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

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Abstract

We study how the interplay between oligopoly in the transportation industry and oligopsony power retained by non-atomistic importers affects the transmission of trade policy. Using Chilean customs data, we document strong concentration among carriers and importers and show that freight prices are determined through bilateral bargaining under two-sided market power. We estimate a trade model that endogenizes transportation costs by embedding oligopoly and oligopsony in the transport sector, along with bilateral bargaining. We find sizable carrier markups, partially offset by importer bargaining power. Embedding this mechanism into a quantitative trade model, we find that the endogenous response of transportation costs reduces the welfare cost of tariffs by 50% compared to the standard case of iceberg trade costs. This effect is primarily driven by decreasing returns to scale in carriers' supply. Bargaining, in turn, plays a central role in shaping price levels and market allocations in the transportation sector.

Keywords: Transport Costs, Bilateral Bargaining, Market Power, Gains From Trade.

JEL Classification: F10, F12, F14, R4, D43

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1 Introduction

Every year, the transportation sector carries over $20 trillion worth of internationally traded goods around the globe. Recent events, such as the Suez Canal obstruction in 2021, severe port congestion in 2022, and piracy attacks in the Red Sea in 2023, have highlighted the indispensable role of the transportation sector in global trade. Yet, relatively little is known about the market structure of this sector and how prices for transportation services are determined. In particular, growing evidence suggests that the transportation market is characterized by large firms providing transport services (Hummels et al., 2009; Ignatenko, 2020; Asturias, 2020; Ardelean and Lugovskyy, 2023), which interact with equally large domestic firms (Bernard et al., 2007; Ciliberto and Jäkel, 2021; Alfaro-Urena et al., 2022).

In this paper, we apply and estimate a model of imperfect competition a là Alviarez et al. (2023) in the transportation sector, where transportation prices are the outcome of bilateral negotiations between non-atomistic importers and large carriers. We provide reduced form evidence that the unit freight prices paid by importers to carriers result from a bargaining process between two sides of the market, both having substantial market power. We estimate that carriers charge high markups to importers. However, importers have twice the bargaining power of carriers. We then embed these features into a general equilibrium trade model of importing to quantify the welfare effects of tariffs and transportation cost shocks in the presence of bilateral negotiations in the transportation sector. We show that the presence of endogenous transportation costs reduces the welfare costs of higher tariffs.

We use Chilean import customs-level data spanning from 2007 to 2022 to document new empirical facts about the market structure of the transportation sector and the pricing of international freight services. A key novelty of the dataset is that it records, for each shipment, the carrier responsible for the final leg before customs clearance. This information, combined with freight costs and the mode of transportation, allows us to measure unit freight prices at the shipment level and construct a panel at the importer–carrier level.

We document four key empirical facts. First, the customs data strongly reject the assumption of iceberg trade costs. We find a median coefficient of variation in unit freight costs across markets of approximately 0.9, far exceeding the standard threshold for uniform pricing, which sets the coefficient of variation below 0.01. This implies that freight charges are not proportional to shipment value, clearly contradicting the iceberg cost assumption commonly used in trade models. Second, we find evidence that both sides of the market, importers and carriers, operate in highly concentrated environments. The top 10% of Chilean importers account for, on average, 95% of total import value. Similarly, the average Herfindahl-Hirschman Index (HHI), computed as the share of imports handled by each carrier within a given market, is 0.45, far above the threshold value of 0.25 often used to define an industry as highly concentrated. We interpret this as initial evidence that both carriers and importers possess market power.

Third, we conduct a variance decomposition of unit freight prices using the framework originally developed in the labor literature by Abowd et al. (1999). We find that nearly 90% of the variation in unit freight prices within carrier-markets is explained by a carrier–importer match-specific component. Lastly, we present reduced-form evidence consistent with both sides exerting market power in the price negotiation of transportation services. Within a given carrier–market pair, unit freight prices decline with the importer's share of the carrier's total shipments, and rise with the carrier's share of the importer's total imports.

These empirical findings suggest that transportation prices are consistent with the outcome of a bilateral bargaining process between buyers (importers) and sellers (carriers), both of whom possess market power.

Next, we adapt a model of bilateral bargaining a là Alviarez et al. (2023) to the transportation market, in which both carriers and importers have market power. Carriers' market power arises from their non-atomistic nature and the imperfect substitutability of the services they offer, leading to oligopolistic competition. In contrast, non-atomistic importers exert buyer market power, reflecting the presence of upward-sloping supply curves on the carrier side. Crucially, we model the determination of equilibrium unit freight prices using a Nash-in-Nash bargaining framework. These equilibrium prices are shaped by both the relative bargaining power of the two parties and the strategic incentives originating from oligopolistic and oligopsonistic behavior.

We bring the model to the data to estimate three key parameters that determine the equilibrium transportation prices: the bargaining power of carriers and importers in the negotiation process over the final price, the market power of importers, measured through the carriers' scale elasticity, and the market power of carriers, proxied by their substitutability. We exploit the network structure of our data, which characterizes importer–carrier relationships, to create valid and relevant IVs and estimate these parameters using a GMM approach.

We estimate within-market substitutability across carriers to be approximately 3. This suggests the presence of sizable markups that carriers charge to importers in the transportation sector. Next, we estimate the carriers' supply elasticity to be approximately 0.56, strongly supporting the existence of upward-sloping supply curves for carriers. Additionally, we find that importers have roughly 2.3 times more bargaining power than carriers when negotiating the final price. Finally, the combination of an importer markdown of 0.93 and a carrier markup of 2.1 results in a median bilateral markup of 13% over the final transportation price. We also estimate the parameters at the market level and show that both buyer market power and importer bargaining power are positively (negatively) correlated with the number of carriers (importers) in the market. Similarly, carrier market power, proxied by low substitutability, is weaker in markets with more carriers and stronger in markets with more buyers. These cross-market patterns provide external validation for our estimates.

We embed the bilateral bargaining framework into a quantitative trade model of importing to assess the implications of imperfect competition and bilateral negotiations in the transportation sector for aggregate welfare. The economy consists of a finite number of heterogeneous domestic firms that produce differentiated goods for final consumers. Additionally, the economy features a roundabout production structure, as in (Caliendo and Parro, 2015). Firms can choose to import a bundle of foreign intermediate inputs, subject to fixed import costs. These imported inputs enhance firm productivity by imperfectly substituting for domestic inputs (Halpern et al., 2015; Blaum et al., 2018). Importing firms negotiate unit freight prices with transportation carriers through Nash-in-Nash bargaining, in markets characterized by a finite number of heterogeneous carriers operating under upward-sloping supply curves.

We estimate the model using a combination of customs data and firm-level balance sheet information for the Chilean manufacturing sector. Parameters related to the domestic production process, including final producers' demand elasticity and the substitutability between domestic and imported inputs, are calibrated using data from the Survey of Manufacturing Industries (ENIA). The remaining five parameters are estimated using a two-stage Simulated Method of Moments (SMM), targeting nine moments from both the domestic economy and the transportation sector. Specifically, we discipline the productivity distributions of domestic firms and carriers by matching moments from the cross-sectional distributions of domestic market shares, carrier market shares, and bilateral importer-carrier market shares.

We use the estimated model to quantify the importance of dual market power and bilateral bargaining in the transportation sector for the aggregate economy. We show that the increase in consumer prices due to the introduction of tariffs is 50% higher in the case of iceberg trade costs compared to when transportation costs are endogenous. The lower welfare costs of tariffs with endogenous transport costs are driven by a decline in transport costs, which partially offsets the rise in the factory-gate price of imported goods due to the introduction of the tariffs. The rise in the price of imports reduces the demand for imported goods and, consequently, the demand for transportation services. The price of transportation services drops mostly due to the presence of decreasing returns to scale, while bilateral markup adjustments are relatively small. Bargaining, in turn, plays a central role in shaping price levels and market allocations in the transportation sector.

We also perform a series of counterfactuals that directly affect transportation services. First, we study the impact of a symmetric cost shock to carriers such as an increase in fuel prices and the extension of the EU ETS to the shipping market. In both cases, we find negligible effects on aggregate welfare but significant changes in carriers' profits and transportation prices. Lastly, we analyze an asymmetric cost shock stemming from a measure that disproportionately affects certain carriers. An example of such a policy is the recent proposal under the USTR's Section 301 investigation into Chinese dominance in the maritime sector. We find that affected carriers lose market power and see a reduction in profits. However, non-targeted companies can increase their prices and profits, as they gain market share.

Related Literature This paper relates to at least three strands of literature. First, we contribute to the extensive literature in international trade that studies the determinants of transport costs (Anderson and Van Wincoop, 2003; Eaton and Kortum, 2002). We contribute to this body of work by showing that transportation prices are determined through the interaction between carriers and importers, both of which have market power, and that the equilibrium price results from a bargaining process. This builds on the growing body of evidence suggesting that transport costs are determined endogenously in equilibrium, rather than being externally imposed (Heiland et al., 2019; Brancaccio et al., 2020; Ganapati et al., 2021; Wong, 2022; Do et al., 2024; Tolva, 2025). Early work by Hummels et al. (2009) uses aggregate data to examine the role of market power and price discrimination in shipping. More recent research, enabled by transaction-level data, has explored how freight costs are shaped by factors such as firm size (Ignatenko, 2020), the number of competing shipping firms (Asturias, 2020), and information and search frictions (Ardelean and Lugovskyy, 2023). [1]

Second, this paper contributes to the literature on firm-to-firm market power by examining importer–carrier relationships. Recent empirical advances in this area have been enabled by the increasing availability of domestic and international firm-to-firm transaction data (Alfaro-Urena et al., 2022; Dhyne et al., 2022). The richness of our data allows us to quantify the market power of both sides, assess their relative bargaining strength, and provide benchmark estimates for key parameters in this industry. We estimate the elasticity of substitution across carriers to be around 3, consistent with previous findings obtained from different settings and econometric approaches (Brancaccio et al., 2020; Asturias, 2020; Wong, 2022; Jeon, 2022). We also find evidence of decreasing returns to scale in carriers' supply, in line with Chen (2024a,b) and Otani (2024). Finally, despite the different context studied in Alviarez et al. (2023), we similarly document a strong bargaining position for importers.

Lastly, we contribute to the literature that quantifies the welfare effects of import tariffs (Arkolakis et al., 2012; Caliendo and Parro, 2015; Blaum et al., 2018). Prior work highlights the importance of market structure for the pass-through of tariffs (Alviarez et al., 2023; Amiti et al., 2019b) and other shocks, e.g. exchange rate fluctuations (Atkeson and Burstein, 2008; Amiti et al., 2019a). We contribute to this literature by showing that the negative impact of import tariffs on domestic consumer welfare is attenuated when transportation costs are endogenous, arising from bilateral bargaining between importers and carriers. Specifically, we quantify how importer market power, carrier market power, and relative bargaining power affect the pass-through of tariffs to domestic price indices.

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 estimates the structural 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.

[1] Ardelean et al. (2022) surveys recent research on maritime shipping, reflecting the growing availability of micro-level data in this area.

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. For each transaction, the data includes information on the importer, the product (HS8), the mode of transport (sea, air, and road freight), and the country of origin. There is also information on the content of the transactions themselves such as the weight, the number of items, both the CIF and FOB values, and freight and insurance costs. More importantly for this paper, we also observe the name of the shipping company that took care of the transportation of the goods. 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 can be found in Appendix B.

We choose to focus our attention on imports because a large share of the Chilean shipments is organized by the importers, in line with previous studies (Ardelean and Lugovskyy, 2023; Teshome, 2018). 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 Incoterms, any transaction can be classified into two broad categories depending on whether it is the importer's or the exporter's responsibility to arrange the shipping of the good. Thus, we focus on those transactions that are recorded as arranged primarily by the importer to ensure that the parties involved in the bargaining of the freight price are only the carrier company and the importing firm.[2]

Structure of Chilean Freight Market Maritime transport is the most used mode of transport for Chilean imports. Figure E.1 in Appendix E shows that more than 50% of transactions are conducted by sea. This is in line with aggregate statistics on international trade and international shipping (Ardelean et al., 2022). 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 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.

Firms tend to use a single mode of transport for the majority of their transactions as shown in Figure E.2 in Appendix E. Approximately 80% of importers use a single mode of transport for each origin-product pair. However, multiple modes are used for imports from

[2] Appendix C presents a more in-depth description of what the Incoterms are and some key statistics of the trade flows by this variable. Throughout the paper, we show that this choice does not impact the key empirical findings. This is consistent with the results in Ardelean and Lugovskyy (2023) where larger firms face lower freight rates independently of who arranges the delivery (Proposition 1).

specific countries. The choice of transport mode is not solely determined by a combination of the country of origin and the characteristics of the imported goods. Thus, we define a market as an origin-HS2-mode triplet.[3]

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.

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 freight prices display patterns consistent with bilateral bargaining and two-sided market power.

Concentration in Trade and Transportation We show that both the imports market and the transportation industry are characterized by the presence of large firms.

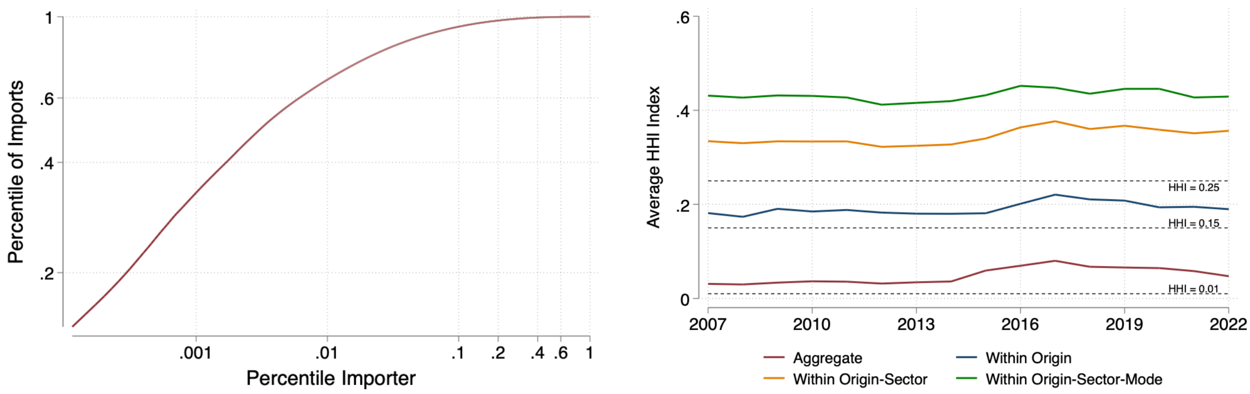
The left panel of Figure 1 shows that only a handful of firms drive aggregate imports, in line with previous literature (Bernard et al., 2007; Mayer and Ottaviano, 2008; Ciliberto and Jäkel, 2021). The red curve plots the cumulative distribution of imports in 2015 after ranking importers from the left 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.

As our baseline specification, we define a market as a combination of mode of transportation (sea, air, and road), country of origin, and 2-digit products as we believe key competitive forces operate within routes (and are potentially product-specific).

We show that markets' concentration is high across freight carriers by calculating the average HHI index across different markets over time (Figure 1) The green line shows that the average HHI in the market is well above 0.4, indicating the presence of strong concentration among freight carriers. We also consider a more aggregate definition of markets, such as aggregating across modes (orange line) or across products (blue line). In both cases, the average HHI indices are lower but still indicate the presence of moderate concentration. Moreover, despite multiple mergers and acquisitions in the shipping industry, Figure 1 shows that concentration has not increased over the last 15 years.

