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Abstract[1]

We develop a quantitative theory of prices in firm-to-firm trade with bilateral negotiations and two-sided market power. Markups reflect oligopoly and oligopsony forces, with relative bargaining power as weight. Cost pass-through elasticities into import prices can be incomplete or complete, depending on the exporter's and importer's bargaining power and market shares. In U.S. import data, we find that U.S. importers have substantial market power and disproportionate leverage in price negotiations. The estimated model produces accurate predictions of the impact of Trump tariffs on pair-level prices. At the aggregate level, ignoring two-sided market power could exaggerate tariff pass-through by about 60 percent.

JEL classifications: F12, F13, F14, F62

Keywords: Market power, Global value chains, Pass-through, International trade

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1 Introduction

The recent surge in protectionist trade policies has spurred new interest in the tariff pass-through literature. Studies of the 2018 trade war show evidence of a near-complete pass-through of U.S. import tariffs into import prices, implying welfare losses for U.S. consumers.[2] Yet conventional trade theory has long held that the tariffs applied by a large country should cause foreign firms to lower export prices. What could explain these unexpected patterns? Was the trade war a special episode, or do traditional approaches to understanding tariff incidence overlook relevant channels of shock transmission? As the uncertainty surrounding trade policy remains high, a reassessment of theories of international prices becomes a priority for economists and policymakers.

Today, nearly 80 percent of world trade involves global value chains, or GVCs (UNCTAD, 2013). The prevalence of global production networks suggests that theories of import prices should revolve around their central features. Prominent among those are the significant lock-in effects giving rise to transaction prices between importers and exporters being negotiated on a bilateral basis (Antràs and Staiger, 2012; Antràs, 2020). In addition, the fixed participation costs forge a sparse network of GVCs dominated by large importers and exporters with substantial market power.[3] Yet, these features are generally missing from pricing models in the trade literature, which typically postulate that prices are set unilaterally by exporters and disciplined by market-clearing conditions.

This study shows that bargaining and two-sided market power are essential to understanding international prices and the economic consequences of tariffs. In developing this argument, this paper makes three contributions. First, it builds a theory of prices in firm-to-firm trade with two-sided market power, which subsumes standard pricing theories as limit cases. Second, it characterizes and tests in U.S. import data the model's predictions for how the markups and tariff pass-through elasticities co-move with the exporter's and importer's bilateral market share, showing how this co-movement is mediated by the firms' bargaining power. Lastly, it estimates the model structurally to perform and test policy counterfactuals about the impact of the 2018 trade war on pair-level and aggregate prices. In doing so, it designs an identification strategy for the two main theory parameters: the relative bargaining power in a given importer-exporter pair and the foreign export supply elasticity, which governs import market power.

Reduced-form patterns on the co-movement between prices and pass-through rates and

[2]See Fajgelbaum et al. (2020); Flaaen et al. (2020); Amiti et al. (2019); Cavallo et al. (2020).

[3]See, e.g., Gaubert and Itskhoki (2021) for a study of dominant exporters, and Morlacco (2019) for one of import market power.

importers' and exporters' bilateral market shares can only be rationalized by the theory when both market power and bargaining power are bilateral. In structural estimation, the bargaining power of U.S. importers is found to be, on average, four times as high as that of their foreign counterparts. The foreign export supply elasticity is estimated at 1.3, indicating that U.S. importers have substantial market power. At the pair level, the model's counterfactual predictions about the impact of Trump tariffs accurately match their realized movements. At the aggregate level, the market power of U.S. importers implies substantial terms-of-trade gains from Trump tariffs, with an aggregate tariff pass-through of 38 percent. Reduced-form estimates, by contrast, indicate a near-complete pass-through, a finding that suggests that relevant channels of price transmission may be absorbed into high-dimensional fixed effects.

Section 2 outlines the theory. Exporters and importers negotiate bilaterally over the price of an intermediate input, taking as given the trade network and the negotiation outcomes elsewhere in the GVC. There is market power on both sides of the transaction. The source of exporters' market power is classical *oligopoly*: exporters are non-atomistic and have monopoly power over their input variety. The source of importers' market power is *oligopsony*: importers face an upward-sloping input supply curve, which they internalize due to their non-atomistic nature. In equilibrium, markups reflect oligopoly and oligopsony forces, with relative bargaining power as weight.

The theory uncovers rich heterogeneity in the tariff pass-through elasticities across importer-exporter pairs. When the exporter sets prices, they will charge a markup over the marginal cost. A standard *strategic complementarity channel* lowers the markup when the exporter is hit with a cost shock, leading to incomplete pass-through (Atkeson and Burstein, 2008). On the contrary, the price equals a markdown below marginal cost when the importer sets prices. Following a shock to the exporter's cost, the importer's demand decreases, deflating the markdown and leading to a more-than-complete pass-through via a *strategic substitutability channel*. The existence of import market power also gives rise to a *terms-of-trade (or cost) channel* of pass-through elasticities. Regardless of who sets the price, the importer's demand reduction triggers an endogenous decrease in the marginal input cost, leading to incomplete pass-through via terms-of-trade effects.[4] The magnitude and relative strength of the different shock transmission channels depends on the importer and exporter's bilateral market shares and bargaining power.

Section 3 brings our model to the data, leveraging a novel dataset containing detailed information on the price and quantity at the transaction level and importers' and exporters'

[4]This channel is labeled the *terms-of-trade channel* due to the parallel with the terms-of-trade effects in conventional trade theory (Johnson, 1953), which this paper extends at the individual firm level.

characteristics. This dataset merges trade and balance-sheet data from the U.S. Census Bureau with balance-sheet information on foreign exporters from the ORBIS database.

The data reveal large dispersion in the price that an exporter receives for the same input variety from different U.S. importers. Exporter-level prices mainly vary based on the characteristics of their relationships with foreign importers, consistent with the evidence from other countries (Fontaine et al., 2020). Within an exporter-product, the price increases with the exporter's share of the importer's imports (the "exporter's supplier share"), and it decreases with the importer's share of the exporter's total quantity (the "importer's buyer share"). This cross-sectional evidence matches the theory predictions, provided that market power is two-sided and both sides of the transaction wield some bargaining power over prices.

Bargaining and two-sided market power can also reconcile reduced-form evidence on the co-movement between tariff pass-through elasticities and bilateral market shares. The pass-through analysis focuses on the 2017-2019 period when U.S. import tariffs experienced substantial unexpected surges during the Trump administration. A standard regression relating bilateral price changes to tariff changes at the exporter-product level shows that a ten percentage points tariff increase reduces the free-on-board (exporter) price by about 0.6 percent on average. The implied pass-through into U.S. import prices is thus almost complete at 99.4 percent. We show that the pass-through is above average in matches where the exporter's supplier share is larger, and below average in matches where the importer's buyer share is larger. This evidence is at odds with a vast exchange-rate pass-through literature showing that pass-through decreases with the exporter's supplier share (Berman et al., 2012; Amiti et al., 2014).

However, these results are expected when considering price bargaining with two-sided market power. On the one hand, the negative relationship between the pass-through elasticity and the importer's buyer share is evidence of import market power. Large importers face a lower residual supply elasticity, leading to more substantial terms-of-trade effects via cost reductions and hence lower pass-through. On the other hand, the positive relationship between the pass-through rate and the exporter's supplier share indicates that importers have high bargaining power. This result needs some explanation. Large exporters face a lower residual demand elasticity. When exporters set prices, low demand elasticity means high markups and, for empirically-relevant values of the supplier share, lower pass-through, which is what the literature shows. However, when importers set prices, low demand elasticity means weak demand responses to the tariff shock, weak terms-of-trade effects, and high pass-through. A positive correlation between the pass-through elasticity and the exporter's supplier share is thus consistent with this second scenario.

While the reduced-form approach has the advantage of transparency and modest data requirements, it also has several limitations. The theoretical predictions on the co-movement between the pass-through and the bilateral shares are highly non-linear and depend on the unobserved bilateral bargaining power. Moreover, the three critical channels of shock transmission vary at the level of supplier-buyer-product-year, each being influenced by the bilateral shares differently. The inferences one can make based on reduced-form evidence alone are thus limited, especially when high-dimensional fixed effects are needed for identification (Goldberg and Hellerstein, 2008).

