendix **??** provides additional information on the cleaning process.

we approximately drop 5% of the observations. Appendix **??** provides additional information on the cleaning process.

Table 3 reports the summary statistics on our sample. As analysed in Section 2, bilateral prices are highly dispersed, and the concentration is high in both the import market and the transportation market. The average number of importers and carriers across markets is 22 and 5, respectively. Importers and carriers are connected to a limited number of partners, translating into high and dispersed market shares s_{ijt}^m and x_{ijt}^m. Lastly, the share of transportation services in the price of imports, s_{imt}^τ, is on average 11%, indicating the quantitative relevance of transportation costs for importers. Table C.1 in Appendix **??** shows that the summary statistics are quantitatively similar across modes of transportation.

Estimates of ρ Table 4 shows the results from the estimation of Equation (7) in difference. As expected, we find that the OLS estimate of the price elasticity is positive, displaying a bias towards zero due to the positive correlation between demand and price shocks (Column (1)). When we instrument prices, the magnitude of the estimated CES elasticity decreases relative to its OLS counterpart to approximately -1.5 (Column (2)), confirming the need for price instruments to correct for the endogeneity bias in this setting. Column (3) and Column (4) further saturate the specification in difference including carrier and carrier, market, and time fixed effects, respectively. The point estimates are not particularly sensitive to the set of fixed effects. For each specification, we report the implied substitutability across carriers, $\widehat{\rho}$. Our preferred specification in Column (4) precisely estimates $\widehat{\rho}$ to be three, indicating a low substitutability across carriers within each market.

Table F.1 in Appendix F shows that the estimated price elasticity and substitutability across carriers is robust across several specifications. Estimating the specification in level with the inclusion of importer-market-time fixed effects delivers a price elasticity of -1.3 and -1.8 at yearly and quarterly frequency, respectively. Similarly, we obtain values of $\widehat{\rho}$ between 2.7 and

Table 4: Estimated $\widehat{\rho}$

	(1) OLS	(2) IV	(3) IV	(4) IV
$\widehat{\beta}$	0.063	-1.562	-2.280	-2.014
	(0.004)	(0.127)	(0.663)	(0.449)
Implied $\widehat{\rho}$		2.562	3.280	3.014
FEs	–	–	FE_j	$FE_j + FE_t + FE_m$
N	1673962	1672850	1672825	1672268

Notes: The table reports the estimated price elasticities from the specification in Equation (8) estimated in difference. Column (1) reports the OLS estimate. In all IV specifications (Columns (2) to (4)), the vector of instruments includes the average price charged by the same carrier j to other importers in other markets. Standard errors are clustered at the importer level. Implied $\widehat{\rho}$ reports the implied ρ, computed as $\widehat{\rho} = -\widehat{\beta} + 1$.

3.6 when aggregating at the carrier level.

Estimates of ϕ and θ Before estimating the two parameters central to the bargaining process, we set the elasticity of substitution across carrier to the estimated value of three, $\rho = 3$, and calibrate the values of the parameters σ and γ to be 6 and 0.5, respectively.[22]

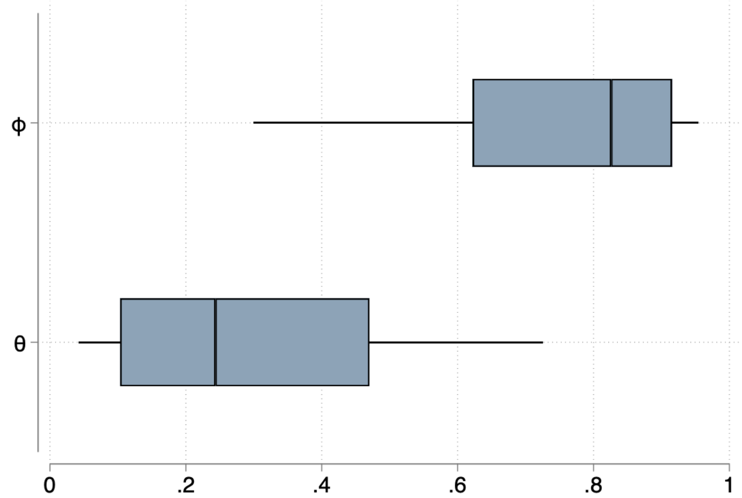
Figure 3 displays the distribution of the estimated parameters across markets. The average and the median bargaining power of the importers, ϕ, across markets are 0.72 and 0.83, respectively. The implied average importers' relative bargaining power is $\overline{\phi} = \frac{\phi}{1-\phi} = 2.57$, indicating that, on average, importers enjoy a substantial degree of buyer market power. The average and the median return to scale of the carriers, θ, across markets are 0.3 and 0.21, respectively, far below one. The implied carriers' supply elasticity is $\frac{\theta}{1-\theta} = 0.43$, indicating that importer market power is sensitive to their size. Figure F.1 in Appendix F displays the distribution of the two parameters depending on the mode of transportation, i.e. distinguishing sea, air, and road freight. The distributions are quantitatively similar across modes, with θ and ϕ being slightly higher and lower in the case of road freight, respectively.[23]

There is a substantial heterogeneity in both bargaining power and return to scale across markets, with an interquartile range of 0.29 and 0.37, respectively. We show that the estimated parameters correlate with observable characteristics of the market in an economically meaningful way. In line with economic intuition, Figure F.3 in Appendix F shows that the bargaining power of the importer, ϕ, is increasing in the number of carriers in the market, and decreasing in the number of importers in the market. Similarly, the estimated return to scale parameter, θ, an inverse measure of importer market power, is decreasing (increasing) in the number of carriers (importers) in the market. Figure F.4 in Appendix F shows qualita-

[22] σ and γ are calibrated using firm-level data from Chilean manufacturing sectors, as described in the quantitative model in Section 4.

[23] Figure F.2 in Appendix F shows the presence of a negative correlation between the estimated importers' bargaining power and the carriers' return to scale across markets, in line with economic intuition.

Figure 3: Distribution Estimated Parameters



Notes: The Figure plots the distribution of the estimated bargaining power parameter ϕ (top row) and return to scale parameter θ (bottom row). The box delimits the interquartile range of the distribution, while the whiskers span from the 10th to the 90th percentiles.

tively similar correlation between the estimated parameters and HHI indices of the bilateral shares s_{ij} and x_{ij}, which also capture the relative degree of bargaining power.

4 Aggregate Implications

In this section, we embed the bargaining framework developed in Section 3 into a rich general-equilibrium model of importing to quantify the effects that bilateral bargaining in the international shipping market has on the aggregate economy and on the transmission of shocks. Additional details on the derivations are in Appendix A.2.

4.1 Theory

Consumption and Demand The economy is populated by a unit measure of consumers who supply L units of labor inelastically. They consume a final consumption bundle C over a fixed and exogenous number of domestic products N:

$$C = \left(\sum_i^N c_i^{\frac{\sigma-1}{\sigma}} \right)^{\frac{\sigma}{\sigma-1}}, \tag{11}$$

where $\sigma > 1$ is the constant elasticity of substitution across the products in the consumption basket. Consumers maximize their utility subject to a standard budget constraint: $\sum_i^N p_i c_i \leq wL + \sum_i^N \pi_i$, where w is the wage rate and π_i are firms' profits. Thus, the demand for each product $i \in N$ is $c_i = p_i^{-\sigma} P^{\sigma} Y$, where P is the aggregate price index and Y aggregate income.

Firms and Input Trade Each product $i \in N$ is produced by a single monopolistically competitive domestic firm combining labor, l, and intermediate inputs, x_i, using a CRS Cobb-Douglas technology:

$$y_i = \varphi_i l_i^{1-\beta_i} x_i^{\beta_i}, \tag{12}$$

where φ_i represents the firm's idiosyncratic productivity. The intermediate input is a combination of domestic and foreign intermediate inputs, q_D and q_{iF}, respectively. These are aggregated using a CES technology:

$$x_i = \left(\eta_i q_{iD}^{\frac{\gamma-1}{\gamma}} + (1-\eta_i) q_{iF}^{\frac{\gamma-1}{\gamma}} \right)^{\frac{\gamma}{\gamma-1}}, \tag{13}$$

where $\eta_i > 0$ is the quality of foreign intermediate inputs relative to the domestic one (capturing home bias), and $\gamma > 1$ captures the substitutability between domestic and foreign intermediates.

The firm has access to foreign inputs after paying a fixed cost of f units of domestic labor. We assume that labor can be hired frictionlessly. The presence of fixed costs implies that domestic producers use foreign inputs in their production process only when the unit cost of production decreases enough via the love of variety channels (Halpern et al., 2015; Gopinath and Neiman, 2014; Antras et al., 2017).

We define a roundabout production in the spirit of Caliendo and Parro (2015), assuming that the domestic intermediate input q_D is also produced using the output of all domestic firms as the final consumption good: $q_{iD} = \left(\sum_v^N y_{iv}^{\frac{\sigma-1}{\sigma}} \right)^{\frac{\sigma}{\sigma-1}}$, where y_{iv} is the output of firm v demanded by a firm i. Thus, the price of the domestic input p_D is endogenous so that non-importing domestic firms are also affected by changes in the transportation sector via their purchases of intermediate inputs from importers.[24]

Building on our result from Section 3, we assume that domestic producers import foreign intermediate inputs from the rest of the world, purchasing transportation services according to Equations (3) and (4). We assume there exists a unique market for transportation services (i.e. a unique route from the rest of the world to the domestic economy), populated by a finite number of carriers, with the total cost of production increasing in the quantity of services produced, t_j: $TC(t_j) = \frac{1}{\zeta_j} t_j^{\frac{1}{\theta}}$, where ζ_j is a constant capturing productivity differences across carriers, and $\theta \in (0,1)$ controls the returns to scale of carriers' production. Bilateral prices of transportation services are determined *via* the static, Nash-in-Nash bargaining process in Equation (5).