[3]Appendix E.1.2 provides information on sectoral and sourcing composition of Chilean imports, both at the aggregate and at firm level (Figure E.4). Chilean firms tend to import from a limited number of countries (Figure E.5), in line with broad evidence from international trade. Moreover, in Figure E.5 in Appendix E, we show that the median firm trade only with 2 product (HS2) in the sample. Similar results hold when we look at trade at the 4-digit product code (HS4).

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 the origin country. The orange and green lines defines markets as a combination of origin-sector and origin-sector-mode, respectively. A sector is defined as a HS2 category. Modes are sea, air, and road freight. Carriers' market share are computed in terms of value shipped.

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 weight (in kilograms) shipped or using HS4 sectors instead of HS2. In addition, Figure E.1 plots the entire distribution of HHI indices for our benchmark market definition (mode-origin-HS2 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.

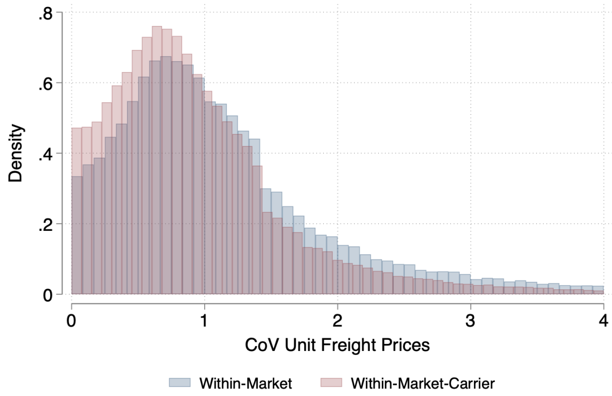
Variation in Bilateral Freight Prices We show that freight prices vary substantially within markets and within carriers, and the importer-carrier match-specific component explains a substantial portion of the variation in freight prices. To calculate ad-valorem freight prices we divide the total freight costs reported by the total weight in kilograms. We also restrict our sample to those transactions reported as arranged by the importer using Incoterms.

Unit freight prices are highly dispersed even within carriers, contrary to widespread modeling assumptions (Figure 2). For each market-time combination, we compute the coefficient of variation (CoV) of unit freight prices. The mean and median CoV across markets are approximately 0.9 and 0.8, respectively, indicating the presence of substantial dispersion in prices (Ignatenko, 2020; Ardelean and Lugovskyy, 2023).[4] We also find that carriers within the same market discriminate across importers, charging them 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 quantities, using 4-

[4] 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.

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-time combination. Markets are defined as a mode-origin-sector combination, where modes are sea, air, and road, and sectors are HS2 categories, respectively. Unit freight prices are computed by dividing total freight cost by the total weight, in kilograms, transported. We restrict our sample to transaction arranged by the importer only.

digit sectors, or using the full sample of transactions. 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.

Most of the dispersion in unit freight prices, τ_{ijmt}, 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 statistical decomposition of unit freight price dispersion:

$$\log \tau_{ijmt} = FE_i + FE_j + FE_{mt} + \beta \mathbf{X}_{ijmt} + \varepsilon_{ijmt}, \tag{1}$$

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 carriers' experience, age of relationship, and size of transactions.

We find that if we look at the variation in unit freight prices explained by each component, firm-level fixed effects cannot capture the full dispersion in τ_{ijmt} (Panel A of Table 1). 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, 4% and 5%, respectively.

Then we look at price dispersion within a carrier-market-year and decompose it into an importer fixed effect and a match residual component (Panel B of Table 1). We find that only 11% of the 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 τ_{ijmt}.

Table 1: Fixed-effect Decomposition of Freight Price Dispersion

	(1)	(2)
Panel A: Share of price dispersion explained by:		
Observables	.	0.023
Buyer FE	0.049	0.051
Transport Company FE	0.041	0.041
Sector x Time x Origin x Mode	0.626	0.606
Match Residual	0.283	0.279
Panel B - Within Carrier-Sector-Origin-Time-Mode:		
Observables	.	0.024
Buyer FE	0.112	0.111
Match Residual	0.888	0.865

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 kilograms 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 HS2 categories. We restrict the sample to transactions reported as arranged by the importer.

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 units of value shipped or per quantity. In addition, we show that similar results hold when we define a market at the 4-digit (HS4) product level or when we include all the transactions that are not arranged by the importer.

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 more importer i relies on carrier j, the higher the markup the carrier can exert. Conversely, the more the carrier j relies on importer i, the lower the markdown the importer can impose.

Formally, we consider the following empirical specification:

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

where τ_{ijmt} is the unit freight price paid by importer i to carrier j in market m at time t, measured as freight costs per kilogram shipped; $\mathbf{X_{ijmt}}$ is a set of control variables such as the carrier's experience and the age of the bilateral relationship; and FE represents a set of fixed effects. We construct instruments for bilateral shares to address their endogeneity with respect to bilateral prices exploiting the network structure of the market (Alviarez et al., 2023). More specifically, we instrument the carrier's seller share s_{ijmt} using the (log) sales

Table 2: Prices and Bilateral Concentration

	(1) OLS	(2) OLS	(3) OLS	(4) IV
Log Carrier Share	0.053	0.053	0.448	0.209
	(0.002)	(0.002)	(0.004)	(0.059)
Log Importer Share	-0.201	-0.201	-0.549	-0.302
	(0.002)	(0.002)	(0.003)	(0.055)
Controls	No	Yes	Yes	Yes
$FE_j + FE_i + FE_{mt}$	Yes	Yes	No	No
$FE_{jmt} + FE_{imt}$	No	No	Yes	Yes
F-stat				74.605
N	1,505,273	1,505,273	1,335,604	1,321,917

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.

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. As before, in our baseline specification we focus on the sample of transactions arranged by the importer as reported by the Incoterms.

In line with economic intuition, buyer market power reduces unit freight prices (β_x), while carrier market power increases unit freight prices (β_s). The quantitative effect of buyer and seller market power is similar. In Column (1) of Table 2, which includes importer, carrier, and market fixed effects, a one percent increase in the carrier's share increases unit freight prices by 0.053 p.p., and a one percent increase in the importer's share decreases unit freight prices by 0.20 p.p.. 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 increases the effect of buyer and seller market power to 0.55 pp and 0.49 pp, respectively (specification in Column(3)). Lastly, instrumenting bilateral shares reduces the magnitude of the two coefficients relative to the OLS counterpart, indicating the importance of correcting for endogeneity.

Table E.2 in Appendix E shows that the qualitative and quantitative results are robust to several alternative specifications. In particular, we explore differences between different transport modes by running the main specification separately for each mode. In addition, we run a set of robustness checks to ensure that our results are not driven by specific choices of the sample. First, we use freight prices calculated using quantities traded rather than weight. Second, we use a more granular definition of the market using HS4 products rather than HS2. Finally, we use the full sample of transactions rather than restricting the sample to those shipping arranged by the importer. We observe small quantitative differences across specifications, supporting the robustness of our results.

3 Estimating Bargaining Power in Transportation Sector

This section derives 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 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.[5]

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 service 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 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.[6] Specifi-

[5]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.

[6]Figure E.3 shows that most of imports are transported in many-to-many carrier-importer relationships, supporting the idea that importers use the services of several carriers at the same time. Moreover, we show in Appendix A.4 that we can microfound the CES composite bundle of transportation services *via* a discrete choice model in which the importer chooses, more realistically, one single carrier subject to idiosyncratic taste shock distributed according to a Gumbel distribution. This framework delivers the same implications as our composite bundle of carrier-specific varieties assumption.

cally, 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 the unit price of imported inputs is $p_{iF} = \overline{p_{iF}} + \tau_i$, where $\overline{p_{iF}}$ is the factory-gate price and τ_i the price index of the bundle of transportation services. We abstract 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: $TC(t_j) = \frac{1}{\zeta_j} t_j^{\frac{1}{\theta}}$, where ζ_j is a constant capturing productivity differences across carriers, and $\theta \in (0, 1)$ controls the returns to scale of carriers' production.

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. An upward sloped supply curve represents a reasonable assumption for the international shipping market: in the presence of capacity constraints, the marginal cost of accommodating an additional shipment rises as vessel-level capacity utilization nears 100 per cent as fully loaded vessels require longer loading and unloading times, ultimately increasing handling costs (Chen, 2024b,a). This assumption is further supported by Dunn and Leibovici (2023), which documents that vessel utilization rates have consistently remained above 90 percent over the past decade.

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 savings 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. Appendix A.1 provides details on the derivations of the key equations, together with analytical expressions for the gains from trade in Equation (5).

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.[7] 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 $\omega_{ij} = \frac{\overline{\phi} \lambda_{ij}}{1 + \overline{\phi} \lambda_{ij}}$ as the effective importer's bargaining power, that depends positively on the Nash bargaining power parameter, $\overline{\phi} = \frac{\phi}{1-\phi}$, and negatively on the importers' gains from trade term Ω_{ij} through the term $\lambda_{ij} = \frac{\sigma-1}{\epsilon_{ij}-1} \frac{\gamma s_{i\tau} s_{ij}}{\Omega_{ij}}$.[8] Intuitively, the bilateral price is closer to the oligopolistic case the lower the bargaining power of the 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 model: 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). For the estimation of the bargaining parameter and the scale elasticity, we set the values of the parameters σ and γ to be 6 and 0.5, respectively, calibrated using firm-level data from Chilean manufacturing sectors, as described in the quantitative model in Section 4.

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

[8]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.

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^m_{ijt}, depends linearly on the log of the bilateral price, τ^m_{ijt}:

$$\log s^m_{ijt} = -(\rho - 1)\left(\log \tau^m_{ijt} - \log \tau^m_{it}\right) + \nu^m_{ijt}, \tag{7}$$

where the superscript m refers to a specific market (i.e. product-route pair), τ^m_{it} is the price index at the importer level, and ν^m_{ijt} 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:

$$\log s^m_{ijt} = \beta \log \tau^m_{ijt} + \alpha^m_{it} + \nu^m_{ijt}, \tag{8}$$

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 freight 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, $cov(\nu^m_{ijt}, \nu^{m'}_{i'jt}) = 0$.[9] We also include 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). Lastly, we include carrier-market fixed effects to control for constant unobserved heterogeneity across suppliers, thereby limiting potential endogeneity issues to time-varying pair-specific shocks.

We estimate the specification in Equation (7) differencing out the importer's price index, τ^m_{it}, which is common across all carriers 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 $\Delta \log x^m_{ijj't} \equiv \log x^m_{ijt} - \log x^m_{ij't}$, we can rewrite Equation (7) as: $\Delta \log s^m_{ijj't} = -(\rho - 1)\Delta \log \tau^m_{ijj't} + \Delta \nu^m_{ijj't}$. This allows us to estimate the specification in Equation (8) abstracting away from importers-market-time fixed effects. For each importer, we use the carrier with the smallest buyer share as reference carrier j' to perform the differencing.

[9] 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, where pricing is influenced by route-specific factors, such as distance, port traffic, etc.

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 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 from the marginal cost of the carrier and write the following moment condition:

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

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).

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

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

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 cost could be correlated with observables such as bilateral shares, creating endogeneity issues. We rely on Hausman-type instruments in constructing Z, which includes the mean buyer and seller bilateral shares in the market excluding the involved pairs $i - j$ and $k - j$ (Hausman et al., 1994; Alviarez et al., 2023).

Data construction 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-year level and construct the key variables of interest s^m_{ijt}, x^m_{ijt}, $s_{i\tau}$ and τ^m_{ijt}. 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 $\frac{\sum_{jm} \tau^m_{ijt} t^m_{ijt}}{\sum_{jm} \left(\bar{p}^m_{iFt} + \tau^m_{ijt} t^m_{ijt}\right)} = \frac{\sum_{jm} \text{Transportation Cost}^m_{ijt}}{\sum_{jm} \left(FOB^m_{ijt} + \text{Transportation Cost}^m_{ijt}\right)}$.

In addition to the cleaning described in Section 2.1, we use the following criteria in constructing the sample used in estimation. First, we drop observations with zero bilateral shares or unit freight price, and trim unit freight price at the 5% level within each route and at the 5% level in the whole sample. Second, we consider only the carrier-importer pairs that trade for at least two consecutive years in order to reduce the impact of occasional and lumpy im-

Table 3: Summary Statistics

	Mean	Std.
Log τ^m_{ij}	0.25	1.57
Importer's Share s^m_{ijt}	0.33	0.27
Carrier's Share x^m_{ijt}	0.06	0.16
Transport Share s^τ_{imt}	0.13	0.13
Number of Carriers per Market	3.72	3.35
Number of Importers per Market	18.91	52.76
Number of Carriers per Importer	1.77	0.82
Number of Importers per Carrier	16.34	26.10

Notes: The Table shows the mean and standard deviation for key variables. τ^m_{ijt} is the unit freight price paid by importer i to carrier j in market m at time t, where unit freight prices are computed by dividing total freight cost by the quantity transported; s^m_{ijt} is the share of carrier j on importer i's total imports from market m at time t; x^m_{ijt} is the share of importer i in j's total quantity transported in market m at time t. s^τ_{imt} 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.

porters. Moreover, due to the econometric strategy used for the estimation of θ and ϕ, we exclude carriers transacting with only one importer within each market because the moment condition is not defined. We only keep markets in which at least three carriers operate and importers transacting with at least two carriers to ensure enough variation for the construction of Z. Lastly, 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.[10] For the estimation of ρ, we further exclude carriers operating in only one market or selling only to one importer because the Hausman-type instrument are not defined. Moreover, estimating ρ in difference requires importers that purchase transportation services from more than one carrier within a market.

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 19 and 4, respectively. Importers and carriers are connected to a limited number of partners, translating into high and dispersed market shares s^m_{ijt} and x^m_{ijt}. Lastly, the share of transportation services in the price of imports, s^τ_{imt}, is on average 13%, indicating the quantitative relevance of transportation costs for importers. Table F.1 in Appendix F shows that the summary statistics are quantitatively similar across modes of transportation.

3.3 Results

This section shows the estimation results, their robustness, their heterogeneity across markets, and the implied bilateral markups.

[10] See Footnote 7.

Table 4: Estimated Model Parameters

	$\widehat{\beta}$	$\widehat{\overline{\phi}}$	$\widehat{\theta}$
	-2.073	2.330	0.562
	(0.418)	(0.159)	(0.101)
Implied ρ	3.073		
Implied ϕ		0.700	
$FE_j \times FE_m$	Y	N	N
N	202196	11664641	11664641

Notes: The Table reports: i) the estimated price elasticities from the specification in Equation (8) estimated in difference using the price charged by the same carrier j to other importers in other market and the number of carriers and importers competing in each market as instruments (first column); ii) the estimated relative bargaining power $\overline{\phi}$ and scale elasticity θ from moment condition (9) using the mean buyer and seller bilateral shares in the market excluding the involved pairs as instruments (second and third column, respectively). Standard errors are robust. Implied ρ reports the implied ρ, computed as $\rho = -\widehat{\beta} + 1$. Implied ϕ reports the bargaining power of the importer knowing that $\overline{\phi} = \frac{\phi}{1-\phi}$.

Main estimates Table 4 reports the estimates from the whole sample. The first column reports the estimated coefficient from Equation (8) and the implied substitutability across carriers, ρ. The second and third columns report the estimated coefficients from the GMM in Equation (10), together with the implied bargaining parameter ϕ. Our preferred specification precisely estimates $\widehat{\rho}$ to be approximately three, indicating a low substitutability across carriers within each market.[11] As a consequence, carriers can charge substantial oligopolistic markups onto the importers.[12] The importers' relative bargaining power $\overline{\phi} = \frac{\phi}{1-\phi}$ is estimated to be 2.3 and the carriers' scale elasticity θ is 0.56, both parameters precisely estimated. The former implies a ϕ of 0.7, which indicates that, on average, importers enjoy a substantial degree of bargaining power, allowing them to put relatively more weight on the markdown. The return to scale of the carriers is far below one, implying a carriers' supply elasticity $\frac{\theta}{1-\theta}$ of approximately 1.28, indicating that importers exert buyer market power on the carriers.[13]

Heterogeneity across markets We estimate the vector of parameters for each individual market, defined as a origin-product-mode triplet.[14] Table 5 reports selected moments of the

[11]Table F.2 in Appendix F shows 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)). The strong negative value of the CES elasticity estimated in the main specification supports the validity of our instruments to correct for the endogeneity bias in this setting. The other columns of Table F.2 shows that the estimated price elasticity and substitutability across carriers is robust across several specifications.