Section 4 confronts this challenge by taking a structural approach to understanding pass-through. The estimation strategy focuses on the two critical theory parameters: the relative bargaining power and the exporter's supply elasticity. The identifying assumption is that, within an exporter, year, and input variety, the expected difference in the price across different U.S. importers reflects markup differences. Being the markups non-linear functions of the importers' and exporters' market share and monotonic in the parameters of interest, variations in prices and bilateral market shares identify the model primitives. A GMM procedure minimizing the distance between the observed importer price differentials and the model-implied ones recovers the parameter vector. Instrumental variables obtained from the underlying trade network control for the confounding effect of unobserved variables such as quality differences across importers. Consistent with the model's interpretation of the reduced-form evidence, the importer's bargaining power is estimated at 0.81 in the average match, where 1 indicates full importers' bargaining power and 0 is full exporters' bargaining power. The procedure also recovers a foreign export supply elasticity of about 1.3, indicating the existence of import market power.

Section 5 derives and evaluates the model's counterfactual predictions about the incidence of tariffs, focusing on prices as an outcome variable. The first exercise compares, ex-post, the model's predictions in 2017 about what would happen if tariffs were to change to what happened in 2018 and 2019 when the tariffs did change. To account for the confounding effect of unobserved factors on realized prices, the analysis considers an "IV" test of the model's counterfactual predictions, which consists of comparing the predicted price changes with the projection of the observed price changes on the tariff shocks (Adão et al., 2022). Under the null that the model's counterfactual predictions about price changes are correct, the IV test should deliver a coefficient of exactly one. The results show that the null of an IV coefficient equal to one cannot be rejected in the estimated model. At the same time, the null is rejected in alternative (more traditional) models ignoring bilateral bargaining and two-sided market power.

In the second application of the model, the paper gauges the consequences of Trump tariffs on aggregate import prices, a key metric of a country's terms of trade and welfare. The structural model attributes a 4.5 percent increase in the import price index to the recent trade war, corresponding to an aggregate tariff pass-through of about 38 percent. This estimate is much lower than previously thought and lower than the reduced-form estimate obtained earlier. The critical source of aggregate pass-through incompleteness is the substantial terms-of-trade gains implied by the U.S. importers' market power, which realize as marginal cost reductions. Popular pricing models in the literature focus on markup adjustment as the key source of incomplete pass-through, and do not seem to be appropriate to capture the full extent of shock transmission in the context of trade in GVCs. Similarly, the high-dimensional fixed effects required by reduced-form approaches to estimating pass-through may partly absorb these marginal cost changes, thus inflating the aggregate incidence of tariffs. The results in this paper imply that abstracting from two-sided market power would exaggerate tariff incidence by approximately 60 percent.

Related Literature It has long been understood that firm size and market structure are relevant to understand international prices and trade flows. Studies of dominant exporters and export market power are ubiquitous. On the contrary, dominant importers and import market power have remained largely unexplored, even though similar patterns emerge empirically (Bernard et al., 2007). Bernard et al. (2019) and Bernard et al. (2022) emphasize the critical role of buyers in determining firm size and performance in Japanese and Norwegian data, respectively. In French export data, Fontaine et al. (2020) document significant dispersion in unit values within exporters across buyers, which they mostly attribute to match-specific components. Similar patterns have been documented by Huang et al. (2021) in French, Chilean and Chinese data. Among the few studies considering import market power explicitly, Morlacco (2019) estimates that buyer power among French importers is substantial and significantly affects import prices.

Studies of prices in firm-to-firm trade are also scarce. Dhyne et al. (2022) document that suppliers' markups increase in their average supplier shares among their buyers in Belgian VAT data, and interpret the evidence in a model of oligopolistic competition in firm-to-firm trade. Goldberg and Tille (2013) and Gopinath and Itskhoki (2011) develop theories of bargaining in firm-to-firm trade and discuss the implications for exchange-rate pass-through. Grossman and Helpman (2020) develop a bargaining framework of firm-to-firm trade to study the effect of tariff shocks on the organization of supply chains. Fontaine et al. (2022) study bilateral trade adjustments in a Ricardian model of trade with search frictions. Our contribution to this literature is a tractable and quantitative pricing theory of firm-to-firm trade accounting for both oligopoly and oligopsony forces and new empirical evidence from U.S. import data.

Our paper also contributes to the literature investigating the determinants of shock transmission into markups and prices. Atkeson and Burstein (2008) and Auer and Schoenle (2016) relate the pass-through elasticity to market structure and the exporter's market share; Amiti et al. (2014) shows that the exchange-rate pass-through decreases with the exporter's market shares and imported share of inputs in Belgian data, while Berman et al. (2012) show that the pass-through is decreasing in the exporter's size in French export data. Using U.S. firm-to-firm import data, Heise (2019) shows that the exchange-rate pass-through increases in the longevity of the relationship, interpreting this fact in a model of relationship dynamics.[5] Our theory nests traditional channels of real rigidities and include novel ones related to the oligopsony power of importers.

This paper is also related to a growing literature on how shocks transmit through global (or local) value chains. Acemoglu et al. (2012), Grassi (2018), Di Giovanni et al. (2014), and Magerman et al. (2016) show that idiosyncratic shocks to certain sectors or firms may have aggregate consequences. Carvalho et al. (2021); Boehm et al. (2019); Barrot and Sauvagnat (2016) use natural experiments to identify idiosyncratic shocks to firms and their propagation through the supply chain. Acemoglu and Tahbaz-Salehi (2020) study how firm failures and the resulting disruptions to supply chains can amplify negative shocks in the context of a non-competitive network of firms with bilateral bargaining. We relate to this literature by contributing a study of how idiosyncratic shocks to certain links in the global value chain transmit to prices, a central statistics of shock transmission.

Lastly, this paper relates to a literature in industrial organization studying the relationship between market concentration and prices in bilateral bargaining settings.[6] Our study applies similar techniques to the multi-industry context of firm-to-firm trade. We leverage the trade network and the richness of trade data to develop an identification and that recovers the bilateral bargaining power at the individual match level. To accommodate firm-level data, we rely on a structural framework and functional form assumptions both on the demand and supply sides while allowing for unobserved heterogeneity in estimation.

2 Theory

This section develops a partial equilibrium theory of prices in firm-to-firm trade. The focus is on the bargaining problem of an exporter-importer link in an industry global supply chain. We consider a stylized specification of other upstream and downstream nodes to account

[5]Consistent with Heise (2019)'s findings, we find that the pass-through increases in the importer's bargaining power, which we find increasing in the longevity of the relationship.

[6]See, e.g., Draganska et al. (2010); Crawford and Yurukoglu (2012); Grennan (2013); Lee and Fong (2013).

for their role in price negotiations while maintaining tractability. The model supports our subsequent empirical analysis by highlighting how bilateral market power and concentration determine equilibrium markups (Section 2.3) and pass-through elasticities of a shock to the exporters' marginal cost (Section 2.4). Here, we abstract away from various empirically relevant details that are introduced in Sections 3 and 4.

2.1 Setup

The industry consists of a finite number of foreign exporters and domestic importers of intermediate inputs. Exporters are denoted by i, importers by j. We let $\mathcal{J}_i$ denote the set of importers to an exporter i, while $\mathcal{Z}_j$ is the set of exporters to an importer j. These sets are taken as given.

Each importer j buys a differentiated variety of the intermediate input from each exporter in $\mathcal{Z}_j$, combining them in a CES fashion. Letting q_{ij} and p_{ij} denote the quantity and price of variety i sourced by j, and q_j^f and p_j^f the foreign input quantity and price indices, we write:

$$q_j^f = \Big(\sum_{i\in\mathcal{Z}_j} \varsigma_{ij}\; q_{ij}^{\frac{\rho-1}{\rho}}\Big)^{\frac{\rho}{\rho-1}} \quad \text{and} \quad p_j^f = \Big(\sum_{i\in\mathcal{Z}_j} \varsigma_{ij}^{\rho}\; p_{ij}^{1-\rho}\Big)^{\frac{1}{1-\rho}},$$

where $\rho > 1$ is the substitution elasticity across varieties, and ς_{ij} is a saliency term for variety i.