Under the above assumptions, the firm's profit maximization problem is:

$$\pi_i = \max\{u_i(\tau_i)^{1-\sigma} \times B - wf\mathbf{1}(q_{iF} > 0)\}, \tag{14}$$

where u_i is the unit cost of production for firm i, and B is defined as $B \equiv \frac{1}{\sigma}\left(\frac{\sigma}{\sigma-1}\right)^{1-\sigma} P^{\sigma-1} S$,

[24] Notice that all firms aggregate varieties using the same technology, making the domestic input homogeneous across firms and identical to the final consumption good.

where S is the aggregate spending in the economy.[25]
Formally, the unit cost is given by:

$$u_i = \frac{1}{\varphi_i} w^{1-\beta_i} p_x^{\beta_i} = \frac{1}{\varphi_i} w^{1-\beta_i} \left(\eta_i^\gamma p_{iD}^{1-\gamma} + (1-\eta_i)^\gamma \left(\alpha_{iq}\overline{p_{iF}} + \alpha_{it}\tau_i\right)^{1-\gamma}\right)^{\frac{\beta_i}{1-\gamma}}, \tag{15}$$

where p_x is the price index of the intermediate input bundle x_i in Equation (13). The second term is the price of imports, composed by the factory-gate price set by the exporter, $\overline{p_{iF}}$, and the cost of transportation services, $\tau_i = \left(\sum_{j\in J_i} \alpha_{ij}\tau_{ij}^{\frac{1}{\rho-1}}\right)^{\frac{1}{1-\rho}}$.[26]

General Equilibrium Equations (11)-(14) above describe firms' optimal decisions. We close the model in general equilibrium, imposing the equilibrium in the labor market and balanced trade between the domestic economy and the rest of the world. Balanced trade requires that aggregate exports equal total imported intermediate inputs:

$$\sum_i^N p_i y_i^{ROW} = \sum_i^N (1-s_{iD}) m_i,$$

where m_i denotes total intermediate input spending of firm i, and $(1-s_{iD})$ the share of spending on imported inputs.

An equilibrium is defined as a set of (bilateral) prices $\{w, [p_i], [\tau_{ij}]\}$, labor demands for production and fixed costs, demand for services $[t_{ij}]$, production and consumption $\{[y_i], [c_i], [y_i^{ROW}]\}$, and input demands $\{[q_{iD}], [q_{iF}]\}$ such that firms maximize profits, consumers maximize utility, trade is balanced, and labor and goods markets clear.[27]

4.2 Calibration and Estimation

We now parametrize the model using Chilean customs and micro data. Our calibration and estimation strategy is as follows. Table 5 summarizes the parameters and the calibrated values or the moments used in the estimation.

Bargaining and transportation sector. We use the estimates from Section 3 to parameterize the bargaining process and the transportation sector. We set the elasticity of substitution across carriers to the estimated value of three, $\rho = 3$. We leverage the distribution of parameters estimated across markets in Section 3 and set the bargaining power ϕ to 0.8 and the carriers' return to scale θ to 0.3, respectively, equal to the average estimated parameter

[25] Aggregate spending is defined as a function of L and the model's parameters in the following way $S = L^{net}\frac{\sigma}{(1-\gamma)(\sigma-1)}$.

[26] Notice that, relatively to the specification in Equation (4) in Section 3.1, we consider taste heterogeneity across carriers in importers' transportation demand, α_{ij}. Moreover, we generalized the Leontief production function in Equation (3) to consider heterogeneity across importers in the mix of transportation services and imports.

[27] Formally, the labor market clearing condition is: $L = \sum_i (l_i + f\mathbf{1}(q_{iF} > 0))$. Similarly, the good market clearing condition for each firm i is: $y_i = c_i + y_i^{ROW} + \sum_v^N y_{iv}$.

across markets. From Table 3, we assume that the number of carriers operating in the transportation sector is equal to 5, i.e. the average number of carriers in a market. Similarly, we set the number of importers equal to the average number of importers across transportation markets, which is approximately 22.

Domestic Economy. We use firm-level balance sheet information from the survey of manufacturing industries (ENIA) from 1995 to 2018 to calibrate the parameters defining the domestic economy and the production process (σ, β, and γ).[28] We follow Oberfield and Raval (2021) and identify the elasticity of substitution σ from the firms' profit margin, i.e. $\frac{\text{Revenues}_i}{\text{Costs}_i} = \frac{\sigma}{\sigma-1}$. We compute costs as the sum of wage bill, material and electricity expenditure, and user cost of capital. We set the demand elasticity equal 6, close to the median value in the manufacturing sector of 5.9. We then identify the share of material in the production, β, leveraging the observed factor shares. Given a value for σ, the observed material spending share allows us to identify β: $\frac{m_i}{p_i y_i} = \beta \frac{\sigma-1}{\sigma}$. We set β to be 0.45, equal to the median material spending share in the manufacturing sector (0.427). Lastly, we identify the substitutability between domestic and imported inputs noting that firm output can be written as:

$$y_i = A\varphi_i l_i^{1-\beta} m_i^{\beta} s_{iD}^{-\frac{\beta}{\gamma-1}},$$

where A collects all general equilibrium variables, m_i total intermediate input spending of firm i, and s_{iD} is the share of spending on domestic inputs. Thus, we leverage the variation in domestic expenditure shares holding material spending fixed to identify γ (Blaum et al., 2018; Zhang, 2017). Using standard structural production function estimation techniques as in Olley and Pakes (1992) and Ackerberg et al. (2015), we estimate a value for γ of 3.77, and calibrate it to be 4 in our quantitative model. In general, the calibrated values for the domestic production process are in line with previous estimates and calibrations (Blaum et al., 2018; Alviarez et al., 2023; Halpern et al., 2015).

Number of firms and fixed costs of importing. The fixed cost of importing, f, is estimated and pinned down by the share of importing firms in the economy. Chilean manufacturing micro data show that 20% of domestic firms are importers. We also assume that the economy is populated by 110 domestic firms (i.e. $N = 110$) so that the number of importers in the transportation sector is consistent with the empirical share of importing firms.

Firm and carrier productivity, and carrier-import matching shocks. Five parameters govern the distributions of firms' heterogeneities. Domestic firm efficiency, φ_i, is drawn from a log-normal distribution with variance σ_φ^2 and unit mean. Similarly, carriers' productivity, ζ_j, is drawn from a log-normal distribution with variance σ_ζ^2 and mean normalized to one. Lastly, we assume that the match-specific taste shocks in the transportation sector, α_{ij}, can be written

[28] Additional information and details on the dataset ENIA, its cleaning, and the calibration in Appendix D.

Table 5: Parametrization

Panel A: Calibrated Parameters		
	Transportation Sector and Bargaining Process	
ρ	3	Estimated from Section
θ	0.3	Average Estimate across Markets from Section
ϕ	0.8	Average Estimate across Markets from Section
N_j	5	Average Number of Carrier per Market
N_i	22	Average Number of Importers per Market
	Domestic Economy	
β	0.45	Median Share of Materials
γ	4	Estimated using Production Function
σ	6	Median Markup
N	110	Share of Importers

as the sum of a carrier-specific and importer-specific components, i.e. $\alpha_{ij} = \alpha_i + \alpha_j$. We assume that α_i and α_j are jointly drawn from a normal distribution with unit mean, variances $\sigma^2_{\alpha_i}$ and $\sigma^2_{\alpha_j}$, and non-zero covariance $\sigma_{\alpha_{ij}}$. We calibrate these parameters by targeting salient features of the empirical distribution of sales and bilateral shares. Specifically, the dispersion and concentration in domestic sales and in carriers' size are informative for the efficiency of importers and carriers. We calibrate the process for α_{ij} targeting the average dispersion in s_{ij} across importers, the average dispersion in x_{ij} across carriers, and their correlation.

Home bias and price of import. We calibrate the economy-wide degree of home bias, η, matching the aggregate share of domestic inputs in the economy. We target the average share of transportation services in the price of imported goods, $s_{i\tau}$, to calibrate the factory-gate price of imports, $\overline{p_{iF}}$, which we assume to be independent across importers.

We estimate the parameters of the model using simulated method of moments. Given the finite number of firms populating the economy, we generate simulated data from the model and solve for the equilibrium of 1000 economies for a given set of parameters. We compute the equivalent model moments for each simulated economy, compute the average moment across economies and compare it to the true moment in the data. We choose the optimal model parameter vector, $\Theta = \{\eta, \overline{p_{iF}}, \sigma^2_\varphi, \sigma^2_\zeta, \sigma^2_{\alpha_i}, \sigma^2_{\alpha_j}, \sigma_{\alpha_{ij}}, f\}$, to make simulated model moments close to data moments. We estimate the optimal vector of parameters $\widehat{\Theta_{SMM}}$ such that:

$$\widehat{\Theta_{SMM}} = \Theta : \min_{\Theta} \left(m(\tilde{x}|\Theta) - m(\tilde{x})\right) W \left(m(\tilde{x}|\Theta) - m(\tilde{x})\right)', \tag{16}$$

where $m(\tilde{x})$ is the vector of data moments, and $m(\tilde{x}|\Theta)$ is the vector of simulated model moments. In estimating Equation (16), we employ a mix of stochastic optimization routine and non-stochastic search algorithm. We use the asymptotically efficient weighting matrix W, and cluster standard errors by firm.[29]

[29]Figure in Appendix plots the relationship between the estimated parameters and selected target moments that hold significant importance for identification, supporting identification.

Estimated parameters and untargeted moments TBD

5 Counterfactuals

With the estimated models at hand, we aim to quantitatively study the aggregate implications of dual market power. In particular, we are interested in understanding the importance of the bargaining mechanism introduced for the determination of transportation prices and, thus, aggregate welfare. We then show that the pass-through of trade tariffs is 40% lower in our model compared to a standard model with iceberg trade frictions. Lastly, we show that carbon policies such as the extension of the EU ETS on the shipping market have negligible effects on aggregate welfare.

Impact of Counterfactual Pricing Policies Here on conduct and models w/out bargaining, buyer mp, etc.

Pass-through of Tariff Shocks

- Iceberg case:

$$\frac{\partial \log P}{\partial \log \overline{p_F}} = \sum_i s_i \frac{\partial \log u_i}{\partial \log \overline{p_F}} \equiv \frac{\beta(1 - \sum_i s_i s_{iD})}{1 - \beta \sum_i s_i s_{iD}}$$

$s_i = \frac{p_i y_i}{\sum_i (p_i y_i)}$

- Lower pt in our model because when price of imports increases, reduces the size of transportation sector (need less shipping because imports decrease). By DRS, mc in transportation goes down, reducing price of transport. This partially offset the rise in the price of imports, reducing the rise in final prices.

- When accounting for entry/exit, the offsetting is stronger. When firms exit, the remaining importers have stronger buyer mp (reallocation of x_{ij}). this allows them to further reduce their cost of transport.