[12]The estimated price elasticity is in the range of values provided in the literature, estimated leveraging different data and econometric strategies. Wong (2022) and Jeon (2022) estimate values around 3 using the round-trip effect and ship size and age as instruments, respectively; Brancaccio et al. (2020) and Asturias (2020) estimate elasticities between 5 and 6 for the dry bulk and container sectors, respectively. Chen (2024b) and Chen (2024a) use the Houti attacks in 2023 as instrument and estimate a smaller elasticity of around 1.2 .

[13]Chen (2024b) and Otani (2024) strongly reject constant and decreasing marginal costs when analyzing the effects of shipping alliances and cartels, respectively. Similarly, Chen (2024a) estimates a supply elasticity of around 2.2 using CTS data on vessel capacity.

[14]We estimate the parameters applying the main specification in each market. In case β is positive or does not converge, we use only the price charged by the same carrier j to other importers in other market as instrument or estimate Equation (8) in level introducing importer-time-market fixed effects. In case the estimation of ϕ and θ does not converge, we add the median buyer and seller bilateral shares in the market excluding the involved

Table 5: Heterogeneity across Markets

	$\widehat{\rho}$	$\widehat{\phi}$	$\widehat{\theta}$
Mean	3.99	0.64	0.42
Weighted Mean	3.57	0.52	0.54
Median	2.35	0.73	0.36
Interquartile Range	2.42	0.45	0.45
Number of Markets	819	505	505

Notes: The Table reports moments from the distribution of parameters ρ, ϕ, and θ, estimated at the market level. Markets are defined as a origin-product(HS2)-mode triplet. Price elasticities are estimated from the specification in Equation (8); bargaining power and scale elasticity θ from moment condition (9). In the second row, markets are weighted by the number of $i-j$ pairs in each market.

distribution of parameters across markets. As expected, the mean and the median parameter across markets are close to the one estimated in the main specifications, with or without weighting by the number of pairs in each market. Importantly, we find the presence of a substantial heterogeneity across market, with an interquartile range of 2.4 for the substitutability across carriers and 0.45 for both the bargaining power and scale elasticity. Figure F.1 in Appendix F displays the distribution of the three parameters depending on the mode of transportation. The distributions are quantitatively similar across modes, with the parameters being slightly more dispersed in the case of road freight.

We show that the estimated parameters correlate with observable characteristics of the market in an economically meaningful way, supporting the validity of our estimates. In line with economic intuition, Table 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. Moreover, carriers' market power, which is inversely related to ρ, is lower in markets with more carriers and higher in markets with more importers. We also find qualitatively similar relationship between the estimated parameters and the HHI indices of the bilateral shares s_{ij} and x_{ij}, which also capture the relative degree of bargaining power of the two sides of the market.[15]

Implied bilateral markups We use the estimated parameters from Table 4 to measure the implied bilateral markups and their components. Table 6 reports moments from the distribution of average market-level bilateral markups μ_{ij}, and the underlying oligopolistic markups, oligopsonistic markdowns, and bargaining weights. The mean and median bilateral markups are 12 and 13 per cent, respectively, in line with the estimates for the transportation industry from De Loecker and Eeckhout (2017). The average oligopolistic markup ranges from 1.6 to 3.1 given the low elasticity of demand, while the oligopsonistic markdown lies between 0.8

pairs or the number of carriers and importers competing in each market as instruments.

[15]Table F.4 in Appendix F shows the presence of a negative (positive) correlation between the estimated importers' bargaining power and the carriers' return to scale across markets (substitutability across carriers), in line with economic intuition.

Table 6: Bilateral Markups

	Mean	p10	p50	p90
Oligopolistic Markup	2.305	1.670	2.144	3.100
Oligopsonistic Markdown	0.911	0.793	0.927	0.985
Bargaining Weight	0.777	0.739	0.773	0.814
Bilateral Markup	1.118	1.032	1.129	1.176

Notes: The table displays moments from the distribution of average market-level oligopolistic markups, oligopsonistic markdown, bilateral markups, and bargaining weights. Markups are constructed using the estimated parameters from Table 4.

to 0.98. The bilateral markup is the combination of oligopolistic and oligopsonistic forces, with a average bargaining weight of 77 per cent on the latter. At the pair-level, Figure F.2 in Appendix F shows the presence of a strong positive correlation between markups and markdowns, ultimately driven by the fact that buyer and seller shares are positively correlated.

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_{iD} 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, 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_{iD} 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.

Building on 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 freight prices 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 $B \equiv \frac{1}{\sigma} \left(\frac{\sigma}{\sigma-1} \right)^{1-\sigma} P^{\sigma-1} S$, where S is the aggregate spending in the economy.[16] Formally, the unit cost is given by:

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

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 of the factory-gate price set by the exporter, $\overline{p_{iF}}$, and the cost of transportation services, $\tau_i = \left(\sum_{j \in J_i} \alpha_{ij} \tau_{ij}^{\frac{1}{\rho-1}} \right)^{\frac{1}{1-\rho}}$, where α_{ij} represents taste heterogeneity across carriers in importers' transportation demand.

[16]Aggregate spending is a function of L and the model's parameters: $S = L^{net} \frac{\sigma}{(1-\gamma)(\sigma-1)}$.

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.[17]

4.2 Calibration and Estimation

We now parametrize the model using Chilean customs and micro data. Our calibration and estimation strategy is as follows. Tables 7 and 8 summarize the parameters and the calibrated values or the moments used in the estimation.

4.2.1 Externally Calibrated Parameters

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, $\rho = 3.5$. We leverage the distribution of parameters estimated across markets in Section 3 and set the bargaining power ϕ to 0.7 and the carriers' return to scale θ to 0.5, respectively, equal to the average estimated parameter across markets. From Table 3, we assume that the number of carriers operating in the transportation sector is equal to 4, i.e. the average number of carriers in a across transportation markets. Similarly, we set the number of importers equal to the average number of importers across transportation markets, which is approximately 19.

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). 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 to 6, close to the median

[17] 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: $y_i = c_i + y_i^{ROW} + \sum_v^N y_{iv}$.

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 production function estimation techniques as in Levinsohn and Petrin (2003) 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). Appendix D provides additional information on the dataset ENIA, its cleaning, and the calibration.

4.2.2 Internally Estimated Parameters

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 microdata show that 20% of domestic firms are importers. We also assume that the economy is populated by 95 domestic firms (i.e., $N = 95$) 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. Four parameters govern the distributions of firms' heterogeneities. Carriers' productivity, ζ_j, is drawn from a log-normal distribution with variance σ_ζ^2 and unit mean. Domestic firms' efficiency, φ_i, is drawn from a log-normal distribution with variance σ_φ^2 and mean μ_φ. Lastly, we assume that the match-specific taste shocks in the transportation sector, α_{ij}, are drawn from a normal distribution with unit mean and variance $\sigma_{\alpha_{ij}}^2$. We estimate these parameters by targeting salient features of the empirical distribution of sales and bilateral shares. Specifically, the dispersion in domestic sales and in carriers' size is informative for the efficiency of importers and carriers. A non-zero mean allows us to capture differences in productivity between domestic firms and carriers, which is calibrated targeting the aggregate share of domestic inputs in the economy. We calibrate the process for α_{ij} targeting the average dispersion and the average maximum in s_{ij} across importers, the average dispersion and the average maximum in x_{ij} across carriers, and their correlation. We normalize μ_ζ to one, so that one can interpret μ_φ as the average relative productivity between importers and carriers.

Table 7: Calibrated Parameters

Panel A: Calibrated Parameters		
Transportation Sector and Bargaining Process		
ρ	3.5	Estimated from Section 3.3
θ	0.5	Estimated from Section 3.3
ϕ	0.7	Estimated from Section 3.3
N_j	4	Average Number of Carrier per Market
N_i	19	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	95	Share of Importers
η	0.5	Normalized
L	1	Normalized

Notes: The Table reports the value of the calibrated parameters and the moment from the data used for calibration. We use data from the import transaction data from the Chilean Customs from 2007 to 2022, and the survey of manufacturing industries (ENIA) from 1995 to 2018. Additional information on data and their cleaning in Appendices B and D.

Home bias and price of import. Without loss of generality, we normalize η to 0.5. We target the average share of transportation services in the price of imported goods, $s_{i\tau}$, and the aggregate share of domestic inputs in the economy (home bias) to calibrate the factory-gate price of imports, $\overline{p_{iF}}$, which is assumed to be the same across importers.

Algorithm for Estimating the Model 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 50 economies for a given set of parameters. We compute model moments for each simulated economy, compute the average moments across economies, and compare them to the true moments in the data. For each simulation, the model is solved numerically using a nested fixed-point (NXFP) algorithm. Given initial values of P and f, we solve an inner fixed-point problem to recover the bilateral freight rates τ_{ij} that satisfy the Nash-in-Nash equilibrium conditions. Given the resulting τ_{ij}, we then update the outer fixed point over P and f. This procedure continues until both the inner and outer fixed-point conditions are jointly satisfied.[18]

[18] The fixed cost of importing, f, is estimated separately for each economy by identifying the value that makes the marginal non-importing firm indifferent between sourcing inputs domestically and importing. To recover the implied fixed cost f that rationalizes the observed import behavior, we focus on the most productive firm that does not import in equilibrium, indexed by $i^\star$. We compute the equilibrium in a counterfactual scenario in which $i^\star$ imports and earns a profit $\pi_{i^\star}^{\text{CF}}$. We then solve for the fixed cost f that makes $i^\star$ indifferent between importing and not importing, using the equation:

$$f = \frac{\pi_{i^\star}^{\text{CF}} - \pi_{i^\star}^{\text{B}}}{w},$$

where $\pi_{i^\star}^{\text{B}}$ is the baseline profit from not importing and w is the wage.

We choose the optimal model parameter vector, $\theta = \{\overline{p_{iF}}, \sigma^2_{\varphi}, \mu_{\varphi}, \sigma^2_{\zeta}, \sigma^2_{\alpha_{ij}}, f\}$, using a two-step simulated model moments estimation procedure. We estimate the optimal vector of parameters $\widehat{\theta_{SMM}}$ such that:

$$\widehat{\theta_{SMM}} = \arg\min_{\theta} \left(\frac{\hat{m}(\tilde{x}|\theta) - m(x)}{m(x)} \right)' W \left(\frac{\hat{m}(\tilde{x}|\theta) - m(x)}{m(x)} \right), \tag{16}$$

where $m(x)$ is the vector of data moments, $\hat{m}(\tilde{x}|\theta)$ is a vector averaging the simulated model moments, and W is the optimal weighting matrix estimated in the first step. Given the non-linearity of the model, we employ a stochastic optimization routine (simulated annealing) in both steps of the estimation where convergence is achieved when there are no sizable improvements in the objective functions for more than 3000 evaluations.

Estimated Parameters and Model Fit Panels A and B of Table 8 report the estimated values with their standard errors, and the data and simulated moments, respectively. The estimation process demonstrates an overall good fit and precision.

The model reproduces the aggregate domestic share and the average share of transportation costs in import prices, $s_{i\tau}$. The model achieves this with factory-gate price of imports, $\overline{p_F}$, of 1.48 and carriers being more efficient than domestic firms, on average.[19] More efficient carriers translate into lower transportation costs, influencing the relative price of domestic and imported goods and, thus, the aggregate domestic share and the average share $s_{i\tau}$.

The model reproduces well the dispersion in domestic sales and the dispersion in carriers' aggregate market shares. The volatility of firms' and carriers' productivity, together with the volatility in idiosyncratic import-carrier match shocks, jointly target the moments on the distribution of buyer and seller shares. The model reproduces successfully both the average maximum bilateral share, their dispersion, and their correlation.

On Identification We show that the model is strongly identified thanks to the careful choice of empirical moments. Structural estimation based on simulated moments inevitably raises questions of identification, especially in models where analytical characterizations are unavailable. We address the issue through two standard approaches widely accepted in the literature. First, we follow Andrews et al. (2017) and display the sensitivity matrix $\Lambda = -(G'WG)\,G'W$ in Table F.5 in Appendix F. Intuitively, this can be seen as a local approximation of the mapping from moments to estimated parameters, where W is the probability limit of $\hat{W}$ and G is the Jacobian of the probability limit of $\hat{m}(\tilde{x}, x \mid \theta)$ at θ_0.

Second, we examine how variation in individual parameters affects the simulated moments (Kaplan, 2012; Berger and Vavra, 2015; Morten, 2019). Identification relies on the premise that each parameter should predominantly influence a subset of the moments used in estimation. To explore this, we vary one parameter at a time while holding the others fixed, and examine the sensitivity of the moments to these changes. Moments that are informative

[19] Given our distributional assumptions, the average domestic firms' productivity, φ_i, are equal to $\exp(\mu_{\varphi_i} + 0.5 * \sigma^2_{\varphi_i}) \approx 0.55$. Similarly, the average carriers' productivity, ζ_j, is equal to 5.

Table 8: Parametrization

A. Estimated parameters	Estimate	(Std. Error)
Std of domestic firm productivity, σ_φ	0.42	(0.01)
Mean of domestic firm productivity, μ_φ	-0.81	(0.03)
Std of carrier productivity, σ_ζ	1.22	(0.07)
Std idiosyncratic importer-carrier match shock, $\sigma_{\alpha_{ij}}$	0.45	(0.01)
Factory-gate price of imports, $\overline{p_{iF}}$	1.48	(0.06)
Fixed cost of importing, f	0.13	(0.01)
B. Targeted moments	**Data**	**Model**
Std sales share in domestic economy	0.03	0.04
Aggregate domestic share	0.89	0.82
Correlation(s_{ij}, x_{ij})	0.10	0.12
Average Max x_{ij}	0.43	0.39
Average Std in x_{ij} across carriers	0.13	0.09
Average Max s_{ij}	0.47	0.47
Average Std in s_{ij} across importers	0.18	0.17
Average $s_{i\tau}$	0.13	0.13
Std aggregate shares across carriers	0.20	0.20

Notes: Panel A reports the parameters estimated using a two-stage SMM and the corresponding standard errors. Panel B reports the moments in the data and in the simulated model. The model moments are generated as the average between 50 economies. The moments from the data are computed using data from the import transaction data from the Chilean Customs from 2007 to 2022, and the survey of manufacturing industries (ENIA) from 1995 to 2018. Additional information on data and their cleaning in Appendices B and D.

about a given parameter should exhibit greater responsiveness to its variation. Figure F.4 in Appendix F plots the relationship between each estimated parameter and the corresponding percentage change in moments. As expected, some moments respond more strongly to specific parameters, providing support for parameter identification.

4.3 The Aggregate Impact of Endogenous Trade Costs

We examine how the endogeneity of transportation prices, arising from bargaining frictions and decreasing returns to scale in the transportation sector, shapes equilibrium prices and the transmission of tariff and cost shocks.