Importer j combines foreign and domestic inputs to produce a differentiated variety of the final good, which they subsequently sell downstream. Let q_j denote total output of firm j. We assume a unit substitution elasticity across foreign and domestic inputs, which implies a constant output elasticity of the foreign input, i.e., $\frac{d\ln q_j}{d\ln q_j^f} = \gamma \in (0,1)$. The quantity of foreign and domestic inputs are chosen to minimize total costs, taking as given the input price indices.[7]

The previous assumptions imply that γ also corresponds to the share of foreign intermediates in total costs as well as the elasticity of firm j's marginal cost to the foreign input price index, i.e.:

$$\gamma = \frac{p_j^f q_j^f}{c_j q_j} = \frac{d\ln c_j}{d\ln p_j^f} \in (0,1]. \tag{2.1}$$

In the downstream market, firm j faces an iso-elastic demand with elasticity

$$\nu = -\frac{d\ln q_j}{d\ln p_j} > 1, \tag{2.2}$$

[7]Hence, we assume that even though the importer has bargaining power vis-a-vis each of its upstream suppliers, they still treat the import price index as given when choosing optimal input shares.

where total demand for q_j depends on the price p_j and exogenous demand shifters.

On the exporter side, each exporter i produces a unique variety of the foreign intermediate input and sells it to all the importers in $\mathcal{J}_i$; they purchase the raw material needed to make their input variety from upstream links in the value chain. Letting q_i denote exporter i's total output, we assume a total cost function of the form: $TC(q_i) = \Phi q_i^{\frac{1}{\theta}}$, where Φ is a constant summarizing exogenous factors such as the unitary price of raw inputs used and exporter i's productivity, while the parameter $\theta \in (0, 1]$ captures the returns to scale of exporter i's production.

This formulation of technology implies that average cost are equal to θc_i, where c_i is the exporter's marginal cost. The latter is a non-decreasing function of output with elasticity equal to

$$\frac{1-\theta}{\theta} = \frac{d \ln c_i}{d \ln q_i} \geq 0. \tag{2.3}$$

The elasticity $\frac{1-\theta}{\theta}$ also coincides with the inverse export supply elasticity, a measure of import market power. When $\theta \in (0, 1)$ production upstream features decreasing returns to scale, the marginal cost increases in total output and average costs are below marginal cost. In this case, the inverse export supply elasticity is positive, which means that there is import market power. Conversely, production features constant returns to scale and constant marginal and average costs when $\theta = 1$. There is no import market power in this case.

2.2 Exporter-Importer Bargaining Over Prices

Importer j and exporter i negotiate bilaterally over the input price p_{ij}. We assume that prices are allocative, such that the bilateral quantity q_{ij} is pinned down by the importer's demand function given the agreed p_{ij}.[8] The price p_{ij} solves the following generalized Nash product:

$$\max_{p_{ij}} \Big(\underbrace{\pi_i\left(p_{ij}\right) - \tilde{\pi}_{i(-j)}}_{GFT_i(p)} \Big)^{1-\phi} \Big(\underbrace{\pi_j\left(p_{ij}\right) - \tilde{\pi}_{j(-i)}}_{GFT_j(p)} \Big)^{\phi}, \tag{2.4}$$

where $\phi \in (0, 1)$ is the (exogenous) importer's bargaining power, and the terms inside parentheses are the gains from trade for exporter i (GFT_i) and importer j (GFT_j), written as a function of p_{ij}. In equilibrium, all transactions generate some positive surplus making both exporter and importer better off by transacting.

We assume that the importer's (exporter's) gains from trade is the firm's payoff from conducting transactions with all counterparts, minus the payoff from conducting transactions

[8] Appendix B.2 discusses the dual problem where importers and exporters negotiate over quantity, and the price is pinned down by the importer's inverse demand function. The two models deliver symmetric theoretical insights.

with all counterparts except i (j).[9] For exporter i, this definition implies that the gains from trade $GFT_i\,(p_{ij})$ are given by the revenues from selling the intermediate input to importer j, minus the cost of producing a higher quantity of output q_i. For importer j, the gains from trade $GFT_j\,(p_{ij})$ are given by the extra revenues that the firm earns downstream due to the lower costs granted by sourcing the input from exporter i, minus the cost of sourcing the input.

Let us consider the following bilateral market shares for importer j and exporter i:

$$
\begin{aligned}
x_{ij} &\equiv \frac{q_{ij}}{q_i} \in (0,1), \\
s_{ij} &\equiv \frac{p_{ij}\; q_{ij}}{\sum_{k\in\mathcal{Z}_j} p_{kj}\; q_{kj}} \in (0,1).
\end{aligned}
$$

x_{ij} is the importer's *buyer share*, defined as the share of importer j's quantity over the total quantity supplied by exporter i; s_{ij} is the exporter's *supplier share*, defined as the share of exporter i's sales over importer j's total imports. Given these definitions, the gains from trade are:

$$GFT_i\,(p_{ij}) \equiv p_{ij}\; q_{ij} - \theta\; c_i\; q_i\; \Delta^x_{ij}, \tag{2.5}$$

$$GFT_j\,(p_{ij}) \equiv p_j\; q_j\; \Delta^s_{ij} - p_{ij}\; q_{ij}, \tag{2.6}$$

where the factors $\Delta^x_{ij} \equiv 1-(1-x_{ij})^{\frac{1}{\theta}}$ and $\Delta^s_{ij} \equiv 1-(1-s_{ij})^{\frac{\gamma(1-\nu)}{1-\rho}}$ capture the change in the exporter's total costs upstream and importer's total revenues downstream attributable to the match. Our theory implies that these factors are exact function of the two bilateral shares x_{ij} and s_{ij}, respectively. Intuitively, importer j's demand affects exporter i's total costs, the more so the larger the importer's share of the exporter's *quantity*. Conversely, exporter i affects importer j's total costs (and revenues) via a love-of-variety channel; this effect is stronger the larger the exporter's share in the importer's total *imports.*

To tractably analyze the division of surplus, we invoke the *Nash equilibrium in Nash bargains* (Nash-in-Nash) solution concept: the price negotiated between firms i and j is the pairwise Nash bargaining solution, taking as given agreement by all other pairs (Horn and Wolinsky, 1988). In other words, each exporter-importer pair bargains as if the outcome of all other pairs do not adjust in response to a bargaining disagreement. In practice, the price p_{ij} solves problem (2.4), taking as given the price and quantity elsewhere in the network,

[9] Here, we follow Chipty and Snyder (1999) and Goldberg and Tille (2013) and assume that in the modeled bargaining process, each importer takes as given the fact that the exporter will trade with the other importers and so considers itself the marginal buyer. Vice-versa, each exporter takes as given the fact that the importer will trade with the other exporters and so considers itself the marginal supplier.

price and quantity indices of all inputs, and demand and supply shocks downstream and upstream.

2.3 Bilateral Markups

Solving for the first-order condition associated with problem (2.4) yields an optimal price setting equation expressing the bilateral price p_{ij} as a markup μ_{ij} times the exporter's marginal cost c_i. In what follows, we characterize how negotiations affect the bilateral markup μ_{ij}. For clarity of exposition, we present special cases first, and then generalize the results. Detailed derivations of the main theoretical results are in Appendix B.1.