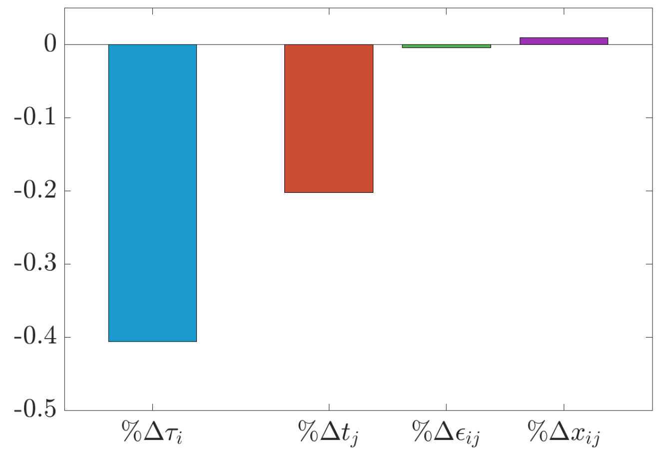
- effect of entry/exit non-linear. When a firm stop importing, their mc increases, raising final prices. When many importers exit (e.g. large tariff shocks), this effect offsets the reallocation of bargaining power for remaining firms.

- Additional negligible effects: higher carriers' markups because $s_{i\tau}$ goes down, making demand less elastic. Heterogeneity across importer is very small, due to exposure to imports, implies a reallocation of buyer market power but not quantitatively relevant.

Table 6: Pass-through of Tariffs

Tariff Increase by	Iceberg Trade Costs	Bilateral - No Entry/Exit	Bilateral
10 %	0.76	0.41	0.36
20 %	1.52	0.79	0.77
30 %	2.28	1.12	1.16

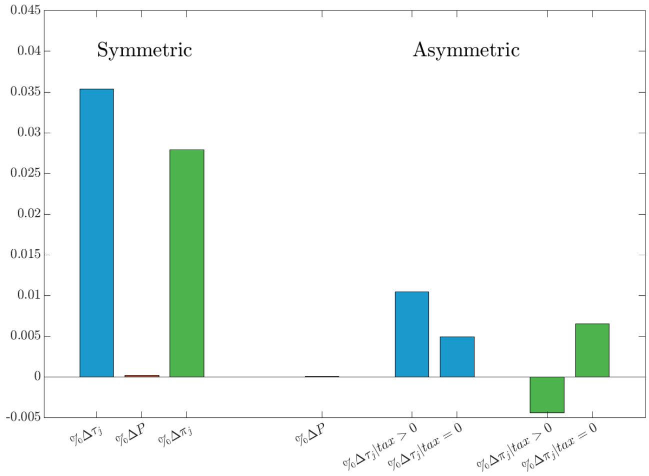
Figure 4: Pass-through of Tariffs - Decomposition



Carbon Tax on Transportation

- Map EU carbon policy from data to our model. approx 50euros per ton of CO2, equivalent to a 5% increase in transport costs for chile.
- We consider two cases: a 5% increase in the mc of all carriers (symmetric); a 5% increase in the mc of one carrier (asymmetric).
- Symmetric case: higher mc means higher transport cost, and ultimately higher final prices, but the effect is extremely small (reason: transport costs are a small share of cost of production for final goods). Interestingly, carriers are able to increase profits, probably due to the steep demand.
- Asymmetric case: aggregate effect still negligible. prices go up also for carriers not affected directly because of reallocation of s_{ij} and thus higher markups. Consequently, reallocation of profits towards them.

Figure 5: Carbon Policy



6 Conclusion

This paper examines the role of imperfect competition and bilateral negotiations in the transportation sector and their impacts on international trade. Our analysis provides several key contributions to the literature on international trade and industrial organization.

First, we document empirical evidence of high concentration in the transportation sector using detailed Chilean customs data. We find an average Herfindahl-Hirschman Index (HHI) of 0.55 across transportation markets, significantly above the threshold typically used to define oligopolistic industries. This finding challenges the common assumption in trade literature of perfectly competitive transportation markets.

Second, we provide evidence of bilateral negotiations between carriers and importers in determining transportation prices. Our analysis reveals substantial dispersion in unit freight prices within carrier-markets, with 89% of this variation attributable to specific carrier-importer relationships. This observation contradicts the standard "iceberg" cost assumption prevalent in many trade models.

Third, we develop a theoretical framework that incorporates bilateral bargaining between carriers and importers, allowing for both seller and buyer market power.

Fourth, we integrate this bilateral bargaining framework into a quantitative trade model, providing a more nuanced understanding of how the transportation sector influences trade flows, gains from trade, and shock transmission. This approach allows us to move beyond the simplifying assumption of exogenous iceberg trade costs and quantify the importance of market power in the transportation sector as an additional friction to international trade.

Our findings have important implications for trade policy and our understanding of global value chains. By highlighting the role of imperfect competition and bargaining power in the transportation sector, this research suggests that policies aimed at reducing concentration or enhancing competition in transportation markets could have significant effects on international trade patterns and welfare gains.

In conclusion, this paper contributes to a more comprehensive understanding of the mechanisms underlying international trade by shedding light on the often-overlooked complexities of the transportation sector. Our results underscore the importance of considering market structure and bargaining processes in transportation when analyzing international trade dynamics and formulating trade policies.

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A Derivations and Proofs

A.1 Derivations of Bilateral Prices

The solution for bilateral transportation prices τ_{ij} given the framework in Section 3 follows previous work from Alviarez et al. (2023).

Importer Given the assumptions in Section 3, importer i's profits in case of successful negotiations can be written as:

$$\pi_i = (\mu_i - 1)\mu_i^{-\sigma} u_i^{1-\sigma}, \tag{17}$$

where μ_i is constant and u_i is the marginal cost of importer i. It follows that the derivative of i's profits wrt the bilateral transportation price τ_{ij} is:

$$\begin{aligned}
\frac{\partial \pi_i}{\partial \tau_{ij}} &= (\mu_i - 1)\mu_i^{-\sigma}(1-\sigma)u_i^{-\sigma}\frac{\partial u_i}{\partial \tau_{ij}} \\
&= (\mu_i - 1)\mu_i^{-\sigma}(1-\sigma)u_i^{-\sigma}\frac{\partial u_i}{\partial p_{iF}}\frac{\partial p_{iF}}{\partial \tau_i}\frac{\partial \tau_i}{\partial \tau_{ij}} \\
&= (\mu_i - 1)\mu_i^{-\sigma}(1-\sigma)u_i^{-\sigma}\gamma\frac{u_i}{p_{iF}}\frac{\tau_{ij}^{-\rho}}{\tau_i^{-\rho}} \\
&= (\mu_i - 1)p_i^{-\sigma}(1-\sigma)\frac{q_{iF}}{q_i}\frac{t_{ij}}{t_i} \\
&= (\mu_i - 1)(1-\sigma)t_{ij}
\end{aligned}$$

where the last equation is obtained noticing that $t_i = q_{iF}$ given the Leontief production function.

We can derive importer i's profits in case of failed negotiation, $\pi_{i(-j)}$, provided that the cost of a unit of transportation bundle without j is now:

$$\widetilde{\tau}_i = \tau_i(1 - s_{ij})^{\frac{1}{1-\rho}} = \tau_i(1 + \Delta\tau), \tag{18}$$

where $s_{ij} = \frac{\tau_{ij}t_{ij}}{\sum_{z \in J_i}\tau_{iz}t_{iz}}$ is the share of carrier j in total transportation costs of importer i. Thus, we can write:

$$\pi_{i(-j)} = (\mu_i - 1)q_i\widetilde{u}_i = (\mu_i - 1)q_i u_i \left(1 + s_{i\tau}\Delta\tau\right)^{\gamma(1-\sigma)},$$

where $s_{i\tau} = \frac{\tau_i}{p_{iF}} = \frac{\tau_i}{\overline{p}_{iF} + \tau_i}$ is the share of transportation costs in the price of imported goods. It follows immediately that the gains from trade for importer i are:

$$\pi_i(\tau_{ij}) - \pi_{i(-j)} = (\mu_i - 1)q_i u_i \left(1 - (1 + s_{i\tau}\Delta\tau)^{\gamma(1-\sigma)}\right). \tag{19}$$

Carrier By the same token, we derive the gains from trade for carrier j. The profits of carrier j in case of successful negotiation are:

$$\pi_j(\tau_{ij}) = \tau_{ij}t_{ij} + \sum_{z\neq i\in Z_j} \tau_{zj}t_{zj} - \theta c_j t_j, \tag{20}$$

where c_j is the marginal cost of production given the upward-slope supply curve, and $t_j = \sum_{i\in Z_j} t_{ij}$. It is immediate to show that:

$$\begin{aligned}\frac{\partial \pi_j(\tau_{ij})}{\partial \tau_{ij}} &= t_{ij} + \tau_{ij}\frac{\partial t_{ij}}{\partial \tau_{ij}} - \theta t_j \frac{\partial c_j}{\partial \tau_{ij}} - \theta c_j \frac{\partial t_j}{\partial \tau_{ij}} \\ &= t_{ij} + \tau_{ij}\frac{\partial t_{ij}}{\partial \tau_{ij}} - c_j \frac{\partial t_{ij}}{\partial \tau_{ij}} \\ &= t_{ij}\left(1 - \epsilon_{ij} - \epsilon_{ij}\frac{c_j}{\tau_{ij}}\right),\end{aligned}$$

where $\epsilon_{ij} = -\frac{\partial t_{ij}}{\partial \tau_{ij}}\frac{\tau_{ij}}{t_{ij}}$ is the perceived demand elasticity of the carrier. Specifically, given the structure on the importer side,

$$\epsilon_{ij} = (1 - s_{ij})\cdot\rho + s_{ij}\cdot(s_{i\mathcal{T}}\cdot(1 - \gamma + \sigma\cdot\gamma)) \tag{21}$$

Moreover, in case of failed negotiations, the profits of carrier j become:

$$\pi_{j(-i)} = \sum_{z\neq i\in Z_j} \tau_{zj}t_{zj} - \theta\widetilde{c_j}\sum_{z\neq i\in Z_j} t_{zj} = \sum_{z\neq i\in Z_j} \tau_{zj}t_{zj} - \theta\widetilde{c_j}t_j(1 - x_{ij}), \tag{22}$$

with $\widetilde{c_j} = c_j\,(1 - x_{ij})^{\frac{1-\theta}{\theta}}$, where $x_{ij} = \frac{t_{ij}}{t_j}$ is the share of total sales of j purchased by importer i.

Combining the equations above, we can write the gains from trade for carrier j as:

$$\pi_j(\tau_{ij}) - \pi_{j(-i)} = \tau_{ij}t_{ij} - \theta c_j t_j\left[1 - (1 - x_{ij})^{\frac{1}{\theta}}\right] = t_{ij}(\tau_{ij} - c_j\widehat{\mu_{ij}}), \tag{23}$$

where $\widehat{\mu_{ij}} = \theta\frac{1-(1-x_{ij})^{\frac{1}{\theta}}}{x_{ij}}$ is the markup in the oligopsony case.