4.3.1 Bargaining and Equilibrium Transportation Prices

Table 9 shows that both bargaining power and decreasing returns to scale are crucial for explaining price levels and allocations in the transportation sector. Holding the returns to scale parameter fixed, an economy that abstracts from giving the importer any bargaining power (i.e., $\phi \to 0$) exhibits, on average, transportation prices that are 38 percent higher, as carriers can extract larger markups. This increase in transportation costs raises import prices, which, in turn, elevates the marginal costs faced by domestic producers, ultimately resulting

Table 9: Comparative Static

	τ_{ij}							
	Weighted Mean	Mean	Median	$\max s_{ij}$	$\max x_{ij}$	$s_{i\tau}$	s_{iF}	% Change in CPI
Baseline	0.36	0.45	0.39	0.47	0.39	0.13	0.18	1.00
$\phi \to 0$	0.50	0.57	0.51	0.43	0.37	0.16	0.17	0.56
$\phi \to 1$	0.32	0.41	0.36	0.50	0.41	0.12	0.19	-0.22
$\theta \to 1$	0.54	1.97	1.13	0.76	0.37	0.19	0.16	0.80
$\theta \to 1 \& \phi \to 0$	1.03	2.53	1.45	0.60	0.35	0.30	0.12	0.16

Notes: The Table displays equilibrium objects for different values of importer bargaining power, ϕ, and carrier's return to scale, θ. It includes the mean, median, and weighted mean of bilateral transportation prices; the maximum bilateral shares s_{ij} and x_{ij}; the average share of transportation costs in the price of imported goods and the share of foreign intermediate goods across importers; the percent different in the domestic price index relative to the baseline model. The weights uses within market $\times$ time bilateral transportation quantities.

in consumer prices that are 0.56 percentage points higher.[20]

Relaxing the assumption of decreasing returns to scale and instead imposing constant returns (i.e., $\theta \to 1$) generates qualitatively and quantitatively similar effects, with transportation and consumer prices rising by 50 percent and 0.80 percentage points, respectively. However, the mechanisms at play are fundamentally different and lead to counterfactual implications for market allocations. When bargaining power is held constant and constant returns to scale are imposed, the carriers' supply curve becomes flat, with variation across firms arising solely from differences in productivity draws.

A flat supply curve eliminates the buyer power of importers, resulting in higher transportation prices. Moreover, under constant returns, more productive carriers have a lower marginal cost curve, thereby maintaining their cost advantage and capturing disproportionately large market shares. The resulting allocation is highly concentrated and counterfactual: the largest carriers in this scenario reach bilateral market shares (s_{ij}) of approximately 75 percent which is substantially higher than the one observed in the data and in the baseline model.

4.3.2 Tariff shocks and GFT

We assess whether endogenous transportation costs affect the welfare effects of tariff shocks. We benchmark our results against a standard iceberg trade cost case. To guide the analysis, we derive a first order approximation of the welfare effects of tariff shocks. We show that the pass-through of trade tariffs is 50 percent higher in a standard model with iceberg trade frictions compared to our model, mostly driven by the presence of decreasing returns to scale.

Approximation for the GFT We map a rise in ad valorem tariffs $\bar{t}$ into the model with an increase in the factory gate price of imported goods, $\overline{p_F}(1+\bar{t})$. We measure aggregate welfare in terms of changes in the aggregate consumers' price index, but results are qualitatively similar using real consumption. We can approximate the change in the aggregate consumers'

[20]The same reasoning applies when bargaining power is fully assigned to importers, i.e., $\phi \to 1$, leading to lower prices along the same chain of transmission.

price index following a change in ad valorem tariffs as follows:

$$\frac{\partial \log P}{\partial \log \bar{t}} \approx \frac{\beta \sum_i s_i s_{iF} \left(1 - s_{i\tau} + s_{i\tau} \cdot \frac{\partial \log \tau_i}{\partial \log \bar{t}}\right)}{1 - \beta \sum_i s_i (1 - s_{iF})} \equiv \frac{\beta \cdot (\mathbf{s} \circ \mathbf{s}_F)^\top (\mathbf{1_I} - \mathbf{s}_\tau + \mathbf{s}_\tau \circ \mathbf{g})}{1 - \beta \cdot \mathbf{s}^\top (\mathbf{1_I} - \mathbf{s}_F)} \tag{17}$$

where s_i is the market share of firm i on final consumption and $\frac{\partial \log \tau_i}{\partial \log \bar{t}}$ is the endogenous response of transportation costs to tariff changes. The second part of Equation (17) rewrites the forms, with $\circ$ indicating the Hadamard product. It can be shown that the vector of $\frac{\partial \log \tau_i}{\partial \log \bar{t}}$, g, can be approximated as:

$$\mathbf{g} \equiv \begin{bmatrix} \frac{\partial \log \tau_1}{\partial \log \bar{t}} \\ \vdots \\ \frac{\partial \log \tau_I}{\partial \log \bar{t}} \end{bmatrix} = -\left[\mathbf{I} + \gamma \frac{1-\theta}{\theta} \mathbf{B} \; \mathrm{diag}(\mathbf{s}_\tau)\right]^{-1} \left(\gamma \frac{1-\theta}{\theta} \mathbf{B}(\mathbf{1} - \mathbf{s}_\tau)\right)., \tag{18}$$

where $\mathbf{s}_\tau = (s_{1\tau}, \ldots, s_{I\tau})^\top$, $B_{ii'} = \sum_j s_{ij} \, \Phi_{ij} \, x_{i'j}$, and $\Phi_{ij} \equiv \frac{1}{1+\Gamma_{ij}+\Lambda_{ij}}$. The latter represents the pass-through rate due to bilateral markup adjustments, Γ_{ij}, and cost elasticity, Λ_{ij}. Appendix A.5 provides additional details on the derivation of the approximation, and markup and cost elasticities. Figure 5 in Appendix A.5 shows that Equations (17) and (18) are successful in providing a close approximation of the changes in consumer welfare.

Baseline vs Iceberg Table 10 shows that the presence of endogenous trade costs reduces the welfare costs of tariff shocks relative to the iceberg case. Specifically, a 20 % ad valorem increase in tariffs increases the aggregate price index by 0.79% in the presence of endogenous trade costs when not accounting for firms' entry and exit. In contrast, in a model with standard iceberg trade costs, the price index would increase by 1.24 %, almost twice as high as in our baseline specification. The lower welfare costs of tariffs in the presence of endogenous trade costs are driven by a decline in trade costs. This partially offsets the increase in the factory-gate price of imported goods for domestic importers ($p_{iF} = \overline{p_F}(1 + \tau^{tax}) \uparrow\uparrow + \tau_i \downarrow$), ultimately reducing the cost for final consumers. This is captured by the term in parenthesis at the numerator of Equation (17), which is equal to one in the iceberg case and lower than one in our baseline model as $\frac{\partial \log \tau_i}{\partial \log \bar{t}} < 0$.[21] [22]

The decline in transportation costs is primarily driven by carriers' cost-side adjustments, while bilateral markup responses contribute comparatively less. An increase in import prices reduces the demand for imported goods and, given the Leontief structure of production, lowers the associated demand for transportation services. In the presence of decreasing returns to scale, this contraction in demand leads to a decline in transportation prices. The

[21] A small part of the difference between the welfare effects in the baseline model and in the iceberg scenario can be attributed to the assumption of additive transportation costs. Additivity implies that the pass-through of tariff on import prices p_{iF} is equal to $(1 - s_{it})$, while it is equal to one in the multiplicative iceberg case.

[22] A direct comparison between our results and the recent literature on the effects of trade wars is not straightforward. Several studies using product-level FOB import prices document near-complete pass-through of the 2018 Trump tariffs to U.S. import prices (e.g., Fajgelbaum et al. (2020) and Amiti et al. (2019b)). By contrast, our framework focuses on CIF import prices, explicitly accounting for transportation costs, while remaining agnostic about the degree of pass-through to FOB prices.

Table 10: Pass-through of Tariffs

Model	Description	Bargaining	RTS	Aggregate PT
(1)	Baseline	Yes	Yes	0.79
(2)	Iceberg	No	No	1.24
(3)	Additive	No	No	1.07
(4)	$\phi \to 0$	No	Yes	0.64
(5)	$\phi \to 1$	Yes	Yes	0.85
(6)	$\theta \to 1$	Yes	No	0.90
(7)	$\theta \to 1$ & $\phi \to 0$	No	No	0.60

Notes: The Table displays the percentage change in welfare due to a 20 percent tariff increase for different values of importer bargaining power, ϕ, and carrier's return to scale, θ. Welfare is measured as the consumer aggregate price index. Numbers are averaged across simulated economies.

last term in Equation (18)—$\left(\gamma\frac{1-\theta}{\theta}, \mathbf{B}(\mathbf{1}-\mathbf{s}_\tau)\right)$—captures this channel under the assumption of fixed markups and cost elasticity (i.e., $\Phi_{ij} = 1$). The magnitude of this initial effect is reported in the first row of Figure 3.

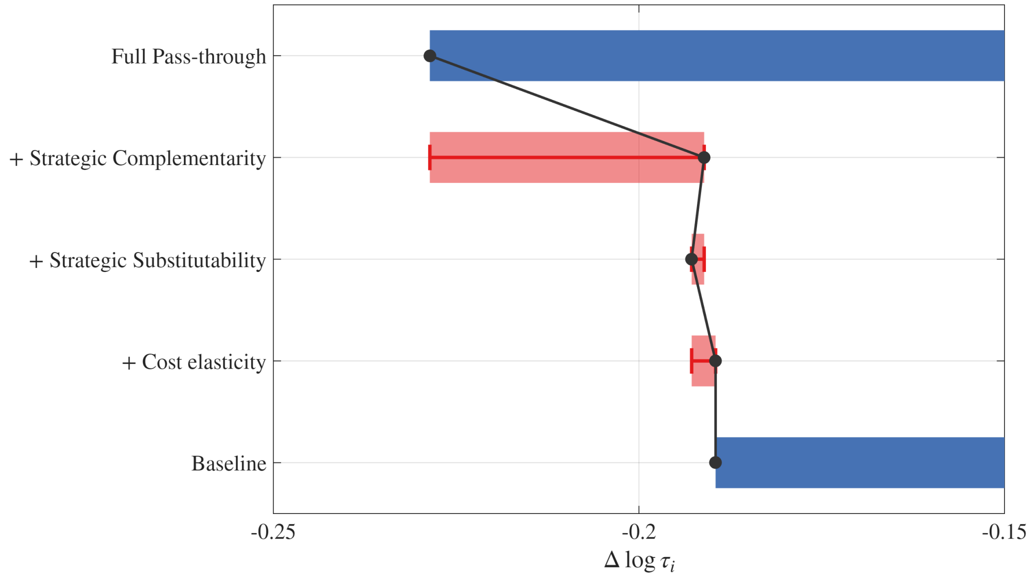
Markup adjustments are relatively small and primarily driven by strategic complementarities. The total decline in transportation prices is affected by variable markups and non-zero cost elasticities, both of which represent sources of incomplete pass-through ($\Phi_{ij} \leq 1$). On the one hand, carriers' oligopolistic markups limit pass-through due to strategic complementarities; on the other hand, importers adjust their markdowns in response to cost changes, amplifying pass-through through strategic substitutability (Amiti et al., 2019a; Alviarez et al., 2023). The sum of the top second and third rows in Figure 3 captures the contribution of bilateral markup adjustments. While both markup and markdown changes occur, the former dominates, resulting in a more muted decline in transportation costs.[23]

The effects of tariffs are heterogeneous across importers due to differences in their bargaining positions within the transportation market. Figure F.5 in Appendix F shows that, at the micro level, the increase in bilateral markups is more pronounced for importer-carrier pairs with higher bilateral shares (s_{ij}), consistent with greater exposure to carrier market power. In contrast, importers with larger buyer market shares experience a smaller increase in bilateral markups, reflecting their stronger bargaining position. Thus, although the tariff is uniform across importers, its impact on transportation costs, and hence on total import costs, is highly heterogeneous.

Entry and exit Figure F.6 in Appendix F shows that accounting for the entry and exit of importers magnifies the welfare losses from tariffs in a non-linear manner, depending on the size of the tariff shock. Tariffs raise the price of imported inputs, reducing the incentive for domestic firms to import. When a firm exits the importing market, its marginal cost increases, leading to higher output prices and, ultimately, an increase in the aggregate price index. This entry/exit margin amplifies the negative effect of tariffs on consumer welfare. However, the exit of importers also induces a reallocation of bargaining power toward the remaining

[23] The fourth column reports the contribution of cost elasticity, capturing an additional channel of incomplete pass-through driven by endogenous cost adjustments beyond the initial shock to transportation prices.

Figure 3: Decomposition



Notes: The Figure displays the decomposition of the term at the numerator of Equation (18) in the baseline model for a 20 percent tariff, averaging across simulated economies. The first (top) bar represents the term $\left(\gamma \frac{1-\theta}{\theta} \mathbf{B}(\mathbf{1}-\mathbf{s}_{\tau})\right)$ when $\Phi_{ij} \equiv 1$. The second bar highlights the contribution of strategic complementarities, setting $\Phi_{ij} = \frac{1}{1+\frac{\partial \log \overline{\overline{\mu_{ij}}}}{\partial \log \tau_{ij}}}$. In the third bar, we add the contribution of strategic substitutability, setting $\Phi_{ij} = \frac{1}{1+\Gamma_{ij}}$. The fourth bar represents the contribution of the cost elasticities, setting $\Phi_{ij} = \frac{1}{1+\Lambda_{ij}+\Gamma_{ij}}$. The last bar represents the full effect combining all elements from the previous bars.

importers, who, by accounting for a larger share of their carrier's business on average (higher x_{ij}), can exercise stronger buyer market power. This reduces their negotiated transportation costs, partially offsetting the increase in input prices caused by the tariff. Thus, the net effect on welfare depends on the size of the tariff and the extent of importer exit from the transportation market.

Effect of bargaining and returns to scale Both bargaining power and returns to scale influence tariff pass-through, primarily through their impact on equilibrium allocations. Table 10 reports the pass-through of tariffs to the consumer price index under alternative model specifications for bargaining power and returns to scale. Shifting bargaining power to one side of the market alters both the nature of strategic interactions, favoring either complementarities or substitutability, and the equilibrium expenditure shares (see Table 9). For example, when all bargaining power is allocated to carriers ($\phi \to 0$), bilateral markup adjustments reflect only strategic complementarities. In the absence of offsetting substitution effects, transportation prices respond less to tariff shocks, resulting in higher pass-through to consumer prices. However, under this specification, the share of transport costs ($s_{i\tau}$) is higher, while the share of imported inputs (s_{iF}) is lower than in the baseline model—both of which dampen the overall pass-through to consumer prices. As Table 10 shows, this second effect dominates, leading to a lower welfare cost of tariffs relative to the baseline. The opposite holds when bargaining power is entirely shifted to importers ($\phi \to 1$).

Assuming constant returns to scale in the transportation sector increases the welfare cost of tariffs by 0.11 percentage points relative to the baseline, though it remains substantially below that implied by the iceberg specification. In this scenario, transportation prices are unresponsive to tariff shocks because carriers face constant marginal costs, implying that the term $\frac{\partial \log \tau_i}{\partial \log t}$ in Equation (17) is zero. Consequently, the deviation from the iceberg benchmark is not driven by the endogeneity of transportation costs, but rather by equilibrium differences in expenditure shares: specifically, a higher share of transport costs ($s_{i\tau}$) and a lower share of imported inputs in production (s_{iF}).

4.3.3 Cost Shock to the Transportation Sector

Lastly, we show how symmetric (such as carbon taxes and oil shocks) and asymmetric (such as USTR remedies) shocks specific to carriers' costs are passed into transportation prices and ultimately aggregate welfare.

Symmetric Cost Shocks: Oil Shock and Carbon Tax We leverage the estimated model to assess the potential aggregate welfare effects of cost shocks impacting all carriers, such as an oil shock or a global carbon tax on international shipping.