Special Case: Exporters Have all the Bargaining Power ($\phi \to 0$). When $\phi \to 0$, exporters set price unilaterally and importers are price takers. In this case, the solution to (2.4) simplifies to a standard Nash-Bertrand solution, with the markup μ_{ij} equal to:

$$\mu_{ij}\Big|_{\phi\to 0} \equiv \mu_{ij}^{oligopoly} = \frac{\varepsilon_{ij}}{\varepsilon_{ij}-1} \geq 1, \tag{2.7}$$

$$\varepsilon_{ij} = (1-s_{ij})\ \rho + s_{ij}\ \tilde{\nu}. \tag{2.8}$$

The term ε_{ij} captures the importer's demand elasticity, and $\tilde{\nu} = 1-\gamma+\nu\gamma$ is a parameter that depends on the cost and demand elasticities γ and ν defined in equations (2.1) and (2.2), respectively. We refer to the markup in equation (2.7) as the "oligopoly" markup. Insofar as $\rho > \nu$, a condition that we maintain throughout, the demand elasticity ε_{ij} and the oligopoly markup $\mu_{ij}^{oligopoly}$ are a decreasing and increasing function of the supplier share s_{ij}, respectively (Dhyne et al., 2022).[10] When this share is infinitesimal ($s_{ij} \to 0$), the demand elasticity ε_{ij} collapses to ρ, the substitution elasticity across foreign varieties. When the share is close to one ($s_{ij} \to 1$) the demand elasticity ε_{ij} converges to $\tilde{\nu}$, which is proportional to the substitution elasticity across varieties of the final good, ν.

Special Case: Importers Have All the Bargaining Power ($\phi \to 1$). When $\phi \to 1$, importers set price unilaterally, while exporters behave as price takers. In this case, the optimal markup is given by:

$$\mu_{ij}\Big|_{\phi\to 1} \equiv \mu_{ij}^{oligopsony} = \theta\ \frac{1-(1-x_{ij})^{\frac{1}{\theta}}}{x_{ij}} \leq 1. \tag{2.9}$$

[10] Note that, unlike more standard Nash-Bertrand models such as Atkeson and Burstein (2008), the supplier share is defined at the match level in our theory, rather than at the firm level. In this sense, our model features *pricing-to-buyer* rather than *pricing-to-market*.

This term is always below or equal to one, which means that it is effectively a *markdown* below marginal cost. We refer to it as the "oligopsony" markdown.

This markdown decreases with the importer's buyer share x_{ij}. It converges to $\mu_{ij}^{oligopsony} \rightarrow 1$ when the importer's buyer share is infinitesimal ($x_{ij} \rightarrow 0$), in which case price equal marginal cost ($p_{ij} = c_i$). Vice versa, when the importer is a monopsonist ($x_{ij} \rightarrow 1$), the markdown converges to $\mu_{ij}^{oligopsony} \rightarrow \theta$, such that price equal average cost ($p_{ij} = \theta c_i$). The intuition is that when $\theta < 1$, the marginal cost of output is higher than its average cost, generating "technological" rents to the exporter that accrue to the exporter's gains from trade. Large importers understand their role in determining the exporter's rents and aim to extract these rents by setting a price below marginal cost. The larger the importer's buyer share, the larger the importer's market power, and the lower the price.[11] When $\theta = 1$, marginal and average cost coincide such that technological rents do not exist, nor does import market power. In this case, full importer's bargaining power always coincides with marginal cost pricing.

General Case: Bilateral Bargaining Power ($0 < \phi < 1$). The following proposition summarizes our first theoretical result.

Proposition 1. *The bilateral markup negotiated by the $i - j$ match when the importer's bargaining power is $0 < \phi < 1$ is*

$$\mu_{ij} = (1 - \omega_{ij}) \cdot \mu_{ij}^{oligopoly} + \omega_{ij} \cdot \mu_{ij}^{oligopsony}, \tag{2.10}$$

where $\omega_{ij} \equiv \frac{\frac{\phi}{1-\phi}\lambda_{ij}}{1+\frac{\phi}{1-\phi}\lambda_{ij}} \in (0,1)$, $\lambda_{ij} \equiv \frac{(\nu-1)\gamma}{\varepsilon_{ij}-1} \ \frac{s_{ij}}{\Delta_{ij}^{s}} \geq 0$, and where $\mu_{ij}^{oligopoly}$ and $\mu_{ij}^{oligopsony}$ are given by equations (2.7) and (2.9), respectively.

When $0 < \phi < 1$, both exporter i and importer j have some negotiating power. The markup μ_{ij} in this case is a weighted average between the oligopoly markup in equation (2.7) and the oligopsony markdown in equation (2.9). The weight ω_{ij} depends on the factor $\frac{\phi}{1-\phi}\lambda_{ij}$, which is the product of two terms: the relative importer's bargaining power ($\frac{\phi}{1-\phi} \in \mathbb{R}_+$) and a term ($\lambda_{ij} \in \mathbb{R}_+$) inversely related to the importer's gains from trade. We interpret $\frac{\phi}{1-\phi}\lambda_{ij}$ as the *effective* importer's bargaining power: when the importer's bargaining power is high or their gains from trading with exporter i are low, the weight ω_{ij} converges to one, and μ_{ij} converges to the oligopsony markdown in equation (2.9). Vice versa, when either the

[11] The exporter's gains from trade in equation (2.5) can be rewritten as $GFT_i = q_{ij} \cdot (p_{ij} - \theta \ \frac{\Delta_{ij}^{x}}{x_{ij}} \ c_i) = q_{ij} \cdot (p_{ij} - \mu_{ij}^{oligopsony} c_i)$, which makes clear that by negotiating the price equals to $p_{ij} = \mu_{ij}^{oligopsony} c_i$, the importers set $GFT_i = 0$. As a result, price-setting importers aim to extract via negotiations the exporter's gains from trade they contribute generating.

importer's bargaining power is zero or their gains from trading with exporter i are very high, the weight ω_{ij} goes to zero, in which case μ_{ij} coincides with the oligopoly markup in equation (2.7).

Appendix B.3 investigates how λ_{ij} (and hence ω_{ij}) varies with the exporter's supplier share s_{ij}. To a first order approximation both around $s_{ij} \to 0$ and $s_{ij} \to 1$, $\lim_{s \to 0,1} \lambda_{ij} = 1$ such that $\lim_{s \to 0,1} \omega_{ij} = \phi$, which means that the weight converges to the importer's bargaining power. We also show that λ_{ij} and ω_{ij} are approximately constant for intermediate and empirically-relevant values of s_{ij}. We adopt the approximation $\frac{d\omega_{ij}}{ds_{ij}} \simeq 0$ in the remainder of the theoretical analysis.

Abstracting from such second-order terms, the markup in (2.10) depends on s_{ij} and x_{ij} only through their effect on $\mu_{ij}^{oligopoly}$ and $\mu_{ij}^{oligopsony}$, respectively. Hence, the bilateral markup μ_{ij} inherits the properties of the special-case markups: it increases with the exporter's supplier share s_{ij} as long as $\phi < 1$, and it decreases with the importer's buyer share x_{ij} as long as $\phi > 0$. In this sense, markups reflect oligopoly and oligopsony forces, with relative bargaining power as weight.

Discussion and Extensions We discuss two extensions of our bargaining theory: an alternative specification of the outside options, and an alternative bargaining protocol.

Our model assumes that each player's outside option during negotiations is the payoff they would get from conducting transactions with all pre-existing counterparts except the current one. This specification of the outside options ignores new matches that could form in case of disagreement. Empirically, this assumption resonates with the substantial stickiness in trade relationships (Antràs and Chor, 2013; Martin et al., 2020; Monarch, 2022). Theoretically, it allows us to write the bilateral markup as a function of the buyers' and suppliers' shares – which are observed in the data – and the unknown parameter vector, a feature that we exploit in Section 4 for structural estimation. Appendix B.4 dispenses with parametric assumptions on the disagreement payoffs and let ϱ_{ij} and σ_{ij} denote the profits of buyer j and the total cost of exporter i when the negotiation breaks. We derive an expression for the equilibrium markup analogous to equation (2.10), with the only difference that both the term λ_{ij} and the oligopsony markup are now a function of two unobserved terms: the importer's (ϱ_{ij}) and exporter's (σ_{ij}) outside options. This difference aside, all the qualitative insights are fully symmetric in the two models.