Bilateral prices Given the expressions for the gains from trade above, the FOC for the problem in Equation (5) is:

$$0 = \frac{\partial \pi_j}{\partial \tau_{ij}} + \overline{\phi}\frac{\pi_j - \pi_{j(-i)}}{\pi_i - \pi_{i(-j)}}\frac{\partial \pi_i}{\partial \tau_{ij}},$$

where $\overline{\phi} = \frac{\phi}{1-\phi}$. Substituting the relevant expressions from above, we get:

$$\begin{aligned}0 &= (1 - \epsilon_{ij} + \epsilon_{ij}\frac{c_j}{\tau_{ij}}) + \overline{\phi}\frac{\tau_{ij} - c_j\widehat{\mu_{ij}}}{q_i u_i\left(1 - (1 + s_{i\mathcal{T}}\Delta\tau)^{\gamma(1-\sigma)}\right)}(1-\sigma)t_{ij} \\ &= -1 + \frac{\epsilon_{ij}}{\epsilon_{ij} - 1}\frac{c_j}{\tau_{ij}} - \overline{\phi}\frac{c_j}{\tau_{ij}}\widehat{\mu_{ij}}\frac{1-\sigma}{\epsilon_{ij} - 1}\frac{\tau_{ij}t_{ij}}{q_i u_i \Omega} + \overline{\phi}\frac{1-\sigma}{\epsilon_{ij} - 1}\frac{\tau_{ij}t_{ij}}{q_i u_i \Omega}\end{aligned}$$

$$
\begin{aligned}
&= -1 + \overline{\overline{\mu_{ij}}}\frac{c_j}{\tau_{ij}} - \bar{\phi}\lambda_{ij}\widehat{\mu_{ij}}\frac{c_j}{\tau_{ij}} + \bar{\phi}\lambda_{ij} \\
\tau_{ij} &= c_j\left((1-\omega_{ij})\widehat{\mu_{ij}} + \omega_{ij}\overline{\overline{\mu_{ij}}}\right).
\end{aligned}
$$

which is Equation (6) in the main text, where $\omega_{ij} = \frac{\bar{\phi}\lambda_{ij}}{1+\bar{\phi}\lambda_{ij}}$, $\lambda_{ij} = \frac{\sigma-1}{\epsilon_{ij}-1}\frac{\tau_{ij}t_{ij}}{q_i u_i \Omega}$, $\Omega = \left[1-(1+s_{i\tau}\Delta\tau)^{\gamma(1-\sigma)}\right]$, and $\overline{\overline{\mu_{ij}}} = \frac{\epsilon_{ij}}{\epsilon_{ij}-1}$ is the standard markup in case of oligopoly.

A.2 Derivations of Bilateral Prices in Quantitative Model

Solution for bilateral transportation prices. Given $t_i = \left(\sum_{j\in J_i}\alpha_{ij}^{\frac{1}{\rho}} t_{ij}^{\frac{\rho-1}{\rho}}\right)^{\frac{\rho}{\rho-1}}$ and $\tau_i = \left(\sum_{j\in J_i}\alpha_{ij}\tau_{ij}^{1-\rho}\right)^{\frac{1}{1-\rho}}$:[30]

1. Define failed negotiation bit for importer in nash-bargaining:

$$
\begin{aligned}
\pi_{i(-j)} &= (\mu_i - 1)\mu_i^{-\sigma}\widetilde{u_i}^{1-\sigma}P^\sigma Y \\
\widetilde{u_i} &= w^{1-\beta_i}p_x^{\beta_i} = w^{1-\beta_i}\left(\eta_i^\gamma p_D^{1-\gamma} + (1-\eta_i)^\gamma(\alpha_{iq}\bar{p_F} + \alpha_{it}\widetilde{\tau_i})^{1-\gamma}\right)^{\frac{\beta_i}{1-\gamma}}
\end{aligned}
$$

   where $\widetilde{\tau_i} = \tau_i(1-s_{ij})^{\frac{1}{1-\rho}} = \tau_i(1+\Delta\tau)$, with $s_{ij} = \alpha_{ij}\left(\frac{\tau_{ij}}{\tau_i}\right)^{1-\rho}$. We can therefore rewrite $\widetilde{u_i}$ as follows:

$$
\begin{aligned}
\widetilde{u_i} &= w^{1-\beta_i}p_x^{\beta_i} = w^{1-\beta_i}\left(\eta_i^\gamma p_D^{1-\gamma} + (1-\eta_i)^\gamma(\alpha_{iq}\bar{p_F} + \alpha_{it}\widetilde{\tau_i})^{1-\gamma}\right)^{\frac{\beta_i}{1-\gamma}} \\
&= w^{1-\beta_i}\left(\eta_i^\gamma p_D^{1-\gamma} + (1-\eta_i)^\gamma[p_{iF}(1+s_i^\tau\Delta\tau)]^{1-\gamma}\right)^{\frac{\beta_i}{1-\gamma}} \\
&= w^{1-\beta_i}p_x^{\beta_i}\left(1 + s_i^F[(1+s_i^\tau\Delta\tau)^{1-\gamma} - 1]\right)^{\frac{\beta_i}{1-\gamma}} \\
&= u_i\left(1 + s_i^F[(1+s_i^\tau\Delta\tau)^{1-\gamma} - 1]\right)^{\frac{\beta_i}{1-\gamma}}
\end{aligned}
$$

   where $s_i^\tau = \frac{\alpha_{it}\tau_i}{\alpha_{iq}\bar{p_F} + \alpha_{it}\tau_i}$ is the share of transport cost in the cost of imported inputs; $s_i^F = (1-\eta_i)^\gamma\frac{p_{iF}^{1-\gamma}}{p_x^{1-\gamma}}$ is the share of imported inputs in the mix of intermediate inputs.

2. Gains from trade for importer:

$$
\begin{aligned}
\pi_i - \pi_{i(-j)} &= (\mu_i - 1)\mu_i^{-\sigma}P^\sigma Y\left(u_i^{1-\sigma} - \widetilde{u_i}^{1-\sigma}\right) \\
&= (\mu_i - 1)u_i y_i(1-\Omega)
\end{aligned}
$$

   where $\Omega = \left(1 + s_i^F[(1+s_i^\tau\Delta\tau)^{1-\gamma} - 1]\right)^{\frac{\beta_i(1-\sigma)}{1-\gamma}}$

3. Moreover:

$$
\begin{aligned}
\pi_i &= (p_i - u_i)y_i = (\mu_i - 1)\mu_i^{-\sigma}u_i^{1-\sigma}P^\sigma Y. \\
\frac{\partial\pi_i}{\partial\tau_{ij}} &= (\mu_i - 1)\mu_i^{-\sigma}(1-\sigma)u_i^{-\sigma}P^\sigma Y\frac{\partial u_i}{\partial\tau_{ij}}
\end{aligned}
$$

[30] Without loss of generality, we abstract away from importers' idiosyncratic productivity.

$$
\begin{aligned}
&= (\mu_i - 1)\mu_i^{-\sigma}(1-\sigma)u_i^{-\sigma}P^{\sigma}Y\frac{\partial u_i}{\partial p_x}\frac{\partial p_x}{\partial p_{iF}}\frac{\partial p_{iF}}{\partial \tau_i}\frac{\partial \tau_i}{\partial \tau_{ij}} \\
&= (\mu_i - 1)\mu_i^{-\sigma}(1-\sigma)u_i^{-\sigma}P^{\sigma}Y\beta_i w^{1-\beta_i}p_x^{\beta_i-1}(1-\eta_i)^{\gamma}\frac{p_{iF}^{-\gamma}}{u_i^{-\gamma}}\alpha_{it}\alpha_{ij}\frac{\tau_{ij}^{-\rho}}{\tau_i^{-\rho}} \\
&= (\mu_i - 1)p_i^{-\sigma}(1-\sigma)P^{\sigma}Y\beta_i w^{1-\beta_i}p_x^{\beta_i-1}\frac{q_{iF}}{x}\alpha_{it}\frac{t_{ij}}{t_i} \\
&= (\mu_i - 1)(1-\sigma)t_{ij}
\end{aligned}
$$

4. Determine bilateral prices: (failed negotiation for carrier is as in Morlacco)

$$
\max_{\tau_{ij}} \left(\pi_j - \pi_{j(-i)}\right)^{1-\phi}\left(\pi_i - \pi_{i(-j)}\right)^{\phi} \tag{24}
$$

The foc for the following problem is:

$$
\begin{aligned}
0 &= \frac{\partial \pi_j}{\partial \tau_{ij}} + \bar{\phi}\frac{\pi_j - \pi_{j(-i)}}{\pi_i - \pi_{i(-j)}}\frac{\partial \pi_i}{\partial \tau_{ij}} \\
&= 1 - \epsilon_{ij} + \epsilon_{ij}\frac{c_j}{\tau_{ij}} + \bar{\phi}\frac{\tau_{ij} - c_j\mu^{OLIGS}}{u_i y_i(1-\Omega)}(1-\sigma)t_{ij} \\
&= -1 + \frac{\epsilon_{ij}}{\epsilon_{ij}-1}\frac{c_j}{\tau_{ij}} - \bar{\phi}\lambda_{ij} + \bar{\phi}\lambda_{ij}\frac{c_j}{\tau_{ij}}\mu^{OLIGS} \\
\tau_{ij} &= c_j\left(\frac{1}{1+\bar{\phi}\lambda_{ij}}\mu^{OLIGO} + \frac{\bar{\phi}\lambda_{ij}}{1+\bar{\phi}\lambda_{ij}}\mu^{OLIGS}\right)
\end{aligned}
$$

where $\lambda_{ij} = \frac{\sigma-1}{\epsilon_{ij}-1}\frac{1}{1-\Omega}\frac{t_{ij}\tau_{ij}}{u_i y_i} = \frac{\sigma-1}{\epsilon_{ij}-1}\frac{1}{1-\Omega}\beta_i s_i^F s_i^\tau s_{ij}$, where the last ratio is share of variety j in total cost.