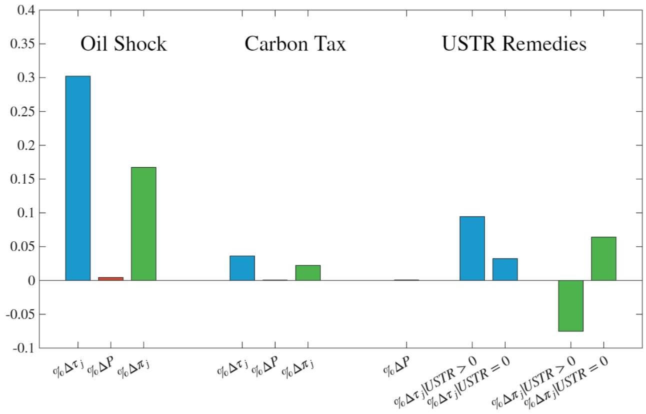
Fuel cost represents the single most important item in shipping costs, accounting for 47% of the total (Stopford, 2008). Therefore, large fluctuations in the price of oil, like the one in 2022, can influence carriers' costs, transportation prices, and ultimately trade flows, affecting consumers' prices. As an example of the effect of a severe change in fuel prices, we assume that the marginal cost of all carriers increases by 47% following the 100% rise in oil prices. [24] In Figure 4, we find that a sudden increase in fuel costs causes a 30 p.p. increase in transportation prices, indicating that the pass-through is incomplete. The implied pass-through rate is around 0.3, in line with estimates from Hummels (2007) and slightly larger than Brancaccio et al. (2023). The effect on consumers' prices appears to be small, less than 1%, when compared to the size of the increase in costs, due to the combination of incomplete pass-through and small share of transportation costs in the consumer price index.

The shipping sector contributes to the emission of 800 million tonnes of CO_2 at the global level, approximately 3% of the total greenhouse gas emissions (Lugovskyy et al., 2023). We assume the presence of a carbon tax applied to all carriers, τ^{green}, that increases the carriers' marginal cost: $\tau_{ij} = \mu_{ij} c_j (1+\tau^{green})$. In the exercise, we apply a €50 tax per ton of CO_2, which is mapped to be equivalent to a 5 percent increase in transportation costs, $\tau^{green} \approx 0.05$.[25]

[24] The price of oil increased significantly in 2022 due to a combination of supply disruptions, geopolitical tensions, and strong post-pandemic demand. Figure F.3 in Appendix F shows that between March and June of 2022 the price of crude oil (Brent) peaked at $120 per barrel from a pre-pandemic average of about $60.

[25] We choose a €50 tax per ton of CO_2 in line with the EU Commission projections for the 2030s, https://energy.ec.europa.eu/data-and-analysis/energy-modelling/eu-reference-scenario-2020_en, which lies between the €100 per ton of CO_2 in Coster et al. (2024) and the €29 per ton of CO_2 in Shapiro (2016). We measure the carbon emission of Chilean imports as follows: we first compute the total tonne-km for each mode of transportation using customs and BACI/CEPII data; 2) compute the CO_2 emissions generated by applying fuel efficiency coefficients from ECTA/CEFIC (7 gCO2/ton-km for sea freight, 602 gCO2/ton-km for for air freight, and 62 gCO2/ton-km for for road freight); 3) compute the cost of the carbon tax, given a €50 tax per ton of

Figure 4: Oil Shock, Carbon Tax, and USTR remedies



Notes: This Figure reports the changes in transport costs (blue), domestic prices (red), and carriers' profits (green) across three counterfactual scenarios: on the left, a symmetric increase in fuel prices due to an oil shock; in the center, a carbon tax; and on the right, an asymmetric increase in costs due to port fees. We abstract from the effects of the entry/exit margin.

Figure 4 shows that the pass-through of the carbon tax is incomplete and the welfare cost for final consumers is negligible. Transportation prices increase on average by 4 percent, indicating that the carbon tax is passed incompletely by carriers. The reason is that their perceived elasticity (markup) increases (decreases) as the share $s_{i\tau}$ increases, while a minor role can be attributed to the presence of decreasing returns to scale. Despite the increase in transportation prices, the aggregate price index rises only marginally, indicating that the cost for consumers of the carbon tax is small (Coster et al., 2024).[26]

Asymmetric Cost Shocks: the case of USTR's remedies We employ our model to study the potential impact of asymmetric policies such as the one proposed under the USTR's Section 301 investigation of Chinese dominance in the maritime sector. According to the USTR's report, China aggressively targeted the maritime sector in pursuing dominance, and proposed several remedies such as a service fee of \$1 million to enter a U.S. port on Chinese vessel operators, among others. The testimony of the World Shipping Council (WSC), the leading industry association of the sector, suggests that such remedies could increase the costs of a container by \$750, representing an increase between 30% and 100% relative to the current spot price.[27] We map this scenario to our model assuming that the policy applies heterogeneously to a subset of carriers increasing their marginal costs (Chen, 2024c).[28] We consider an increase of 30% in costs which is the lowest increase suggested by the WSC.

In this asymmetric case, carriers that are directly affected increase their shipping prices by around 10 percent, incompletely passing the higher costs onto their customers. The sud-

CO_2, relative to the total freight costs.

[26]Notice that we are not accounting for any additional consumers' benefit arising, for instance, from lower carbon emissions. Thus, our quantification can be interpreted as an upper bound of the overall costs.

[27]Report and testimony are at: https://ustr.gov/sites/default/files/enforcement/301Investigations/FRNActionabilityChinaTargetingMaritime.pdf and https://www.worldshipping.org/s/Hearing-Testimony_World-Shipping-Council_Joe-Kramek-USTR-2025-0003-filed-20-March.pdf

[28]Specifically, we apply the additional costs to one carrier at the time and report the average effect across the different iterations.

den increase in costs significantly reduces the profits of the affected companies due to the joint effect of losing competitiveness relative to other shippers and losing market shares, which lowers their market power. Conversely, other carriers benefit from this competitive advantage, increasing their seller market shares, s_{ij}, and exerting stronger market power over importers. This allows them to raise their markups and prices by approximately 5 percent, and generate additional profits. As in the previous cases, since transportation plays a small role in determining changes in final consumer prices, we find that this measure will increase the domestic price index only marginally.

5 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.

Using detailed Chilean customs data, we document empirical evidence of high concentration in the transportation sector. We also provide evidence of bilateral negotiations and dual market power between carriers and importers in determining transportation prices. These findings challenge the common assumption in trade literature of perfectly competitive transportation markets and reject the ”iceberg” cost assumption used in many trade models.

We incorporate bilateral bargaining between carriers and importers into a quantitative trade model, allowing for both seller and buyer market power. We show that the increase in consumer prices following the introduction of tariffs is 50 percent higher in a standard model with iceberg trade costs relative to our framework, largely due to the presence of decreasing returns to scale. Bargaining, in turn, plays a central role in shaping price levels and market allocations in the transportation sector. We also find that carbon policies—such as the extension of the EU Emissions Trading System (ETS) to maritime shipping—have negligible effects on aggregate welfare. However, the asymmetric nature of the policy may lead to substantial reallocation across carriers.

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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:

$$\pi_i = (\mu_i - 1)\mu_i^{-\sigma} u_i^{1-\sigma}, \tag{19}$$

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:

$$\widetilde{\tau_i} = \tau_i(1 - s_{ij})^{\frac{1}{1-\rho}} = \tau_i(1 + \Delta\tau), \tag{20}$$

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:

$$\pi_i(\tau_{ij}) - \pi_{i(-j)} = (\mu_i - 1)q_i u_i \left(1 - (1 + s_{i\tau}\Delta\tau)^{\gamma(1-\sigma)}\right). \tag{21}$$

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:

$$\pi_j(\tau_{ij}) = \tau_{ij}t_{ij} + \sum_{z\neq i\in Z_j} \tau_{zj}t_{zj} - \theta c_j t_j, \tag{22}$$

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,

$$\epsilon_{ij} = (1 - s_{ij})\cdot \rho + s_{ij}\cdot (s_{i\mathcal{T}}\cdot (1 - \gamma + \sigma\cdot \gamma)) \tag{23}$$

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

$$\pi_{j(-i)} = \sum_{z\neq i\in Z_j} \tau_{zj}t_{zj} - \theta \widetilde{c_j} \sum_{z\neq i\in Z_j} t_{zj} = \sum_{z\neq i\in Z_j} \tau_{zj}t_{zj} - \theta \widetilde{c_j} t_j (1 - x_{ij}), \tag{24}$$

with $\widetilde{c_j} = c_j\left(1 - x_{ij}\right)^{\frac{1-\theta}{\theta}}$, 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:

$$\pi_j(\tau_{ij}) - \pi_{j(-i)} = \tau_{ij}t_{ij} - \theta c_j t_j\left[1 - (1 - x_{ij})^{\frac{1}{\theta}}\right] = t_{ij}(\tau_{ij} - c_j\widehat{\mu_{ij}}), \tag{25}$$

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:

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

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

which is Equation (6) in the main text, where $\omega_{ij} = \frac{\overline{\phi}\lambda_{ij}}{1+\overline{\phi}\lambda_{ij}}$, $\lambda_{ij} = \frac{\sigma-1}{\epsilon_{ij}-1}\frac{\tau_{ij}t_{ij}}{q_i u_i \Omega}$, $\Omega = \left[1-(1+s_{i\tau}\Delta\tau)^{\gamma(1-\sigma)}\right]$, 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 $\tau_i = \left(\sum_{j\in J_i}\alpha_{ij}\tau_{ij}^{1-\rho}\right)^{\frac{1}{1-\rho}}$:[29]

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

$$\pi_{i(-j)} = (\mu_i-1)\mu_i^{-\sigma}\widetilde{u}_i^{1-\sigma}P^\sigma Y$$
$$\widetilde{u}_i = w^{1-\beta_i}p_x^{\beta_i} = w^{1-\beta_i}\left(\eta_i^\gamma p_D^{1-\gamma} + (1-\eta_i)^\gamma(\alpha_{iq}\bar{p_F} + \alpha_{it}\widetilde{\tau}_i)^{1-\gamma}\right)^{\frac{\beta_i}{1-\gamma}}$$

   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:

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

[29] 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:

$$
\max_{\tau_{ij}} \left(\pi_j - \pi_{j(-i)}\right)^{1-\phi}\left(\pi_i - \pi_{i(-j)}\right)^{\phi} \tag{26}
$$

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

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

A.4 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:

$$V_{ij} = -\log \tau_{ij} + \frac{1}{1-\rho}\epsilon_{ij}, \tag{27}$$

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

$$t_{ij} = \frac{\tau_{ij}^{1-\rho}}{\sum_{z \in Z_j} \tau_{iz}^{1-\rho}} t_i = \frac{\tau_{ij}^{1-\rho}}{\tau_i^{1-\rho}} t_i \quad \text{with } \tau_i = \left(\sum_{z \in Z_j} \tau_{iz}^{1-\rho}\right)^{\frac{1}{1-\rho}}. \tag{28}$$

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

A.5 Derivations of Equations (17) and (18)

Let consider the consumers' aggregate price index: $P = \left[\sum_{i=1}^{N} p_i^{1-\sigma}\right]^{\frac{1}{1-\sigma}}$. We can compute the change in the price index as:

$$\log P = \frac{1}{1-\sigma} \log\left(\sum_{j=1}^{I} p_j^{1-\sigma}\right)$$

$$\partial \log P = \sum_i s_i \, \partial \log p_i, \qquad s_i \equiv \frac{p_i^{1-\sigma}}{\sum_j p_j^{1-\sigma}}.$$

Given that $p_i = \mu \, u_i = \mu \frac{1}{\varphi_i} w^{1-\beta_i} p_{ix}^{\beta_i}$ and $p_{ix} = \left[\eta_i^\gamma P^{1-\gamma} + (1-\eta_i)^\gamma \left[p_{iF}\left(1+\bar{t}\right) + \tau_i\right]^{1-\gamma}\right]^{\frac{1}{1-\gamma}}$, we have:

$$\partial \log p_i = \beta_i \partial \log p_{ix} = \beta_i \left[s_{iD} \partial \log P + (1-s_{iD}) \left((1-s_{i\tau}) \partial \log \bar{t} + s_{i\tau} \partial \log \tau_i\right)\right]$$

Rearranging terms, we can derive the approximation in Equation (17).

We can derive the approximation for $\frac{\partial \log \tau_i}{\partial \log \bar{t}}$ in Equation (18) as follows:

$$\frac{\partial \log \tau_i}{\partial \log \bar{t}} \equiv \sum_j s_{ij} \frac{\partial \log \tau_{ij}}{\partial \log \bar{t}}$$
$$\frac{\partial \log \tau_{ij}}{\partial \log \bar{t}} \approx \frac{\partial \log \mu_{ij}}{\partial \log \bar{t}} + \frac{\partial \log c_j}{\partial \log \bar{t}} \equiv \frac{\partial \log \mu_{ij}}{\partial \log \tau_{ij}} \frac{\partial \log \tau_{ij}}{\partial \log \bar{t}} + \frac{\partial \log c_j}{\partial \log \tau_{ij}} \frac{\partial \log \tau_{ij}}{\partial \log \bar{t}} + \frac{\partial \log c_j}{\partial \log t_j} \frac{\partial \log t_j}{\partial \log \bar{t}},$$

where the first follows from $\tau_i = \left[\sum_{j=1}^{J} \tau_{ij}^{1-\rho} \right]^{\frac{1}{1-\rho}}$ and the second from $\tau_{ij} = \mu_{ij} c_j$.

Abstracting from general equilibrium effects (Alviarez et al., 2023), we can write:

$$\frac{\partial \log \tau_{ij}}{\partial \log \bar{t}} \approx = \Gamma_{ij} \frac{\partial \log \tau_{ij}}{\partial \log \bar{t}} + \Lambda_{ij} \frac{\partial \log \tau_{ij}}{\partial \log \bar{t}} + \frac{1-\theta}{\theta} \left(-\gamma \sum_{i'} x_{i'j} (1 - s_{i'\tau} + s_{i'\tau} \frac{\partial \log \tau_{i'}}{\partial \log \bar{t}}) \right) \quad \text{where}$$
$$\Lambda_{ij} \equiv - \frac{\partial \log c_j}{\partial \log \tau_{ij}} = x_{ij} \frac{1-\theta}{\theta} \epsilon_{ij} \qquad \text{and}$$
$$\Gamma_{ij} \equiv - \frac{\partial \log \mu_{ij}}{\partial \log \tau_{ij}} = \omega_{ij} \frac{\widehat{\mu_{ij}}}{\mu_{ij}} \frac{\partial \log \widehat{\mu}_{ij}}{\partial \log \tau_{ij}} + (1-\omega_{ij}) \frac{\overline{\overline{\mu_{ij}}}}{\mu_{ij}} \frac{\partial \log \overline{\overline{\mu_{ij}}}}{\partial \log \tau_{ij}}$$
$$= \omega_{ij} \frac{\widehat{\mu_{ij}}}{\mu_{ij}} \left(\frac{x_{ij}(1-x_{ij})^{\frac{1}{\theta}-1}}{\theta - \theta(1-x_{ij})^{\frac{1}{\theta}}} - 1 \right) \rho(1-x_{ij}) + (1-\omega_{ij}) \frac{\overline{\overline{\mu_{ij}}}}{\mu_{ij}} \left(\frac{\rho - \epsilon_{ij}}{(\epsilon_{ij}-1)\epsilon_{ij}} (\rho - 1)(1 - s_{ij}) \right),$$

where in the first row we have used the fact that $t_j = \sum_{i \in I_j} t_{ij} = \sum_{i \in I_j} \frac{t_{ij}}{t_i} q_{iF} = \sum_{i \in I_j} x_{ij} q_{iF}$ and $\frac{\partial \log t_j}{\partial \log \bar{t}} = -\gamma \sum_{i \in I_j} x_{ij} \frac{\partial \log(p_{iF}(1+\bar{t}))}{\partial \log \bar{t}}$.