A second assumption our baseline model maintains is that, once the importer and the exporter negotiate over the input price, the transaction quantity is pinned down by the importer's demand function. That is, prices are allocative. This assumption is justified on two grounds. First, it is consistent with a wealth of empirical evidence on intermediate good prices (See, e.g., Gopinath and Itskhoki, 2011). Second, it is such that our theory nests more traditional ones as limit cases. For example, when exporters set prices unilaterally, the price p_{ij} solves

$$p_{ij}: \ \arg\max \ (p_{ij} - c) \ q(p_{ij}; \mathbf{p}),$$

where $q(p_{ij}; \mathbf{p})$ is the buyer's demand function, and $\mathbf{p}$ summarizes the competitors' prices, just like in standard Nash-Bertrand models (Atkeson and Burstein, 2008; Dhyne et al., 2022).

Appendix B.5 discusses an alternative "efficient" configuration of the bargaining protocol. The pair first chooses the quantity of the intermediate input to maximize the joint surplus; they then bargain over the price to determine what share of the joint surplus each firm receives. We show that despite a different equilibrium expression for the bilateral markup, the prediction that the bilateral markup is increasing in the supplier share s_{ij}, decreasing in the buyer share x_{ij}, and decreasing in the bargaining parameter ϕ remain true even under efficient bargaining.

2.4 Pass-Through

We now investigate the model's predictions about the determinants of the import price pass-through of trade shocks. We consider a generic shifter to the exporter's cost c_i, and denote it by ϑ_i. We define the import price pass-through elasticity as the sensitivity of the bilateral price p_{ij} to an exogenous change in ϑ_i, and denote it as $\Phi_{ij} \equiv \frac{d \ln p_{ij}}{d \ln \vartheta_i}$. In the empirical exercises below, we will think of ϑ_i as an import tariff imposed by the United States government.

A full log-differential of the optimal price-setting equation, where the bilateral markup is given by equation (2.10), yields the following expression for the log change in price:

$$d \ln p_{ij} = \underbrace{\Gamma^s_{ij} \ d \ln s_{ij} + \Gamma^x_{ij} \ d \ln x_{ij}}_{d \ln \mu_{ij}} + d \ln c_i + d \ln \vartheta_i, \tag{2.11}$$

where $\Gamma^s_{ij} \equiv \frac{\partial \ln \mu_{ij}}{\partial \ln s_{ij}} > 0$ is the partial elasticity of the markup μ_{ij} with respect to the supplier share s_{ij}, while $\Gamma^x_{ij} \equiv \frac{\partial \ln \mu_{ij}}{\partial \ln x_{ij}} < 0$ is the partial elasticity with respect to the buyer share x_{ij}.

By definition, an exporter-level shock affects the negotiated price and quantity in all the matches the given exporter is involved with. This means that when the pair $i - j$ negotiate over the new price, full efficiency requires considering how the shock affects the negotiated outcome of all downstream buyers of exporter i, which would be quite impractical. Consistent with our assumption of Nash-in-Nash bargaining, we assume that exporter i and importer j ignore how the price and quantity of other matches change as a result of the shock. In substance, this means focusing on the direct effect of the shock on the negotiated price p_{ij}. We discuss the implications of this modeling choice below.

Treating the competitors' prices and quantities as fixed, we can write:

$$d \ln s_{ij} = -(\rho - 1)(1 - s_{ij}) d \ln p_{ij} \tag{2.12}$$

$$d \ln x_{ij} = -(1 - x_{ij})\varepsilon_{ij} d \ln p_{ij}, \tag{2.13}$$

where ε_{ij} is defined in equation (2.8). The log change in exporter i's marginal cost is given by:

$$d \ln c_i = -\frac{1-\theta}{\theta} x_{ij} \varepsilon_{ij} d \ln p_{ij}. \tag{2.14}$$

We derive our second theoretical result substituting equations (2.12)-(2.14) into equation (2.11).

Proposition 2. *The import price pass-through elasticity to a change in ϑ_i when $d \ln p_{kj} = 0$ for $k \neq i$ and $d \ln q_{ik} = 0$ for $k \neq j$ is given by:*

$$\Phi_{ij} \equiv \frac{d \ln p_{ij}}{d \ln \vartheta_i} = \frac{1}{1 + \Gamma^s_{ij}\ (\rho - 1)\ (1 - s_{ij}) + \Gamma^x_{ij}\ \varepsilon_{ij}\ (1 - x_{ij}) + \frac{1-\theta}{\theta}\ x_{ij}\ \varepsilon_{ij}} \leq 1. \tag{2.15}$$

The previous expression summarizes how an exogenous shock to ϑ_i affects the different price components: the markup – via oligopoly and oligopsony forces – and the marginal cost c_i. To see this, note that with low-enough values of these terms, equation (2.15) can be approximates as:

$$\Phi_{ij} \simeq \Phi^{SC}_{ij} \cdot \Phi^{SS}_{ij} \cdot \Phi^{TT}_{ij},$$

where $\Phi^{SC} \equiv \frac{1}{1+\Gamma^s_{ij}(\rho-1)(1-s_{ij})}$, $\Phi^{SS}_{ij} \equiv \frac{1}{1+\Gamma^x_{ij}\varepsilon_{ij}(1-x_{ij})}$, and $\Phi^{TT}_{ij} \equiv \frac{1}{1+\frac{1-\theta}{\theta}x_{ij}\varepsilon_{ij}}$. We refer to these three terms as the *strategic complementarity* channel (Φ^{SC}), the *strategic substitutability* channel (Φ^{SS}), and the *terms-of-trade* channel (Φ^{TT}). These terms reflect the effect of the trade shock on the oligopoly markup, oligopsony markup, and marginal cost, respectively. We discuss each of these channels in the next three paragraphs, followed by a discussion of the overall elasticity.

Strategic Complementarity Channel The first determinant of import price pass-through reflects strategic complementarities among exporters, a well-known source of real rigidities in prices (Burstein and Gopinath, 2014). This channel captures how the oligopoly markup responds to shocks to the exporter's marginal cost. It is defined as:

$$\Phi^{SC} \equiv \frac{1}{1 + \Gamma^s_{ij}\ (\rho - 1)\ (1 - s_{ij})} \leq 1, \tag{2.16}$$

where $\Gamma^s_{ij} \equiv (1-\omega_{ij})\ \frac{\mu^{oligopoly}_{ij}}{\mu_{ij}}\ \Gamma^{s,oligopoly}_{ij} \geq 0$ and $\Gamma^{s,oligopoly}_{ij} \equiv \frac{1}{\varepsilon_{ij}-1}\frac{\rho-\varepsilon_{ij}}{\varepsilon_{ij}} \geq 0$. The first row of Appendix Figure A.1 plots the contour plots of Φ^{SC}_{ij} as a function of the supplier share s_{ij} and the buyer share x_{ij}, for different values of the importer's bargaining power ϕ. The pass-through elasticity is always below or equal to one via the strategic complementarity channel.

When a cost shock hits the exporter, its price increases, leading importers to substitute away from the exporter's variety. To prevent similar trade diversion effects, the exporter reduces its markup, leading to an *incomplete* pass-through of the cost shock into the price. The price response to the shock is *U-shaped* in the bilateral supplier share: when the exporter's supplier share is either infinitesimal ($s_{ij} \to 0$) or very large ($s_{ij} \to 1$), the scope for strategic complementarities in pricing is reduced, leading to a less significant impact of the shock on the negotiated markup and price (Atkeson and Burstein, 2008; Auer and Schoenle, 2016).

The strength of the strategic complementarity channel decreases with the importer's bargaining power ϕ, through its impact on the markup elasticity Γ^s_{ij}.[12] Intuitively, the higher ϕ, the lower the exporter's contribution to the bilateral markup and the lower the scope for markup adjustment by exporters. In the limit where importers set prices ($\phi \to 1$), markups are fixed from the point of view of exporters and $\Gamma^s_{ij} \to 0$, which means that the pass-through is always one via the strategic complementarity channel.