A.3 Derivations of Quantitative Model

Solution for the aggregate spending S Let's decompose aggregate spending the following way

$$
\begin{aligned}
S &= S^C + S^{ROW} + S^X \\
&= I + \sum_i^N (1 - s_{iD})m_i + \sum_i^N s_{iD}m_i = I + \sum_i^N m_i
\end{aligned}
$$

Recall that

$$
\begin{aligned}
\pi_i &= (p_i - u_i)y_i = (p_i - \frac{\sigma-1}{\sigma}p_i)y_i \\
&= \frac{1}{\sigma}p_i y_i = \frac{1}{\sigma}p_i p_i^{-\sigma}P^{\sigma}Y\frac{P}{P} \\
&= \frac{1}{\sigma}\left(\frac{p_i}{P}\right)^{1-\sigma}PY = \frac{1}{\sigma}\left(\frac{p_i}{P}\right)^{1-\sigma}S
\end{aligned}
$$

$$\vdots$$

$$\sum_{i=1}^{N} \pi_i = \sum_{i=1}^{N} \frac{1}{\sigma} \left(\frac{p_i}{P}\right)^{1-\sigma} S = \frac{1}{\sigma} S$$

so that we can write the representative consumer spending as

$$\begin{aligned} I &= L + \frac{1}{\sigma} S - \sum_{i=1}^{N} f \mathbf{1}(q_{iF} > 0)\} \\ &= L^{net} + \frac{1}{\sigma} S \end{aligned}$$

where $w = 1$ and $L^{net} = L - \sum_{i=1}^{N} f \mathbf{1}(q_{iF} > 0)\}$. Similarly, for the second element of the aggregate spending decomposition

$$\begin{aligned} \sum_{i=1}^{N} m_i &= \sum_{i=1}^{N} \beta \frac{\sigma - 1}{\sigma} p_i y_i \\ &= \sum_{i=1}^{N} \beta \frac{\sigma - 1}{\sigma} \left(\frac{p_i}{P}\right)^{1-\sigma} S \\ &= \beta \frac{\sigma - 1}{\sigma} S \end{aligned}$$

So that

$$\begin{aligned} S &= L^{net} + \frac{1}{\sigma} S + \beta \frac{\sigma - 1}{\sigma} S \\ &= L^{net} \frac{\sigma}{(1-\beta)(\sigma - 1)} \end{aligned}$$

B Additional Theoretical Results

B.1 Micro-foundation for Composite Transportation Bundle

We can microfound our assumption on the existence of a composite bundle of transportation services in Equation (4) from the following discrete choice model.

The importer purchases the transportation services t_i from one carrier. We model the choice of carrier j *via* a discrete choice problem. The indirect utility of importer i from choosing a specific j is:

$$V_{ij} = -\log \tau_{ij} + \frac{1}{1-\rho} \epsilon_{ij}, \tag{25}$$

where τ_{ij} is the bilateral price between i and j, and ϵ_{ij} is a stochastic, order-specific taste component. The importer chooses the carrier j that maximizes the indirect utility: $j^{\star} = \arg\max_{j \in Z_i} V_{ij}$.

We assume that ϵ_{ij} are distributed according to a Gumbel Extreme-Value type I. Thus, we can define the probability that importer i chooses carrier j is, P_{ij}, as

$$P_{ij} \equiv Pr\left(V_{ij} = \max_{z \in Z_j} V_{iz}\right) = \frac{\tau_{ij}^{1-\rho}}{\sum_{z \in Z_j} \tau_{iz}^{1-\rho}}.$$

We can interpret the probability as the share of i's transportation services purchased from j, and define the expected demand of importer i for carrier j transportation services, t_{ij}, as

$$t_{ij} = \frac{\tau_{ij}^{1-\rho}}{\sum_{z \in Z_j} \tau_{iz}^{1-\rho}} t_i = \frac{\tau_{ij}^{1-\rho}}{\tau_i^{1-\rho}} t_i \quad \text{with } \tau_i = \left(\sum_{z \in Z_j} \tau_{iz}^{1-\rho}\right)^{\frac{1}{1-\rho}}. \tag{26}$$

Following standard arguments (Anderson et al., 1987), we recognize the demand system generated by Equation (4) in the main text.

B.2 Carriers' capacity utilization and returns to scale

C Customs Data

C.1 Variable Used

C.2 Cleaning

C.2.1 Multi-product transaction

C.2.2 Shippers cleaning

C.3 Additional Cleaning for Structural Estimation

Table C.1: Summary Statistics by Mode

	Sea		Air		Road	
	Mean	Std.	Mean	Std.	Mean	Std.
Log τ_ijt^m	-0.811	1.301	2.269	0.980	-1.742	0.678
Importer's Share s_{ijt}^m	0.233	0.194	0.240	0.217	0.245	0.186
Carrier's Share x_{ijt}^m	0.062	0.164	0.083	0.192	0.177	0.244
Transport Share s_{imt}^τ	0.062	0.047	0.176	0.140	0.106	0.069
Number of Carriers per Market	5.140	4.364	5.538	4.652	4.283	3.715
Number of Importers per Market	23.660	103.061	21.237	69.450	8.030	14.449
Number of Carriers per Importer	2.939	0.946	2.622	0.810	2.540	1.202
Number of Importers per Carrier	10.239	23.298	11.072	21.415	5.975	8.403

Notes: The table shows the mean and standard deviation for key variables by mode of transportation. τ_{ijt}^m is the unit freight price paid by importer i to carrier j in market m at time t, where unit freight price is computed by dividing total freight cost by the quantity transported; s_{ijt}^m is the share of carrier j on importer i's total imports from market m at time t; x_{ijt}^m is the share of importer i in j's total quantity transported in market m at time t. s_{imt}^τ is the share of transportation services in the price of imports at the importer-market-time level. A market is defined as a mode-origin-sector combination, where modes are sea, air and road, and sectors are HS2 categories. Appendix **??** provides additional information on the cleaning process.

D Manufacturing Data - ENIA

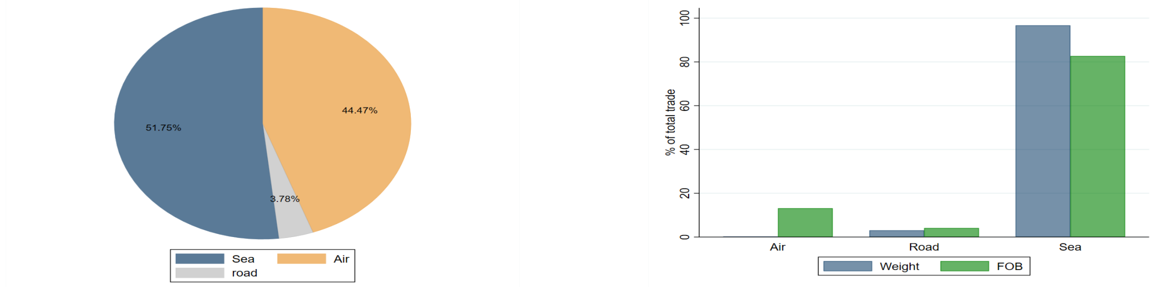
E Additional Data Facts

E.1 Summary Statistics

In this section we report additional facts on the composition Chilean imports and transportation sector along several dimensions.

E.1.1 Composition by Mode

Figure E.1: Trade Volumes and Number of Transaction by Mode

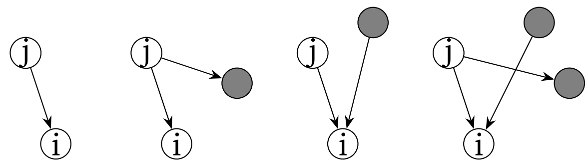


Notes: The left panel reports the share of total transactions that are conducted via each transport mode. The right panel reports the total value, in navy, and weight, in green, traded by each transport mode. In the customs data, trade via rail is also reported but it represents such a small proportion of total trade (¡1%) that we exclude it from the sample

Figure E.2: Number of modes used

Notes: I'll review the grammar and suggest some improvements: This figure reports the share of importers that used one or more transport modes in the sample. The left panel shows the share when the unit of observation is an importer-origin-sector. The right panel shows the same statistic but for a sample in which the unit of observation is an importer-origin.

Figure E.3: Network Structure in International Shipping



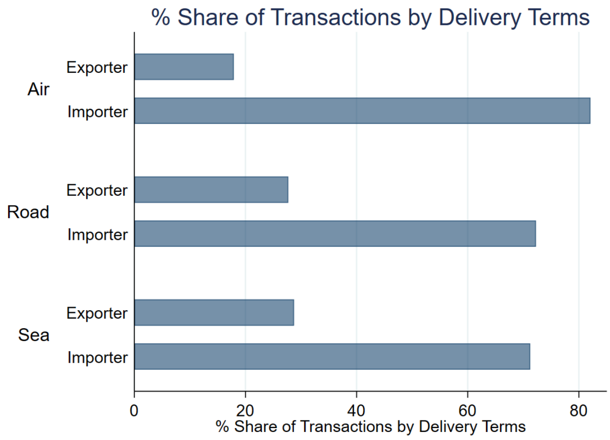
	1:1	1:m	m:1	m:m
Fraction of links	0.036	0.445	0.005	0.525
	(0.386)	(0.242)	(0.162)	(0.248)
Fraction of import value	0.017	0.338	0.007	0.593
	(0.408)	(0.295)	(0.196)	(0.293)

Notes: This figure illustrate the network structure of the data and the type of relationship that importers and carriers have in our sample. We measure the links both in terms of number of links (top row) and in terms of value traded (bottom row).

E.1.2 Composition by INCOTERMS

INCOTERMS defines the delivery terms for each transaction. All transactions can be divided into two main groups depending on whether it is the importer's or the exporter's responsibility to arrange the international shipping of the good. In particular, each transaction can be ranked in terms of the importer's responsibility in the delivery process. For instance, the importer plays a fully passive role in the case the agreed term is the so called DDP (Delivered Duty Paid) which places the greatest burden on the exporter. In this case, the exporter agrees in clearing the good through customs at the destination and also to deliver the good at a previously specified location. Thus, when the agreed term is DDP the importer is a spectator in the delivery process. By contrast, under the EXW (Exworks-Factory) the seller has the minimum obligations. Indeed, it is the importer's responsibility to move the good from a designated factory of production to the desired final location. Following standard classification, we group transactions that fall under the category of EXW, FCA (Free Carrier), FOB (Free on Board), and FAS (Free alongside ship) as transactions in which it is the importer's responsibility to arrange the international shipping of the good. By contrast, transactions falling into the terms of CFR (Cost and Freight), CIF (Cost, Insurance and Freight), DDP (Delivered Duty Paid), CPT (Carriage Paid to), DAP (Delivered at Place) are characterized by the fact that it is the seller's responsability to negotiate and pay for the shipping of the good.