Rearranging terms:

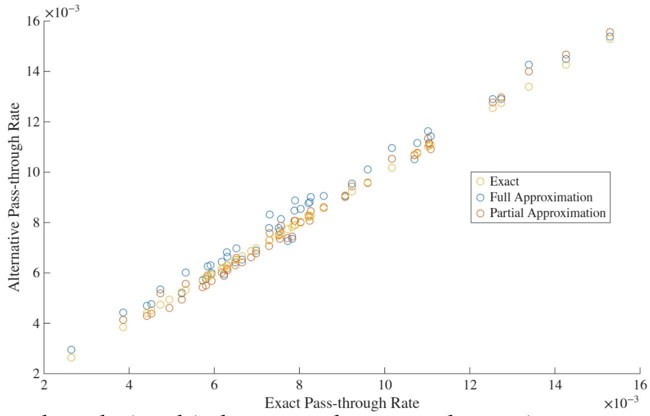
$$g_i = -\kappa \sum_{i'} \left[\sum_j s_{ij} \, \Phi_{ij} \, x_{i'j} \right] \left(1 - s_{i'\tau} + s_{i'\tau} \, g_{i'}\right),$$

where $B_{ii'} = \sum_j s_{ij} \, \Phi_{ij} \, x_{i'j}$, $\kappa = \gamma \frac{1-\theta}{\theta}$, and $\Phi_{ij} \equiv \frac{1}{1+\Gamma_{ij}+\Lambda_{ij}}$. Thus, using matrix notation we can write Equation (18):

$$\left[\mathbf{I} + \kappa \, \mathbf{B} \; \text{diag}(\mathbf{s}_\tau)\right] \mathbf{g} = -\kappa \, \mathbf{B} \left(\mathbf{1} - \mathbf{s}_\tau\right),$$
$$\mathbf{g} = \left[\mathbf{I} + \kappa \, \mathbf{B} \; \text{diag}(\mathbf{s}_\tau)\right]^{-1} \left(-\kappa \, \mathbf{B} (\mathbf{1} - \mathbf{s}_\tau)\right),$$

where $\mathbf{g} = (g_1, \ldots, g_I)^\top$ and $\mathbf{s}_\tau = (s_{1\tau}, \ldots, s_{I\tau})^\top$.

Figure 5: Comparison Exact vs Approximated GFT



Notes: The Figure displays the relationship between the exact change in consumers' aggregate price index and the one computed using the approximation derived in Appendix A.5 for the baseline model. Blue circles report the approximation that used both Equations (17) and (18), while the red circles combine the vector g computed numerically into Equations (17). Each circle represents one simulated economy.

B Customs Data

B.1 Cleaning

We perform some standard cleaning of the transactions reported in the custom to reduce the noise coming from possible mistakes and misreporting in the declarations. Our initial dataset comprises around 30 million transactions. We drop those for which the CIF reported is lower than the FOB value and those for which there was a discrepancy between FOB + reported additional costs and CIF larger than 10%. We also drop all those transactions that are missing the country of origin or that are missing other key information. We also drop sectors such as Arms and Ammunition (HS 93) and Antiques and Art (HS 97).

For the transportation sector, we combine air transport and couriers into a single category, and then we keep only those transactions that report as mode of transport sea, air, or road (99.99% of the sample). We also drop all the transactions that are reported as via land but are with countries that are either implausibly far or not connected at all via land. After this preliminary cleaning we have a dataset of more than 28 million transactions of Chilean firms importing from the rest of the world.

B.1.1 Multi-product transaction

One issue with the transaction-level data is that for multi-product transactions, we cannot observe the weight for each product, which we will need to use to build our freight costs variable. To overcome this problem, we build the share of each product, within the transaction, in terms of quantity and assign the weight accordingly.

Table B.1: Cleaned Names and Top Companies' Share

Ocean		Air		Road	
Transport Company	Mkt Share (Value)	Transport Company	Mkt Share (Value)	Transport Company	Mkt Share (Value)
MAERSK	19.40	LAN CARGO	45.02	PASTENES GUTIERREZ CATALINA ROCIO	8.68
HAPAG LLOYD	16.35	ATALS AIR - POLAR AIR	14.77	MEDINA ENRIQUEZ JUSTO EDUARDO	5.13
ONE	8.42	AIR FRANCE	11.05	ABC CARGAS	4.89
MSC	7.75	IBERIA	6.11	ORTEGA CASANOVA MANUEL ERNESTO	4.66
CMA-CMG	5.68	AVIANCA	4.70	BECERRA VALENZUELA OCTAVIO MIGUEL	4.62

Notes: Top 5 companies, in terms of value shipped in the year 2019 across all product, used by Chilean companies to import goods. Source Chilean Custom.

B.1.2 Shippers cleaning

The final step is to clean the shippers' names in order to have a precise idea of the firm in charge of the transportation of the goods in Chile. To do so, we use two key pieces of information from the custom declaration. First, we observe a string variable reporting the name of the shipper which we clean manually. Second, we have information on the shippers' RUT (Rol Único Tributario) which is a unique tax code that each company has for tax purposes in Chile. We then match this RUT to a list of foreign transporters provided by the Chilean Government in order to further clean and homogenize the list of transportation firms. As the final step, we replace companies' names with the parent owner to reduce the number of firms with the same ownership in the same market. For example, we replace the company name with Lufthansa when we have Swissair or CSCL with COSCO after its acquisition in 2015. Table B.1 provides an example of the cleaned names for the top companies, in terms of value shipped in 2019, in our sample.

Table C.1: Incoterm definition and division of duties

Obligations& Charges	EXW	FCA	FAS	FOB	CFR	CIF	CPT	CIP	DAP	DPU	DDP
Export Packaging	Seller	Seller	Seller	Seller	Seller	Seller	Seller	Seller	Seller	Seller	Seller
Loading Charges	Buyer	Seller	Seller	Seller	Seller	Seller	Seller	Seller	Seller	Seller	Seller
Delivery to Port/Place	Buyer	Seller	Seller	Seller	Seller	Seller	Seller	Seller	Seller	Seller	Seller
Export Duty, Taxes & Customs Clearance	Buyer	Buyer	Seller	Seller	Seller	Seller	Seller	Seller	Seller	Seller	Seller
Origin Terminal Charges	Buyer	Buyer	Seller	Seller	Seller	Seller	Seller	Seller	Seller	Seller	Seller
Loading on Carriage	Buyer	Buyer	Buyer	Seller	Seller	Seller	Seller	Seller	Seller	Seller	Seller
Carriage Charges	Buyer	Buyer	Buyer	Buyer	Seller	Seller	Seller	Seller	Seller	Seller	Seller
Insurance	Negotiable	Negotiable	Negotiable	Negotiable	*Seller	**Seller	Negotiable	Negotiable	Negotiable	Negotiable	Negotiable
Destination Terminal Charges	Buyer	Buyer	Buyer	Buyer	Buyer	Buyer	Buyer	Buyer	Seller	Seller	Seller
Delivery to Destination	Buyer	Buyer	Buyer	Buyer	Buyer	Buyer	Buyer	Buyer	Seller	Seller	Seller
Unloading at Destination	Buyer	Buyer	Buyer	Buyer	Buyer	Buyer	Buyer	Buyer	Buyer	Seller	Seller
Import Duty, Taxes & Customs Clearance	Buyer	Buyer	Buyer	Buyer	Buyer	Buyer	Buyer	Buyer	Buyer	Buyer	Seller

Notes: Incoterm definitions. Source ICC.

C The Incoterms rules

The Incoterms, International Commerce Terms, are a set of standards used in international and domestic contracts for the delivery of goods and are established by the International Chamber of Commerce (ICC) (International Chamber of Commerce, 2021). These rules define 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 goods. 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 to clear the goods through customs at the destination and also to deliver the goods at a previously specified location. By contrast, under the EXW (Exworks-Factory) the seller has the minimum obligations. Indeed, it is the importer's responsibility to move the goods 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 goods. 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 responsibility to negotiate and pay for the shipping of the goods. Table C.1 reports all cases and the duties assigned to the importer and the exporter.

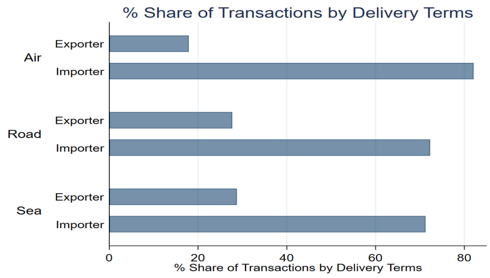
Figure C.1 reports the share of transaction, and value, by mode for each Incoterms category. We can see that for Rail, and partially for air, we have many observations for which the shipment arrangements are not reported. Of the remaining observations, we can see that the predominant delivery terms are ones in which the burden of the transport is on the importer. This is especially true when we look at ocean shipping in the left panel.

Table C.2: Statistics by Incoterm

INCOTERM	mode	Median Freight	Mean Freight	Median Fob	Mean Fob
Exporter		0.21	5.11	15902.99	137828.37
Importer	Sea	0.39	5.67	5910.25	56833.46
Unknown		0.39	6.13	4829.49	228234.86
Exporter		9.06	50.99	1996.92	23248.39
Importer	Air	8.32	77.37	1950.00	11887.48
Unknown		8.45	65.81	1564.63	23741.43
Exporter		0.18	1.30	33306.91	155448.55
Importer	Road	0.44	4.04	9935.06	62576.44
Unknown		0.24	9.18	22006.90	129715.93

Notes: Key statistics by Incoterm. These terms represent which party is in charge of arranging and paying for the delivery of the imported good. Source Chilean Custom.

Figure C.1: Party Arranging Import Transactions



Notes: The panel reports the share of transactions 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.

D Manufacturing Data - ENIA

We use data from the Annual Survey of Manufacturing (ENIA), administrated by the Chilean National Institute of Statistics (INE), covering the years 1995 - 2019. The data is at the establishment-year level and includes approximately 30 manufacturing industries, with roughly 4,000 observations per year. For each observation, the dataset contains information on capital stock, value added, labor, wage bill, domestic and imported materials, revenues, and electricity consumption.[30] Capital stock data are unavailable after 2015. We extend the sample to 2019 by constructing the capital stock using investment and depreciation data via a perpetual inventory method. Industries are defined at the three-digit CIIU Rev. 3 level (Chilean industry classification).

Observations with zero or negative values for capital, materials, revenues, electricity consumption, or wage bill are excluded. Additionally, we drop observations with a labor share or materials share of revenue exceeding one. To remove outliers, we exclude observations in the bottom and top 5% of labor and materials shares of revenue for each industry.

A firm-level measure of capital costs is constructed as the product of capital stock and the rental rate net of depreciation. The average real interest rate for Chile during the sample period, reported in the World Bank World Development Indicators, serves as a proxy for the rental rate of capital (Raval, 2023).[31] The rental rate is combined with sectoral depreciation rates from Oberfield and Raval (2021), after creating a concordance between NAICS and CIIU classifications.

Calibration and Moments Details Under the assumption of constant return to scale, as in our theoretical framework, Autor et al. (2020) shows that markup can be measured as the ratio of firm sales to total costs:

$$\mu_{it} = \frac{\alpha_{it}^v}{S_{it}^v} = \frac{\texttt{Sales}_{it}}{\texttt{Total Cost}_{it}}, \tag{29}$$

where α_{it}^v and S_{it}^v represent the output elasticity and the factor share of input v ($S_{it}^v = \frac{\texttt{Expenditure on } v}{\texttt{Sales}_{it}}$), respectively. The second equality follows from the CRS assumption, i.e. $\alpha_{it}^v = \frac{\texttt{Expenditure on } v}{\texttt{Total Cost}_{it}}$. In mapping Equation (29) to the data, we assume that total costs are equal to the sum of wage bill, materials expenditure, electricity expenditure, and capital costs. We calibrate σ to match the median markup in the economy, which delivers back a value of 6.

Given the implied σ, we calibrate the share of material in the production, β, leveraging the observed factor shares, $\beta \equiv \frac{m_i}{p_i y_i} = \beta \frac{\sigma-1}{\sigma}$. In mapping it to the data, we define materials as the sum of intermediate inputs and electricity consumption.

We estimate the production function in value added applying Levinsohn and Petrin (2003)

[30]The INE applies a small amount of noise to all variables to ensure statistical privacy. For integer variables, such as labor, we use the floor of the value reported by INE.

[31]The real interest rate represents the private sector lending rate, adjusted for the domestic inflation rate as measured by the GDP deflator.

and Ackerberg et al. (2015) techniques, using labor as a variable input and electricity consumption as a proxy variable. We specify the production function as follows

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

in order to estimate γ using the variation in domestic expenditure shares s_{iD}. The share is defined in terms of domestic and imported intermediate inputs. We drop observations with a negative domestic share and trim values at the 5% level within each industry.

Lastly, we leverage ENIA to compute moments useful for the estimation of the moment. We compute the aggregate domestic share as the value-added weighted share of domestic input across firms in the sample. We compute the within-industry dispersion of sales share using firms' revenues, and use the average across industries as targeted moments.

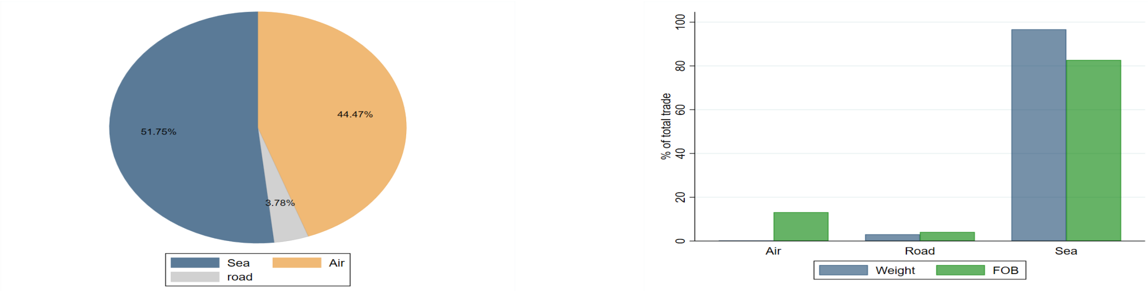
E Additional Data Facts

E.1 Summary Statistics

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

E.1.1 Composition by Mode

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

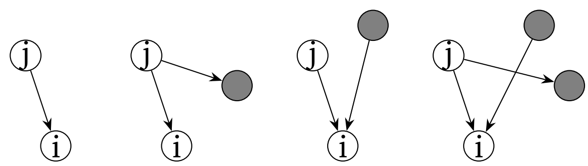


Notes: The left Panel reports the share of total transactions that are conducted via each transport mode. The right Panel reports the total value, in navy, and weight, in green, traded by each transport mode. In the customs data, trade via rail is also reported but it represents such a small proportion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