Strategic Substitutability Channel The import price pass-through elasticity also reflects strategic substitutabilities among importers.[13] This channel summarizes how the oligopsony markdown is affected by exogenous shocks to the exporter's marginal cost. It is defined as

$$\Phi^{SS} \equiv \frac{1}{1+\Gamma^x_{ij}\ \varepsilon_{ij}\ (1-x_{ij})} \geq 1, \tag{2.17}$$

where $\Gamma^x_{ij} \equiv \omega_{ij}\ \frac{\mu^{oligopsony}_{ij}}{\mu_{ij}}\ \Gamma^{x,oligopsony}_{ij} \leq 0$ and $\Gamma^{x,oligopsony}_{ij} \equiv \frac{x_{ij}\ (1-x_{ij})^{\frac{1}{\theta}-1}}{\theta\ \left(1-(1-x_{ij})^{\frac{1}{\theta}}\right)} - 1 \leq 0$. The second row of Appendix Figure A.1 plots the contour plots of Φ^{SS}_{ij} as a function of the supplier share s_{ij} and the buyer share x_{ij}, for different values of ϕ. The strategic substitutability channel is a source of more-than-complete pass-through into import prices.

When a cost shock hits the exporter raising their price, buyer $j's$ demand of the exporter's variety decreases. As a result, the buyer share x_{ij} decreases, putting upward pressures on

[12]The strength of the strategic complementarity channel also increases in the importer's buyer share x_{ij}, through their impact on the markup elasticity Γ^s_{ij}. Quantitatively, the contribution of x_{ij} to the strategic complementarity channel is relatively tiny, and we omit its discussion.

[13]Strategic substitutabilities exist among importers since as the quantity of importer $i's$ competitors decrease, $i's$ buyer share increases, leading to lower markups and higher quantity demanded by i.

the markup and price. Since the scope for markdown adjustment is higher for intermediate levels of x_{ij}, the response of import prices to cost shocks in this case is *hump-shaped* in the share x_{ij}.

The strength of strategic substitutabilities *decreases* with the supplier share s_{ij}, via its effect on the importer's demand elasticity ε_{ij}: large exporters face a lower demand elasticity to price changes and the demand response is more muted in their case, putting downwards pressure on the term Φ_{ij}^{SS}. Lastly, the scope for strategic substitutabilities *increases* with the importer's relative bargaining power ϕ. Intuitively, the lower ϕ, the lower the importer's contribution to the bilateral markup and the lower the scope for markup adjustment by importers. In the limit where exporters set prices ($\phi \to 0$), markups are fixed from the point of view of importers and $\Gamma_{ij}^{x} \to 0$, which means that the pass-through is always one via the strategic substitutability channel.

Terms-of-trade Channel The third and last force determining the import-price pass-through is a terms-of-trade (or cost) channel, defined as:

$$\Phi_{ij}^{TT} \equiv \frac{1}{1 + \frac{1-\theta}{\theta}\ x_{ij}\ \varepsilon_{ij}} \leq 1. \tag{2.18}$$

This term captures the endogenous changes in the exporter's marginal cost over and above the initial impact of the shock. Since the marginal cost varies with the importer's demand only when importers have market power, the existence of a terms-of-trade channel of pass-through elasticities implies import market power. Inspecting equation (2.18) reveals that $\Phi_{ij}^{TT} < 1$, which means that the terms-of-trade channel is a source of incomplete pass-through.

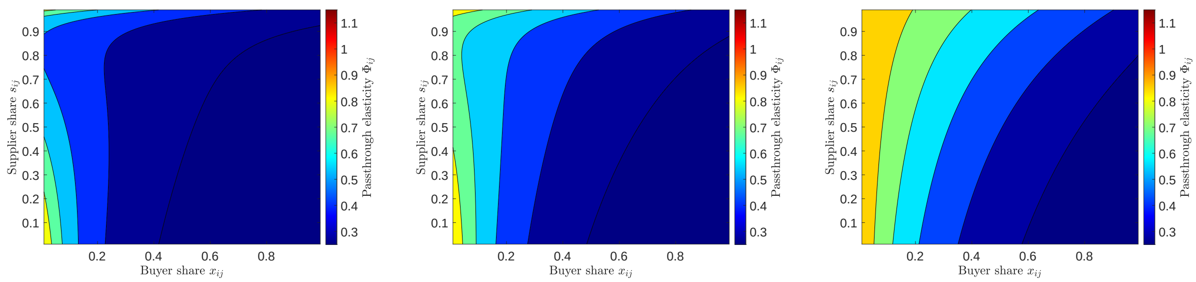
The third row of Appendix Figure A.1 plots the contour plots of Φ_{ij}^{TT}. As it is clear from equation (2.18), the strength of the terms-of-trade channel does not depend on the importer's bargaining power ϕ, since it operates through variations in the exporter's scale of production.

When a cost shock hits the exporter raising the price, buyer j's demand of the exporter's variety decreases, decreasing the aggregate exporter's output and marginal cost, provided that $\theta < 1$. This effect is more substantial when the importer accounts for a larger share of the exporter's total output. When the buyer share is tiny, i.e. $x_{ij} \to 0$, the importer's demand does not affect the exporter's marginal cost, such that marginal costs do not change beyond the effect of the initial shock. The size of this channel is maximized when the importer is a monopsonist ($x_{ij} \to 1$), since in this case the importer's and aggregate import demand coincide.

Importantly, the terms-of-trade channel is less prevalent when the exporter's supplier

Figure 1: Pass-Through Elasticities: Comparative Statics

(a) $\phi \to 0$ (b) $\phi = 0.5$ (c) $\phi \to 1$



Notes: The figure displays the theory-implied values of the pass-through elasticity Φ_{ij} as a function of the two bilateral shares s_{ij} and x_{ij} and the importer's bargaining power ϕ. Panel (a) sets the importer's bargaining parameter equal to $\phi = 0$; Panel (b) sets it to $\phi = 0.5$; Panel (c) sets it to $\phi = 1$. For the other parameters, we use $\gamma = 0.5$, $\rho = 10$, $\nu = 4$, and $\theta = 0.56$.

share s_{ij} is large. As noted above, when s_{ij} is large, the importer's demand elasticity is low, reducing the overall effect of the tariff shock on the exporter's marginal cost.

Comparative Statics: General Case The previous paragraphs described the individual channels affecting pass-through. In anticipation of our empirical work below, it helps to discuss the pass-through comparative statics involving the bilateral market shares once the three channels are jointly considered.

Figure 1 plots the contour plots of Φ_{ij}. The pass-through Φ_{ij} mostly takes value below unity, even with substantial heterogeneity across values of the market shares and the importer's bargaining power. The main source of incomplete pass-through is the terms-of-trade channel, which dominates the variable markup channel for a wide range of the parameter values.

The pass-through elasticity increases with the importer's bargaining power. To build intuition, let's take the case of constant exporter's marginal costs first (i.e., $\theta = 1$), which implies the absence of import market power. We show this case in Figure A.2 in the Appendix. When the exporter sets prices, they will charge a markup over the marginal cost. If $\theta = 1$, only the strategic complementarity channel affects prices, implying a mostly incomplete pass-through. On the other hand, price equals marginal cost when the importer sets prices, so the pass-through is necessarily complete. With import market power ($\theta < 1$), the pass-through elasticity also depends on the terms-of-trade and strategic substitutability channel. The former is a source of incomplete pass-through, and its strength does not depend on who sets the price, hence on the value of ϕ. The latter is a source of more-than-complete pass-through, and its strength increases with ϕ.

A second remark based on Figure 1 is that the relationship between the pass-through elasticity and the bilateral shares is mediated by the value of ϕ. When exporters set prices ($\phi \rightarrow 0$), the pass-through elasticity Φ_{ij} depends on the strategic complementarity and terms-of-trade channels. In this case, the value of Φ_{ij} decreases monotonically with the buyer share x_{ij} and has a *U-shaped* relationship with the supplier share s_{ij}. Vice-versa, when importers set prices ($\phi \rightarrow 1$), the pass-through depends on the strategic substitutability and terms-of-trade channels. In this case, the value of Φ_{ij} decreases monotonically with the buyer share x_{ij} and it increases with the supplier share s_{ij}, as explained above.