Figure E.1: Party Arranging Import Transactions

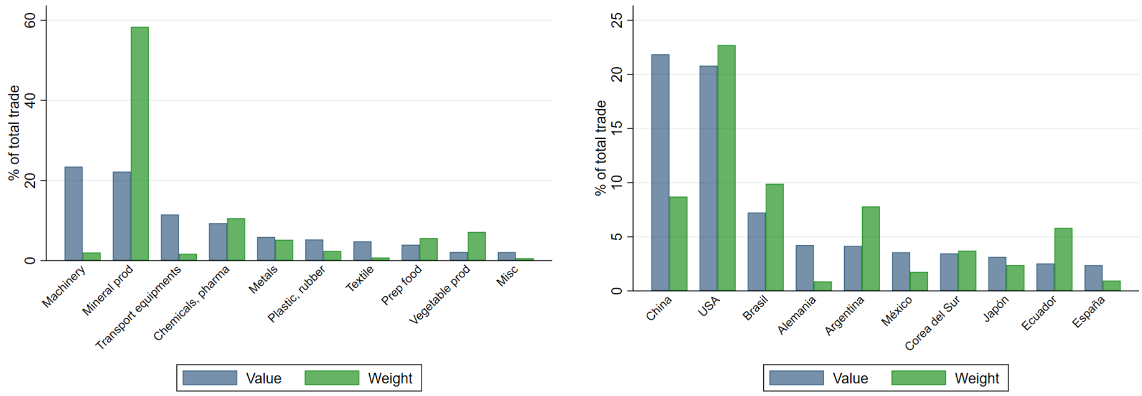


Notes: Share of transaction that are arranged by the importer across different transport modes. The party in charge of the transaction is reported in the variable INCOTERMS included in the Chilean custom data.

E.1.3 Trade Flows Composition

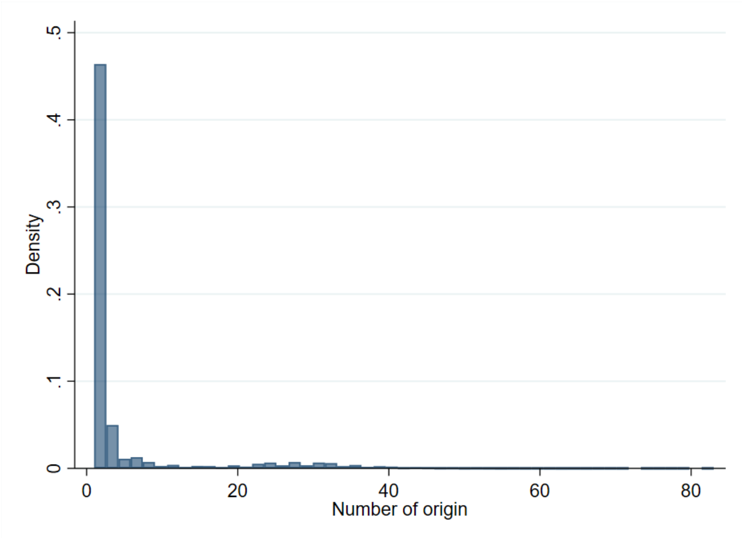
Chilean imports are heterogeneous in terms of product that are brought in from other countries. In Figure E.2 we can see that Chile's imports are spread across different sectors that span natural resource to foods and beverages.

Figure E.2: Import Composition by Sector and Origin



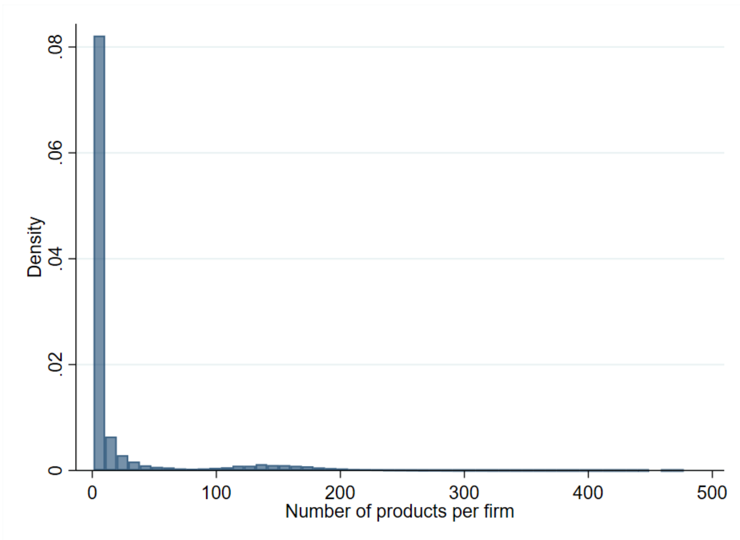
Notes: This figure decomposes Chilean imports by sector (left panel) and country of origin (right panel). A sector is defined as one of the 21 sections that compose the more aggregate version of the HS classification. In both figures, the bars are in descending order based on their total value of trade.

Figure E.3: Numbers of Origins by Importer



Notes: This figure reports the distribution of origins per importer.

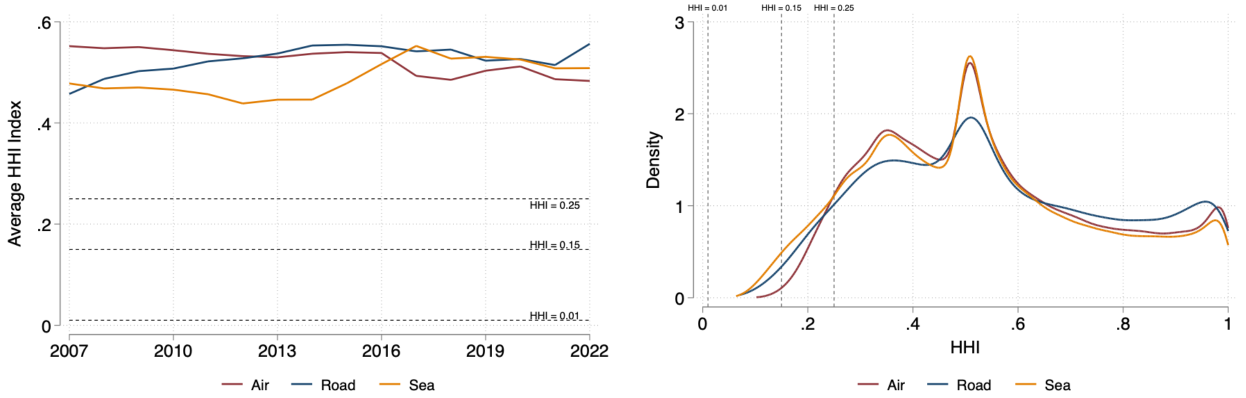
Figure E.4: Numbers of Products by Importer



Notes: This figure reports the distribution of products per importer.

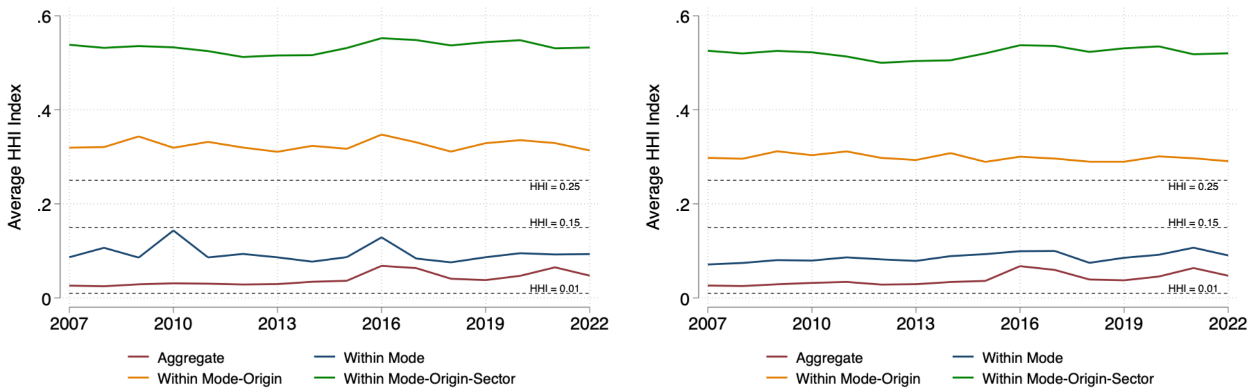
E.2 Additional Evidence on Stylized Facts

Figure E.1: Concentration in International Transportation by Mode



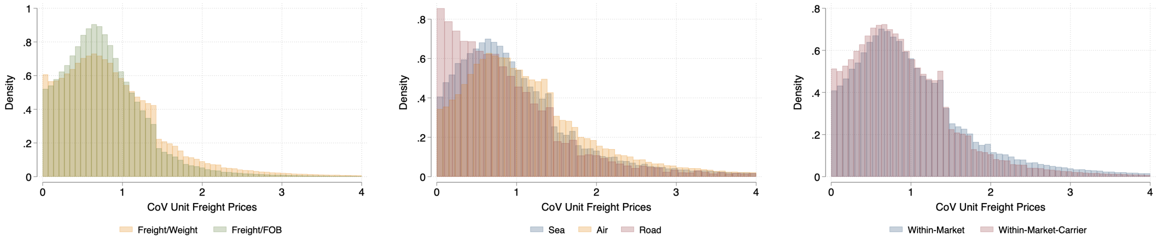
Notes: The left panel plot the average HHI index across the different markets of the transportation sector over time. Markets are defined as a mode-origin-sector combination, where a sector is defined as a HS4 category. We compute the average distinguishing markets by their mode (sea vs air vs road freight). The left panel plots the distribution of HHI indices across the different markets, distinguishing markets by their mode (sea vs air vs road freight). Carriers' market share are computed in terms of value shipped.

Figure E.2: Concentration in International Transportation - Additional Measures



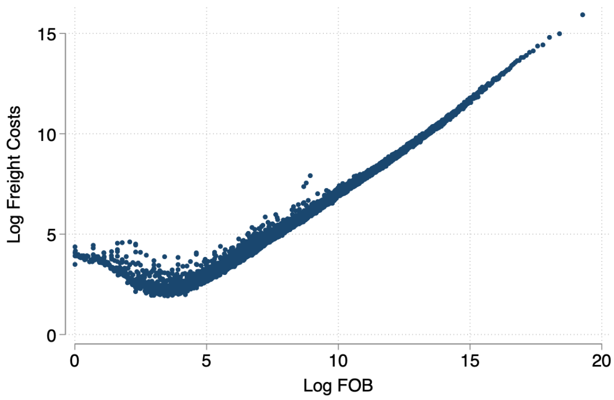
Notes: Both panel plot the average HHI index across the different markets of the transportation sector over time. Markets are defined according different levels of granularity. The red line considers a unique aggregate transportation market. The blue line defines markets by their mode of transportation (i.e. sea vs air vs road freight). The orange and green lines defines markets as a combination of mode-origin and mode-origin-sector, respectively. A sector is defined as a HS4 category. The right panel defines carriers' market shares in terms of quantity shipped while the left panel uses kilograms shipped.