Figure E.2: Number of modes used

Notes: 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



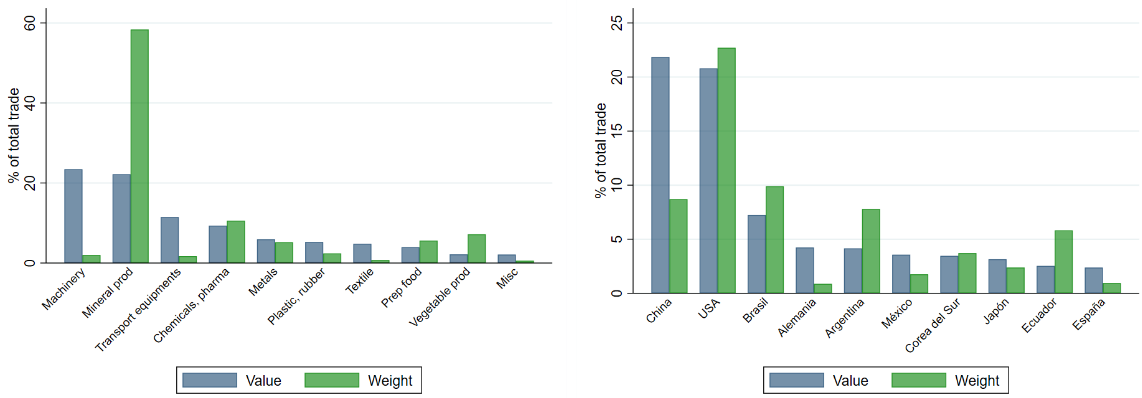
	1:1	1:m	m:1	m:m
Fraction of links	0.036	0.445	0.005	0.525
	(0.386)	(0.242)	(0.162)	(0.248)
Fraction of import value	0.017	0.338	0.007	0.593
	(0.408)	(0.295)	(0.196)	(0.293)

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 Trade Flows Composition

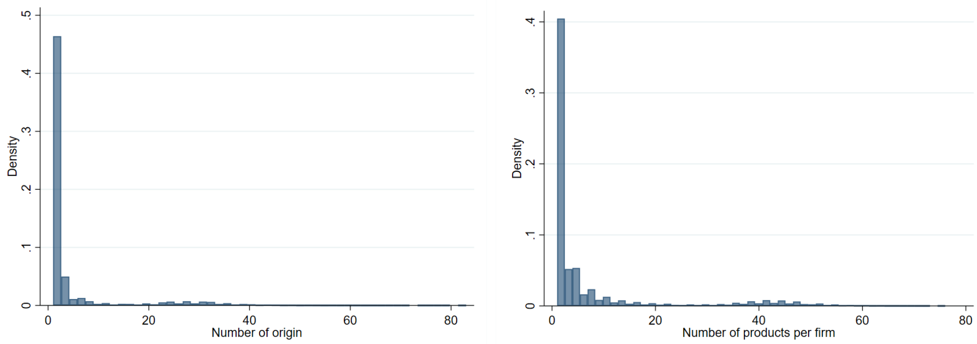
Chilean imports are heterogeneous in terms of products that are brought in from other countries. In Figure E.4 we can see that Chile's imports are spread across different sectors that span natural resources to foods and beverages.

Figure E.4: 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.

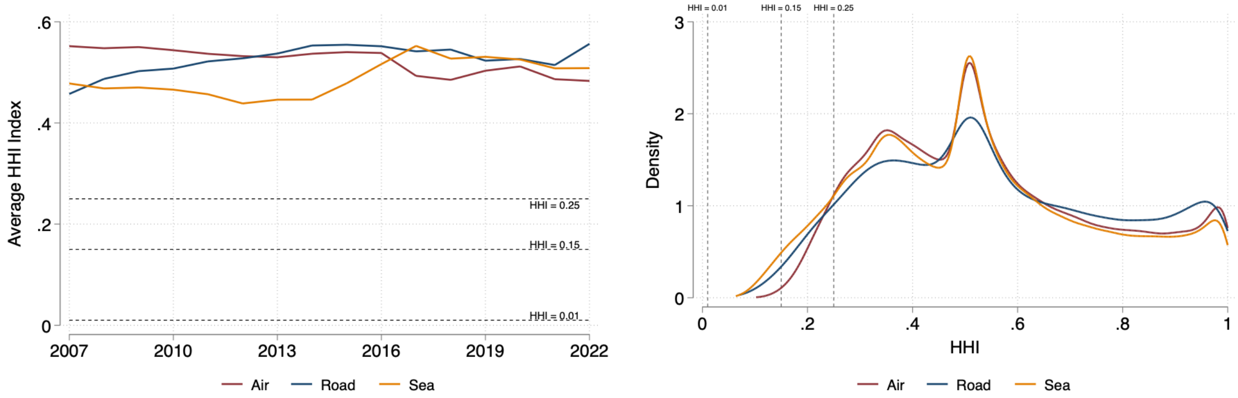
Figure E.5: Numbers of Origins and Product by Importer



Notes: The left panel reports the distribution of origins per importer. The right panel reports the distribution of products per importer.

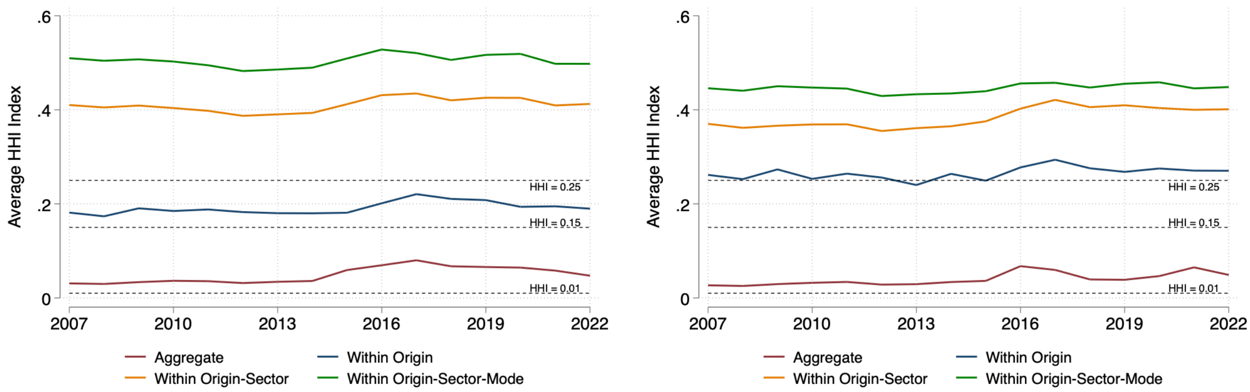
E.2 Additional Evidence on Stylized Facts

Figure E.1: Concentration in International Transportation by Mode



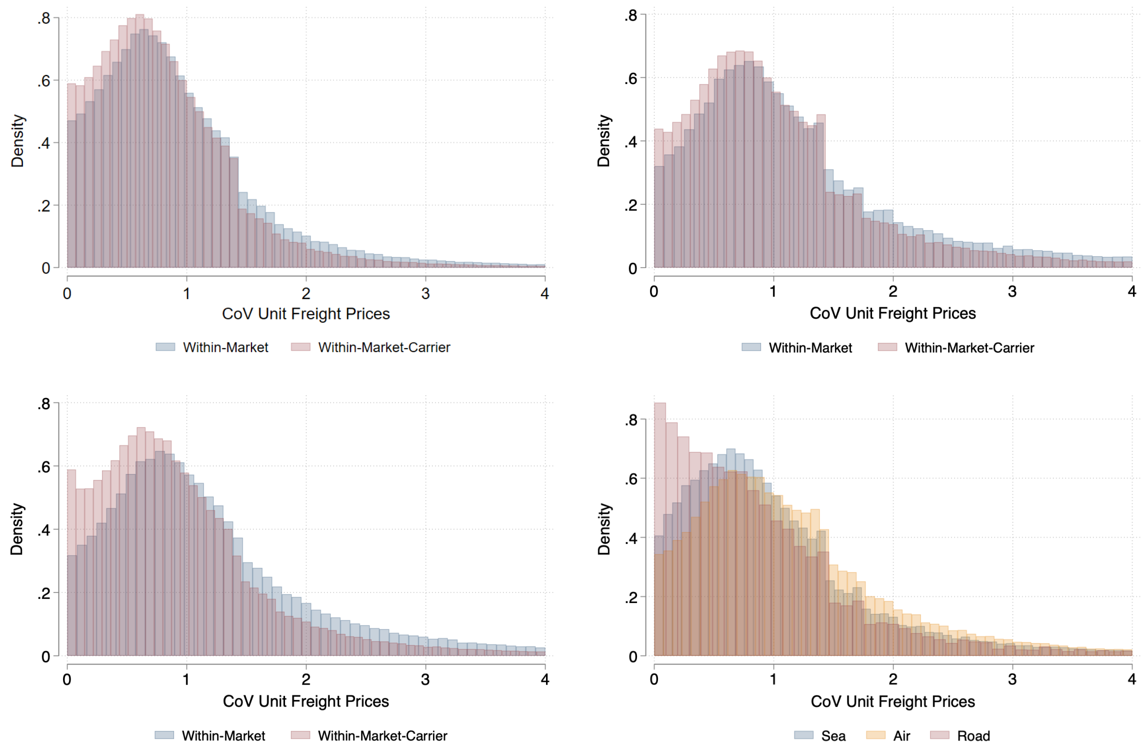
Notes: The left panel plot the average HHI index across the different markets of the transportation sector over time. Markets are defined as a mode-origin-sector combination, where a sector is defined as a HS2 category. We compute the average distinguishing markets by their mode (sea, air, and road freight). The left panel plots the distribution of HHI indices across the different markets, distinguishing markets by their mode (sea, air, and road freight). Carriers' market share are computed in terms of value shipped.

Figure E.2: Concentration in International Transportation



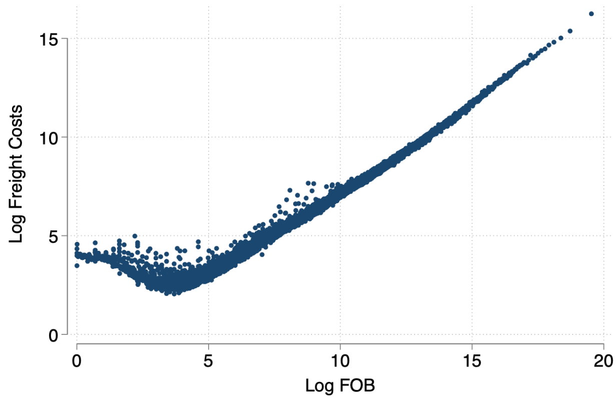
Notes: The left panel reports the average HHI index across different markets of the transportation sector over time but with 4-digit products (HS4). The right panel instead uses 2-digit products but share are computed using the weight in kg transported. The blue line defines markets by the country of origin. The orange and green lines defines markets as a combination of origin-sector and mode-origin-sector, respectively.

Figure E.3: Freight Price Dispersion



Notes: The top 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. In the top right panel, unit freight prices are computed by dividing total freight cost by the quantity transported. The bottom left 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 full sample of transaction. The bottom right 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).

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		Quantities		HS4		Full Sample	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A - Share of price dispersion explained by:								
Observables	.	0.048	.	-0.000	.	0.011	.	0.038
Buyer FE	0.108	0.102	0.108	0.108	0.048	0.049	0.039	0.041
Transport Company FE	0.025	0.026	0.028	0.028	0.035	0.035	0.061	0.062
Sector x Time x Origin x Mode	0.327	0.306	0.476	0.477	0.629	0.618	0.634	0.601
Match Residual	0.540	0.518	0.388	0.388	0.288	0.287	0.265	0.258
Panel B - Within Carrier-Sector-Origin-Time-Mode:								
Observables	.	0.054	.	-0.000	.	0.008	.	0.044
Buyer FE	0.192	0.170	0.162	0.162	0.110	0.110	0.092	0.089
Match Residual	0.808	0.776	0.838	0.838	0.890	0.882	0.908	0.867

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, columns (1)-(2), or by quantities, columns (3)-(4). In columns (5)-(6) we use as market's definition an HS4-origin-mode triplet, while in columns (7)-(8) we do not restrict the analysis to transaction arranged by importers. For each set of regressions, the even column includes observable characteristics such as carrier's experience, age of relationship, size of transaction, while odd column includes only fixed effects.

Table E.2: Prices and Bilateral Concentration - Robustness

	(1) Sea	(2) Air	(3) Quantity	(4) HS4	(5) Full Sample
Log Carrier Share	0.336	0.165	0.274	0.234	0.087
	(0.115)	(0.067)	(0.170)	(0.057)	(0.037)
Log Importer Share	-0.399	-0.274	-0.288	-0.330	-0.189
	(0.107)	(0.062)	(0.153)	(0.053)	(0.036)
Controls	Yes	Yes	Yes	Yes	Yes
$FE_{jmt} + FE_{imt}$	Yes	Yes	Yes	Yes	Yes
F-stat	21.903	52.676	61.728	92.137	135.143
N	840,269	479,406	1,322,471	1,307,289	2,628,934

Notes: The Table reports the estimates from the specification in Equation (2) estimated using IV. All Columns include the additional controls, and carrier-market and importer-market fixed effects. Columns (1) and (2) consider the subsample of sea and air freight, respectively. Column (3) measures unit freight prices per quantities shipped. Columns (4) reports the estimates using HS4 products rather than HS2. Column (5) uses the full sample of transactions. We exclude all importer-market-time and carrier-market-time singletons from the estimation. Standard errors are clustered at the importer level.

F Additional Empirical Results

Table F.1: Summary Statistics by Mode

	Sea		Air		Road	
	Mean	Std.	Mean	Std.	Mean	Std.
Log τ_{ijt}^{m}	-0.873	0.811	1.935	0.662	-0.549	0.818
Importer's Share s_{ijt}^{m}	0.298	0.243	0.383	0.304	0.400	0.252
Carrier's Share x_{ijt}^{m}	0.059	0.154	0.067	0.164	0.139	0.225
Transport Share s_{imt}^{τ}	0.067	0.058	0.215	0.144	0.099	0.091
Number of Carriers per Market	4.099	3.688	3.307	2.854	1.828	0.915
Number of Importers per Market	19.762	52.556	18.227	53.510	3.717	2.213
Number of Carriers per Importer	1.690	0.787	1.525	0.587	1.345	0.449
Number of Importers per Carrier	17.298	22.889	19.031	30.031	2.179	0.318

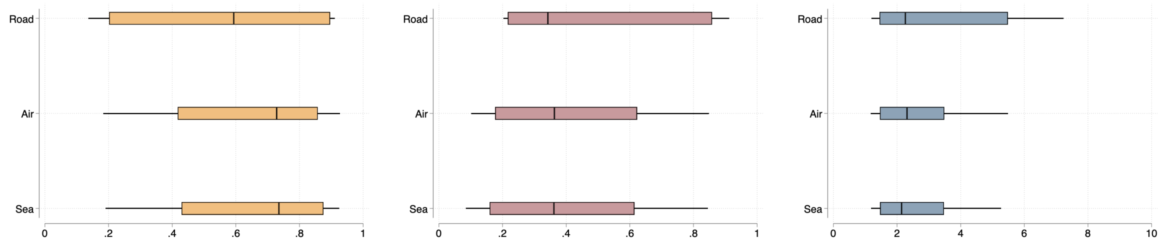
Notes: The Table shows the mean and standard deviation for key variables by mode of transportation. τ_{ijt}^{m} is the unit freight price paid by importer i to carrier j in market m at time t, where unit freight price is computed by dividing total freight cost by the quantity transported; s_{ijt}^{m} 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.

Table F.2: Estimated $\widehat{\rho}$ - Robustness

	(1)	(2)	(3)	(4)	(5)
	OLS	IV	IV	IV	IV
$\widehat{\beta}$	0.021	-2.352	-1.877	-1.564	-2.023
	(0.014)	(0.451)	(0.367)	(0.325)	(0.412)
Implied $\widehat{\rho}$					
		3.352	2.877	2.564	3.023
FEs	$-$	$FE_j + FE_m$	$FE_j + FE_m + FE_t$	$FE_j \times FE_m + FE_t$	$FE_j \times FE_m$
N	203425	203087	203087	202196	202196

Notes: The Table reports the estimated price elasticities. Column (1) is estimated via OLS without any fixed effect. Columns (2) to (4) saturate the specification in difference with different sets of fixed effects and the set of instruments from the main specification. The last column estimates using an alternative set of instruments including the log number of importers and carriers. All specifications are estimated in difference. Standard errors are clustered at the importer level. 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), return to scale parameter θ (center panel), and substitutability across carriers ρ, 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. Values of ρ larger than ten are trimmed.