This observation has implications for our interpretation of the reduced-form evidence in the next Section: Although the importer's bargaining power is not observed, one could discriminate across bargaining regimes by looking at how the pass-through elasticity varies with the supplier share. Specifically, an ambiguous or negative relationship between the tariff pass-through elasticity and the exporter's supplier share is consistent with low values if the bargaining parameter ϕ; vice-versa, a positive relationship between the tariff pass-through elasticity and the exporter's supplier share suggests that U.S. importers may have disproportionate leverage in price negotiations. The reduced-form evidence in Section 3 finds a positive co-movement between Φ_{ij} and s_{ij}, thus supporting the latter scenario.

Discussion and Extensions A critical assumption behind Proposition 2 is that, in negotiating price changes following a shock to ϑ_i, the pair ignores how other nodes in the network respond to the same shock, effectively treating the shock as a pair-level one. This assumption is justified on two grounds: First, it is consistent with the Nash-in-Nash protocol of simultaneous and independent negotiations. Second, it yields an interpretation for pass-through elasticities one could estimate using price data, provided that changes in prices in other network nodes, namely, $d \ln p_{kj}$ for $k \neq i$ and $d \ln q_{ik}$ for $k \neq j$ can be controlled for in regressions. This type of exercise is feasible in our case due to the availability of data on bilateral transactions and two-sided heterogeneity. Moreover, we show in Section 3 that the estimated tariff pass-through elasticity into the bilateral price is largely unaffected by the inclusion of these additional price and quantity controls, suggesting a relatively unimportant role of the indirect effects for pass-through elasticities.

Appendix B.6.2 derives the more general pass-through formula that includes both the direct and indirect effects of the shock. The main equation (B.2) shows that the full pass-through rate can be derived by solving a complex system of equations for each supplier i, highlighting the complexity of considering the full effects of the shock during bilateral negotiations.

3 Data and Stylized Facts

This section introduces the empirical analysis. Section 3.1 describes the main data sources. In Section 3.2, we adjust the baseline model to bring it to the data. Section 3.3 discusses the sample selection and some summary statistics on the main sample. Section 3.4 presents reduced-form evidence on the cross-sectional relationship between bilateral prices and tariff pass-through elasticities and importers' and exporters' bilateral market shares.

3.1 Data Sources

Bringing our model to the data requires detailed information on transaction-level prices and quantities, alongside information on the characteristics of the contracting parties, such as size and age. To that end, we construct a novel dataset matching the U.S. Census Linked/Longitudinal Firm Trade Transaction Database (LFTTD) with the Longitudinal Business Dataset (LBD), the Census of Manufacturers (CM), and the ORBIS dataset.

The LFTTD dataset covers the universe of cross-border import transactions between U.S. importers and worldwide foreign exporters during 1992-2019. For each import transaction, the LFTTD reports the value and quantity shipped (in U.S. dollars), the shipment date, the 10-digit Harmonized System (HS10) code of the product traded, and the transportation mode. The dataset also includes a manufacturing ID (LFTTD-MID) identifying relevant foreign exporter characteristics, including nationality, name, address, and city.

Information about the domestic activity of U.S. importers is collected from the LBD. The LBD provides information on employment and payroll for the universe of U.S. establishments. For manufacturing firms, we also utilize data from the CM. The CM provides statistics on employment, payroll, supplemental labor costs, cost of materials consumed, operating expenses, the value of shipments, value added by manufacturing, detailed capital expenditures, fuels and electric energy used, and inventories. Both datasets are linked to the LFTTD through a firm identifier.

We merge the LFTTD dataset with ORBIS, a worldwide firm-level dataset maintained by Bureau van Dijk. This dataset includes information on listed and unlisted companies' financials, such as revenues, assets, employment, cost of materials, and wage bills; it also provides information on ownership linkages across companies. With the merged dataset, we can identify whether a given cross-border transaction occurs between firms of the same corporate group. The merge is possible because ORBIS provides information on both firms' names and addresses, allowing us to construct a manufacturing ID variable for the foreign exporter in the ORBIS dataset (ORBIS-MID) that can be matched with the corresponding

LFTTD-MID.[14]

Our analysis also uses data on import tariffs in the period of 2017-2019. In this period, the import tariffs imposed by the United States on selected products and trade partners experienced a sizable increase after several decades of low and stable rates. The statutory tariff data we use is from Fajgelbaum et al. (2020), and a full description of these data can be found therein. This data set contains the set of HS8 products subject to increases in tariffs, the set of countries affected for each product, the effective application dates for the tariff changes, and the percentage point increase.

3.2 Measuring Key Variables of the Model

To construct the key variables of interest, we introduce multiple products to our model, where a product is an HS10 code and is denoted by h. We let each importer j source a set of $\mathcal{H}_j$ foreign products from a set of $\mathcal{Z}_j^h$ exporters, $\forall h \in \mathcal{H}_j$. We now define the aggregate foreign input quantity as a Cobb-Douglas composite of individual product quantities, namely:

$$q_j^f = \prod_{h \in \mathcal{H}_j} \left(q_j^{f,h}\right)^{\alpha_j^h}, \quad \text{where} \quad q_j^{f,h} = \Big(\sum_{i \in \mathcal{Z}_j^h} \varsigma_{ij}^h \cdot \left(q_{ij}^h\right)^{\frac{\rho-1}{\rho}}\Big)^{\frac{\rho}{\rho-1}},$$

and $\alpha_j^h \in (0,1)$ is the (observed) Cobb-Douglas share of the HS10 input h on j's total imports of foreign intermediates. This setup implies that equation (2.1) becomes:

$$\alpha_j^h \gamma = \frac{d \ln c_j}{d \ln p_j^{f,h}} \in (0,1],$$

where the product price index $p_j^{f,h}$ is defined as $p_j^{f,h} = \left(\sum_{i \in \mathcal{Z}_j^h} \left(\varsigma_{ij}^h\right)^{\rho} \cdot \left(p_{ij}^h\right)^{1-\rho}\right)^{\frac{1}{1-\rho}}$.

Accordingly, we construct the relevant exporter's supplier share as $s_{ij}^h \equiv \frac{p_{ij}^h q_{ij}^h}{\sum_{k \in \mathcal{Z}_j^h} p_{kj}^h q_{kj}^h}$, where $\mathcal{Z}_j^h$ is the set of firm j's suppliers of input h. The numerator of this share is the sum of all imports of firm j from exporter i (a MID in our dataset) of product h during the year; the denominator adds all the imports of product h across all the foreign suppliers that supply to j.

Unlike the exporter's supplier share, the importer's buyer share $x_{ij}^h \equiv \frac{q_{ij}^h}{\sum_{k \in \mathcal{Z}_i^h} q_{ik}^h}$ is defined in terms of quantities as explained in Section 2.3. Because we only observe U.S. importers

[14] Identifying intra-firm transactions using the ORBIS dataset, instead of the indicator included in the LFTTD dataset, provides aggregate statistics of intra-firm trade that are much closer to the reported by the U.S. Bureau of Economic Analysis, as discussed in Alviarez et al. (2019). Appendix C.1 provides more details on the construction of the MID variable. Appendix C.2 provides more details on the identification of related-party transactions.

in our data, we assume that exporter i's production consists of product-destination specific production lines, such that $\mathcal{Z}_i^h$ in the the denominator of x_{ij}^h only includes U.S. importers.[15]

3.3 Selection and Summary Statistics

We use the following criteria for sample selection.[16] To ensure that the foreign exporters represented in ORBIS data cover a substantial share of the aggregate economy, we only select foreign countries whose firm coverage in ORBIS accounts for more than 50 percent of sales reported in KLEMS/OECD in 2016. We then exclude bilateral trade transactions between an importer and exporter related by ownership ties. Excluding related-party trade ensures observed prices reflect forces such as transfer pricing. To ensure that we have enough variation within each estimation category, we select exporters that sell a given HS10 product to two or more U.S. importers and focus on country-product pairs in which there are at least three exporters. Our final sample covers around 34 percent of U.S. imports, mostly due to the exclusion of related-party trade transactions.