Figure E.3: Freight Price Dispersion



Notes: The left panel plots the distribution of the coefficient of variation of unit freight prices within a market (and time). Markets are defined as a mode-origin-sector combination, where modes are sea, air, and road, and sectors are HS4 categories, respectively. Unit freight prices are computed by dividing total freight cost by the weight in kilograms (orange) or by value (green). The center panel plots the distribution of the coefficient of variation of unit freight prices within a market (and time) distinguishing by the mode of transportation (sea, air, and road). Unit freight prices are computed by dividing total freight cost by the quantity transported. The right panel plots the distribution of the coefficient of variation of unit freight prices within a market and within market-carrier pairs (and time) using the subsample of transactions explicitly organized by the importer according to Incoterm information. Unit freight prices are computed by dividing total freight cost by the quantity transported.

Figure E.4: Rejection of Iceberg Trade Cost Assumption



Notes: The figure plots the relationship between the log freight costs on the vertical axis and the log of value imported using the whole sample of import transactions.

Table E.1: Fixed-effect Decomposition of Freight Price Dispersion - Alternative Measures

	Value		Weight	
	(1)	(2)	(1)	(2)
Panel A - Share of price dispersion explained by:				
Observables	.	0.069	.	0.020
Buyer FE	0.077	0.071	0.036	0.037
Transport Company FE	0.022	0.024	0.046	0.047
Sector x Time x Origin x Mode	0.414	0.378	0.643	0.624
Match Residual	0.487	0.459	0.276	0.273
Panel B - Within Carrier-Sector-Origin-Time-Mode:				
Observables	.	0.090	.	0.016
Buyer FE	0.162	0.135	0.088	0.086
Match Residual	0.838	0.775	0.912	0.898

Notes: The table reports the results of a statistical decomposition exercise based on OLS regressions on the estimating specification in Equation (1). Unit freight prices are computed by dividing total freight cost by value (first two columns) or by weight in kilograms (last two columns). Column (2) includes observable characteristics such as carrier's experience, age of relationship, size of transaction, while Column (1) includes only fixed effects. Markets are defined as a mode-origin-sector combination, where modes are sea, air and road, and sectors are HS4 categories.

Table E.2: Fixed-effect Decomposition of Freight Price Dispersion - Incoterms

	(1)	(2)
Panel A - Share of price dispersion explained by:		
Observables	.	-0.002
Buyer FE	0.088	0.088
Transport Company FE	0.027	0.027
Sector x Time x Origin x Mode	0.609	0.612
Match Residual	0.275	0.275
Panel B - Within Carrier-Sector-Origin-Time-Mode:		
Observables	.	0.001
Buyer FE	0.154	0.153
Match Residual	0.846	0.846

Notes: The table reports the results of a statistical decomposition exercise based on OLS regressions on the estimating specification in Equation (1). We use the subsample of transactions explicitly organized by the importer according to Incoterm information. Unit freight prices are computed by dividing total freight cost by the quantity transported. Column (2) includes observable characteristics such as carrier's experience, age of relationship, size of transaction, while Column (1) includes only fixed effects. Markets are defined as a mode-origin-sector combination, where modes are sea, air and road, and sectors are HS4 categories.

Table E.3: Fixed-effect Decomposition of Freight Price Dispersion - by Mode

	Air		Sea		Road	
	(1)	(2)	(1)	(2)	(1)	(2)
Panel A - Share of price dispersion explained by:						
Observables	.	0.001	.	0.009	.	0.009
Buyer FE	0.087	0.088	0.084	0.082	0.231	0.233
Transport Company FE	0.007	0.007	0.034	0.033	0.033	0.037
Sector x Time x Origin x Mode	0.567	0.565	0.201	0.203	0.414	0.413
Match Residual	0.339	0.339	0.681	0.673	0.321	0.309
Panel B - Within Carrier-Sector-Origin-Time-Mode:						
Observables	.	0.002	.	0.017	.	0.042
Buyer FE	0.155	0.156	0.101	0.098	0.398	0.380
Match Residual	0.845	0.842	0.899	0.886	0.602	0.578

Notes: The table reports the results of a statistical decomposition exercise based on OLS regressions on the estimating specification in Equation (1). We divide the sample according to the mode of transportation (air, sea, and road). Unit freight prices are computed by dividing total freight cost by the quantity transported. Column (2) includes observable characteristics such as carrier's experience, age of relationship, size of transaction, while Column (1) includes only fixed effects. Markets are defined as a mode-origin-sector combination, where modes are sea, air and road, and sectors are HS4 categories.

Table E.4: Prices and Bilateral Concentration - Robustness

	(1) Sea	(2) Air	(3) Road	(4) Weight	(5) Incoterms
Log Carrier Share s_{ij}	0.752***	0.523***	0.585***	0.212***	0.658***
	(0.004)	(0.005)	(0.035)	(0.005)	(0.005)
Log Importer Share x_{ij}	-0.802***	-0.685***	-0.607***	-0.329***	-0.745***
	(0.003)	(0.004)	(0.035)	(0.004)	(0.004)
adj. R^2	0.887	0.749	0.958	0.845	0.910
Controls	Yes	Yes	Yes	Yes	Yes
$FE_{jmt} + FE_{imt}$	Yes	Yes	Yes	Yes	Yes
N	1196245	1071462	26909	2369238	1387686

Notes: The table reports the estimates from the specification in Equation (2) estimated using OLS. All Columns include the additional controls, and carrier-market and importer-market fixed effects. Columns (1), (2), and (3) consider the subsample of sea, air, and road freight, respectively. Column (4) measures unit freight prices per kilogram shipped. Columns (5) reports the estimates using only the subsample of transactions for which the importers explicitly arrange the shipment (according to Incoterms information). We exclude all importer-market-time and carrier-market-time singletons from the estimation. Standard errors are clustered at the importer level.

E.3 AKM (1999) Decomposition

Fraction of Links The main reference is this paper.

Let $\mathcal{S}$ be a set of $\{1, \dots, s, \dots, S\}$ shipper nodes and $\mathcal{M}$ be a set of $\{1, \dots, m, \dots, M\}$ of importer nodes. The network structure is a undirected bipartite multi graph with a unbalanced panel structure. The adjacency matrix at a given point in time looks like this

$$A_t = \begin{pmatrix} 0_{S,S} & B_t \\ B_t^{\intercal} & 0_{M,M} \end{pmatrix},$$

where B_t is a $S \times M$ matrix. Let e be an edge and $E_{(s,m)}$ be the set of edges between s and m (it's a set because it potentially contains repeated links through time) and recall that $E_{(s,m)} = E_{(m,s)}$. Therefore, we define the total (unweighted adjacency matrix) A with elements

$$B_{sm} = \sum_{e \in E_{(s,m)}} \mathbb{1}_e$$

and for the weighted

$$B_{sm}^w = \sum_{e \in E_{(s,m)}} w_e$$

where w_e is the import value associated with the transaction that creates the edge between (s, m). Recall that adjacency matrices are symmetric, but B is not

Decomposition The estimated model takes the following form:

$$\log p_{ijopt} = \alpha + \text{FE}_i + \text{FE}_j + \text{FE}_{opt} + \beta \mathbf{X}_{ijopt} + \varepsilon_{ijopt}, \tag{27}$$

where $ijopt$ represent the importer, transportation company, origin country, product (HS4), and quarter, respectively. The dependent variable is the log of the freight value, FE_i is the time-invariant importer fixed effect, FE_j is the time-invariant transport company fixed effect, $\mathbf{X}_{ijopt}$ is a vector of control variables, and ε_{ijopt} is the residual specific to the transport company-importer relationship and the particular product, period, origin, and transport method under consideration. Identification of the transport company and importer fixed effects comes from the variance of freight prices across transport companies and across importers within a product$\times$period$\times$origin$\times$transport-method. The variance of Equation (27) can be decomposed as follow:

$$\begin{aligned} \text{Var}(\log p_{ijopt}) = {} & \text{Cov}(\log p_{ijopt}, \text{FE}_i) + \text{Cov}(\log p_{ijopt}, \text{FE}_j) + \\ & + \text{Cov}(\log p_{ijopt}, \beta \mathbf{X}_{ijopt}) + \text{Cov}(\log p_{ijopt}, \varepsilon_{ijopt}). \end{aligned} \tag{28}$$

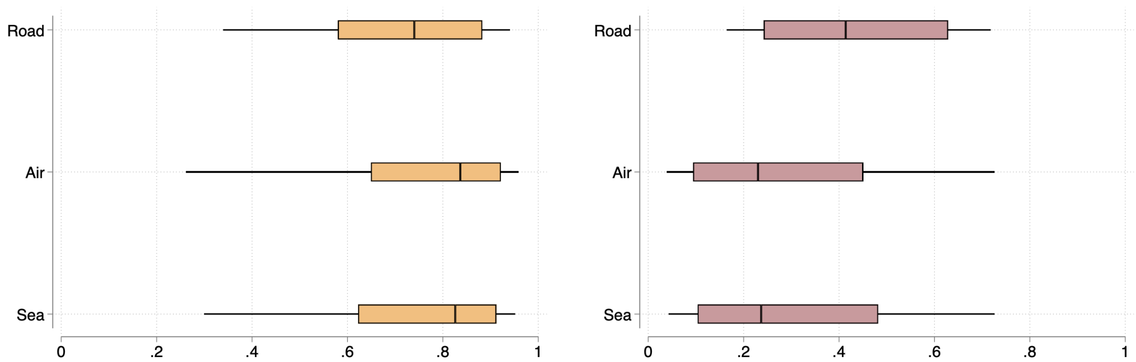
F Additional Empirical Results

Table F.1: Estimated $\widehat{\rho}$ - Robustness

	(1) Additional IV	(2) Level - Yearly	(3) Level - Quarterly	(4) Aggregate	(5) Aggregate
$\widehat{\beta}$	-2.101	-1.306	-1.759	-1.700	-2.606
	(0.455)	(0.270)	(0.370)	(0.404)	(0.711)
Implied $\widehat{\rho}$	3.101	2.306	2.759	2.700	3.606
FEs	$FE_j + FE_t + FE_m$	$FE_j + FE_i \times FE_t \times FE_m$	$FE_j + FE_i \times FE_t \times FE_m$	$FE_j + FE_t + FE_m$	$FE_j + FE_t \times FE_m$
N	1672268	2717731	2492991	502841	500097