Table F.3: Correlation Estimated Parameters - Market Characteristics

	Number of Agents			Concentration		
	$\widehat{\phi}$	$\widehat{\theta}$	$\widehat{\rho}$	$\widehat{\phi}$	$\widehat{\theta}$	$\widehat{\rho}$
Number of Importers	-0.023	0.012	-0.094			
	(0.005)	(0.005)	(0.023)			
Number of Carriers	0.050	-0.018	0.180			
	(0.014)	(0.017)	(0.082)			
HHI(s)				-0.100	0.177	0.492
				(0.108)	(0.105)	(0.618)
HHI(x)				0.458	-0.107	1.463
				(0.071)	(0.074)	(0.399)
N	454	454	670	505	505	760

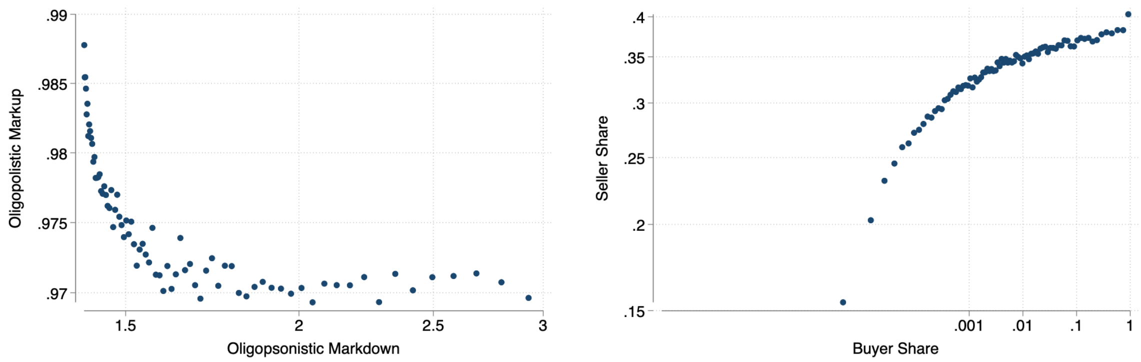
Notes: The first three columns of the Table report the regression coefficients of the average number of importers and carriers at the market level on the estimated bargaining power, the carrier return to scale, and the substitutability across carriers, respectively. The last three columns report the regression coefficients of the average HHI indices of bilateral shares s_{ij} and x_{ij} on the three parameters. 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). HHI indices are constructed at the market-time level. Values of ρ larger than ten are trimmed. Markets with more than 25 importers are excluded. In all cases we absorb transport method fixed effects. Standard errors are clustered at the market (origin-product-mode) level.

Table F.4: Correlation Estimated Parameters across Markets

	Whole Sample		Air		Sea	
	$\widehat{\theta}$	$\widehat{\rho}$	$\widehat{\theta}$	$\widehat{\rho}$	$\widehat{\theta}$	$\widehat{\rho}$
$\widehat{\phi}$	-0.36	0.11	-0.39	0.03	-0.33	0.20
	(0.00)	(0.04)	(0.00)	(0.64)	(0.00)	(0.01)
$\widehat{\theta}$	.	-0.01	.	0.05	.	-0.09
	(.)	(0.87)	(.)	(0.45)	(.)	(0.24)

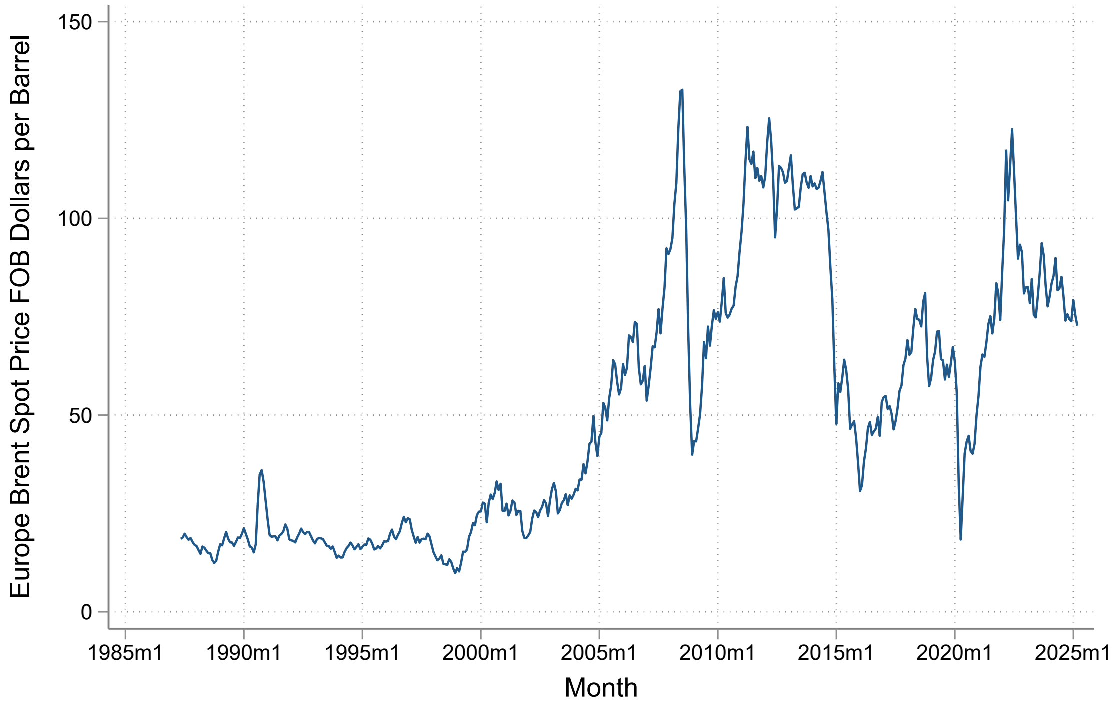
Notes: The Table displays the pairwise correlation coefficient and the corresponding significance level in parenthesis between the estimated bargaining power ϕ, the return to scale parameter θ, and the substitutability across carriers ρ across markets. The first two columns pool all markets together, while the two middle columns (last two columns) focus only air (sea) freight. Values of ρ larger than ten are trimmed.

Figure F.2: Correlation Markups and Markdown



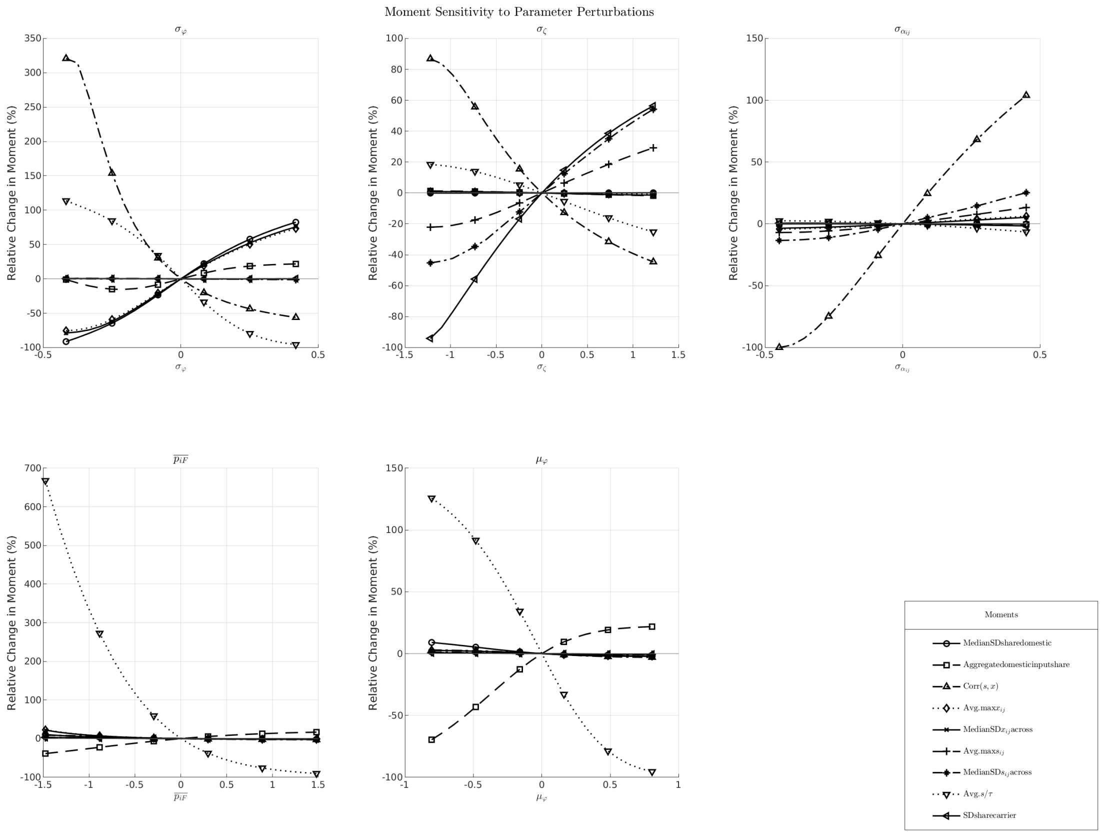
Notes: The left panel displays the relationship between oligopolistic markups and oligopsonistic markdown after absorbing for market-time fixed effects. Markups are constructed using the estimated parameters from Table 4. Values of oligopolistic markup larger than three are trimmed. The right panel displays the relationship between bilateral shares s_{ij} and x_{ij} using log scales, after absorbing for market-time 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).

Figure F.3: Brent Index Evolution



Notes: Variation in the Brent Index. Source: U.S. Energy Information Administration.

Figure F.4: Model identification: sensitivity of moments to parameter variation



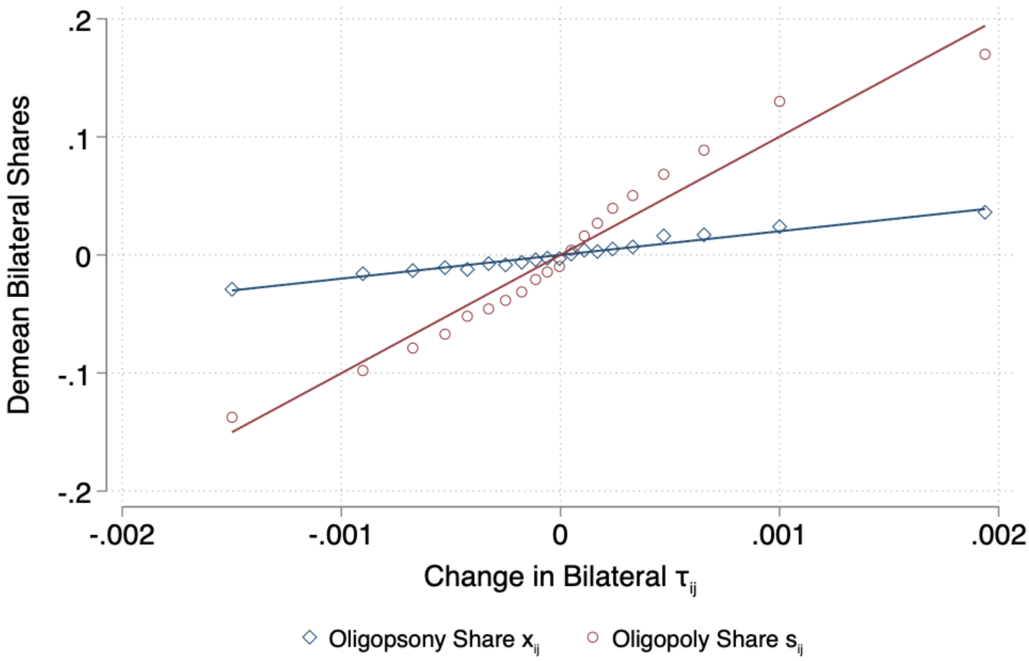
Notes: The Figure illustrates how model moments respond to variation in a single parameter, holding all other parameters fixed at their estimated values. Each moment is normalized to zero at the baseline (optimal) parameter value. The x-axis represents the percentage deviation of the parameter from its estimated value, while the y-axis shows the corresponding percentage change in the standardized moments.

Table F.5: Sensitivity of Moments to Parameters (Λ)

	Moments								
	Med. SD share dom.	Agg. dom. share	Corr(s, x)	Avg. max x_{ij}	Med. SD x_{ij}	Avg. max s_{ij}	Med. SD s_{ij}	Avg. $s_{i\tau}$	SD share carrier
σ_φ	-0.441	-0.065	0.025	0.822	-0.641	-0.869	0.172	-0.005	0.257
σ_ζ	-0.453	-0.073	0.250	1.444	-0.355	0.799	-2.338	-0.017	0.129
$\sigma_{\alpha_{ij}}$	0.033	0.005	-0.213	-0.396	0.036	-0.300	-0.269	0.018	0.096
$\overline{p_{iF}}$	0.381	3.508	0.130	0.350	-0.456	0.079	-0.597	1.013	0.978
μ_φ	0.429	-2.514	-0.077	-1.335	1.361	0.848	0.086	-0.292	-0.653

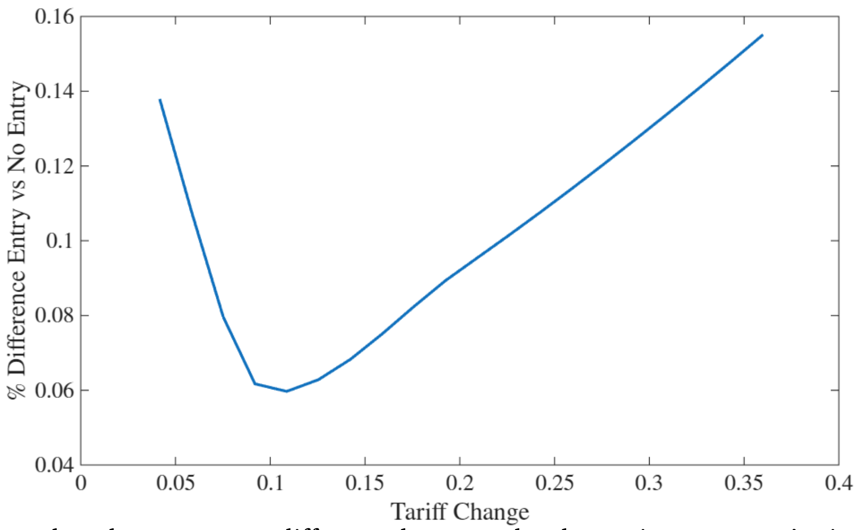
Notes: The Table displays the sensitivity matrix proposed in Andrews et al. (2017). Each entry represents a local approximation of the sensitivity of the estimated parameters to the model moments. It can be used by the reader to test the parameter sensitivity under alternative hypotheses.

Figure F.5: Heterogeneity in Bilateral Prices Changes



Notes: The Figure plots the relationship between the change in bilateral unit freight prices τ_{ij} due to the introduction of a 20 percent tariff on imports and the bilateral shares s_{ij} and x_{ij} in the initial equilibrium. The unit of observation is a carrier-importer pair. We absorb carrier-simulation and importer-simulation fixed effects.

Figure F.6: Extensive Margin and GFT



Notes: The Figure plots the percentage difference between the change in consumers' price index accounting for entry and exit of importers relative to the change in consumers' price index without extensive margin. The percentage difference is computed for different level of tariff changes between 5 and 35 per cent. Welfare changes are computed for the baseline model, averaging across simulated economies.