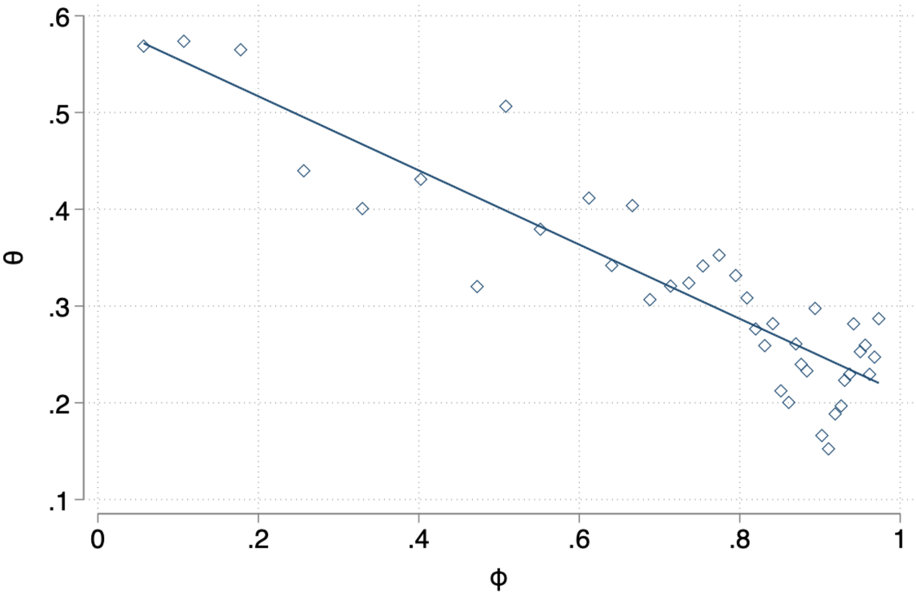
Notes: The table reports the estimated price elasticities. Column (1) is estimated in difference and the set of instruments includes the number of carriers and importers in a given market in addition to the average price charged by the same carrier j to other importers in other markets. Column (2) and (3) estimates the specification in level at yearly and quarterly frequency, respectively. The vector of instruments includes only the average price charged by the same carrier j to other importers in other markets. Columns (4) and (5) aggregate data at the carrier-market-year level and estimate the specification in level using the average price charged by the same carrier j in other markets as instrument. Standard errors are clustered at the importer level in Columns (1) to (3), and carrier level in Columns (4) and (5). Implied $\widehat{\rho}$ reports the implied ρ, computed as $\widehat{\rho} = -\widehat{\beta} + 1$.

Figure F.1: Distribution Parameters by Mode of Transportation



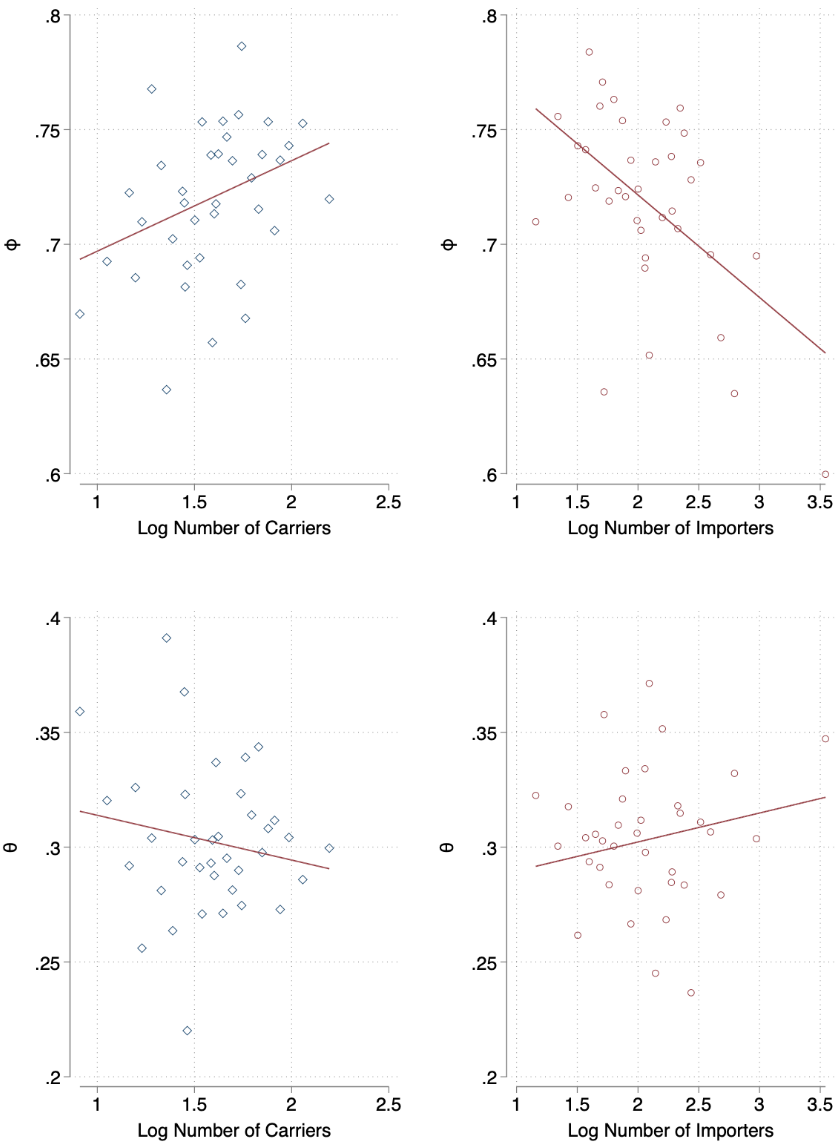
Notes: The Figure plots the distribution of the estimated bargaining power parameter ϕ (left panel) and return to scale parameter θ (right panel) by mode of transportation, i.e. distinguishing sea, air, and road markets. The box delimits the interquartile range of the distribution, while the whiskers span from the 10th to the 90th percentiles.

Figure F.2: Correlation θ and ϕ across Markets



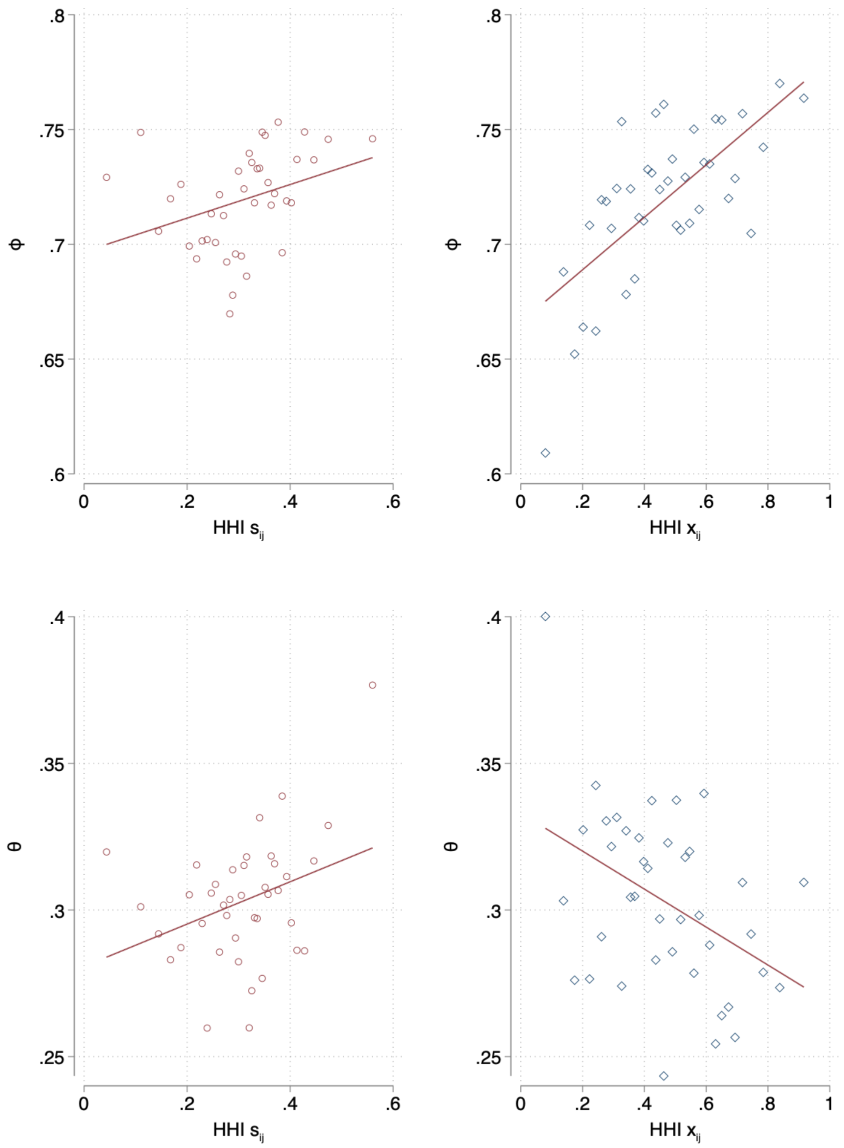
Notes: The binscatter plot displays the relationship between the estimated bargaining power (on the horizontal axis) and return to scale (on the vertical axis) parameters across markets.

Figure F.3: Correlation Estimated Parameters - Number of Firms across Markets



Notes: The top (bottom) left panel plots the relationship across markets between the estimated bargaining power (return to scale) parameter and the (log) number of carriers, after residualizing for the (log) number of importers in the market. The top (bottom) right panel plots the relationship across markets between the estimated bargaining power (return to scale) parameter and the (log) number of importers, after residualizing for the (log) number of carriers in the market. In all cases we absorb transport method fixed effects.

Figure F.4: Correlation Estimated Parameters - HHI across Markets



Notes: The top (bottom) left panel plots the relationship across markets between the estimated bargaining power (return to scale) parameter and the HHI index of bilateral shares s_{ij} at the market-time level, after residualizing for the HHI index of bilateral shares x_{ij}. The top (bottom) right panel plots the relationship across markets between the estimated bargaining power (return to scale) parameter and the HHI index of bilateral shares x_{ij} at the market-time level, after residualizing for the HHI index of bilateral shares s_{ij}. In all cases we absorb transport method fixed effects. s_{ij} is the share of carrier j in total transportation costs of importer i (within a market-time pair); x_{ij} is the share of total sales of j purchased by importer i (within a market-time pair).