We report the summary statistics on our sample in Table 1. Dispersion in bilateral prices is substantial. Below, we show that this is still the case within an exporter-HS10 product and controlling for the importer's characteristics, indicating that a considerable share of the observed price cross-sectional variation depends on the features of the buyer-seller relationship.

Both importers and exporters are concentrated: the average exporter has a supplier share of 15 percent in an importer's imports of an HS10 product; the average buyer share is about 28 percent instead, even with substantial heterogeneity in both shares. Importers and exporters are connected to a limited number of partners in a given year. Moreover, firms' tenure in international trade is long, with an average of about 6 years of experience. Relationships between importers and exporters are sticky even at the HS10 product level, with an average pair trading the same HS10 product for 3 consecutive years (Monarch, 2022). Our modeling assumptions are broadly consistent with these data features.

[15]This data limitation could inflate our measure of the importer's buyer share x_{ij}, potentially affecting our empirical analysis of markups and pass-through rates. As a robustness check, we also replicate the entire empirical analysis focusing only on Canada as an exporting country. The rationale is that since Canadian exporters sell predominantly to the U.S.. (in 2019, the U.S. was the destination of 73 percent of total Canadian exports), the assumption on product-destination specific production lines is inconsequential in this case. Reassuringly, we find that results are largely unaffected in this subsample of our data. These results are available upon request.

[16]Appendix C.3 provides full details on sample selection criteria.

Table 1: Summary Statistics

Variable	Mean	Std.
Log price ($\ln p_{ijt}^h$)	3.52	2.48
Importer's supplier share (s_{ijt}^h)	0.15	0.22
Exporter's buyer share (x_{ijt}^h)	0.28	0.30
Exporters per importer (HS10)	10.16	36.27
Importers per exporter (HS10)	9.59	25.08
Importer experience (tenure)	7.44	4.38
Exporter experience (tenure)	5.87	3.92
Longevity of the relationship	3.05	2.71

Notes: The table shows the mean and standard deviation for key variables, where s_{ijt}^h is the share of exporter i on importer j's imports of product h at time t; x_{ijt}^h is the share of importer j in i's total export quantity of product h to the U.S. at time t; exporter (importer) experience is measured as the number of years since the exporter (importer) first started supplying (sourcing) product h. The longevity of the relationship is measured by the number of years since the foreign exporter first served the U.S. importer. The sample excludes related party transactions and covers the period of 2001-2016.

3.4 Stylized Facts

Before describing our structural approach to estimating the determinants of markups and pass-through elasticities, it is instructive to consider what can be learned from a reduced-form approach to the problem. One of the main implications of our bargaining theory in Section 2 is that, insofar as both importers and exporters have some bargaining power, both the level and changes of bilateral prices p_{ij}^h depends on relationship-specific factors through the value of the two bilateral shares, s_{ij}^h and x_{ij}^h, and parameters. As a result, holding the parameter vector constant, variation in prices and pass-through elasticities across matches should reflect variation in these shares. This section uses U.S. import price data to validate such model's predictions, describing price levels first, and then price changes.

Variation in Bilateral Prices We first gauge how much of the observed dispersion in bilateral prices can be attributed to relationship-specific factors. We consider a standard variance decomposition exercise as in Fontaine et al. (2020). Appendix Table A.1 shows that product and year fixed effects explain about 55 percent of the overall cross-sectional price variation. Of the residual 45 percent, about 20 percent can be attributable to the match-specific residual, even after controlling for time-invariant characteristics of the importer and exporter. When we zoom in on prices within an exporter-product-year, this share increases to 88 percent. Hence, exporter-level prices mostly vary based on the characteristics of their relationships with foreign importers, consistent with our model's predictions and the evidence from other countries (Fontaine et al., 2020).

Next, we turn to a more direct test of our theory. As discussed in Section 2.3, when

Table 2: Prices and Bilateral Concentration

Dependent Variable: $\ln p_{ijt}^h$	OLS		IV	OLS		IV
	(1)	(2)	(3)	(4)	(5)	(6)
Supplier share (s_{ijt}^h)	0.226	0.227	0.519	0.442	0.442	0.397
	[0.006]	[0.006]	[0.034]	[0.013]	[0.013]	[0.008]
Buyer share (x_{ijt}^h)	-0.567	-0.566	-0.100	-0.673	-0.673	-0.586
	[0.01]	[0.01]	[0.019]	[0.015]	[0.015]	[0.009]
Controls	No	Yes	Yes	No	Yes	Yes
$FE_i + FE_j + FE_{ht}$	Yes	Yes	Yes	No	No	No
$FE_{iht} + FE_{jht}$	No	No	No	Yes	Yes	Yes
Observations	9,568,000	9,568,000	9,568,000	9,568,000	9,568,000	9,568,000
R-squared	0.921	0.921		0.974	0.974	
First stage F stat			3,137			18,740
SWF stat (s_{ijt}^h)			9,347			31,500
SWF stat (x_{ijt}^h)			6,885			41,240

*Notes:*The first three columns report the results from a specification of equation (3.1) that controls for exporter, importer, and product-year fixed effects. The last three columns include instead exporter-product-year and importer-product-year fixed effects. Columns (1)-(2) and (4)-(5) report the OLS estimates and Columns (3) and (6) report the IV estimates, along with the corresponding first stage F statistic and Sanderson-Windmeijer (SW) F statistics. All Columns include a control for the longevity of the relationship defined by the number of years since the first time the seller and the buyer transacted product h. Standard errors are robust.

bargaining power is bilateral and conditional on the exporter's marginal cost, the price p_{ij} reflects oligopoly and oligopsony forces, thus increasing with the supplier share s_{ij}^h and decreasing with the buyer share x_{ij}^h. We consider the following regression:

$$\ln p_{ijt}^h = \beta_s s_{ijt}^h + \beta_x x_{ijt}^h + \mathbf{X}_{ijt}^h \gamma + \mathbf{FE} + \upsilon_{ijt}^h, \tag{3.1}$$

where $\mathbf{X}_{ijt}^h$ and $\mathbf{FE}$ are vectors of control variables and fixed effects, which we describe below. The coefficients of interest are β_s and β_x, which we expect being positive and negative, respectively.

To address the standard endogeneity bias associated with ordinary least squares (OLS) regressions of prices on market shares, we build instrumental variables (IVs) for the bilateral shares exploiting the network structure of intermediate input trade: for the exporter's supplier share s_{ijt}^h, we consider the sales of j's *other* exporters to importers *other* than j, and for the importer's buyer share x_{ijt}^h, we consider the purchases of i's *other* importers from exporters *other* than i.

Table 2 reports the results. We find that bilateral prices increase with the exporter's supplier share and decrease with the importer's buyer share, consistent with a scenario where $0 < \phi < 1$. The first three columns report the results from a specification in which we control for exporter, importer, and product-year fixed effects. The last three columns report the results from our preferred specification, which includes exporter-product-year and importer-product-year fixed effects to control for the unobserved exporter marginal cost and unobserved importer demand shocks. The list of regressors also includes the longevity of the relationship, defined as the number of years since the first time the seller and the buyer transacted product h.

The coefficients on both the exporter's and importer's bilateral shares are always statistically and economically significant. The magnitude of the two coefficients is similar: a one percent increase in the supplier share corresponds to an increase of the bilateral price by around 0.2 to 0.5 log points, and a one percent increase in the buyer share corresponds to a decrease of the bilateral price by around 0.1 to 0.7 log points.

Variation in Bilateral Pass-Through Elasticities We next examine how the pass-through of cost shocks are related to the bilateral market shares. For this exercise, we follow Fajgelbaum et al. (2020) and focus on the period 2017-2019, when U.S. imports were affected by large and unexpected surges in import tariffs during the Trump administration. Echoing Fajgelbaum et al. (2020), we will focus on the effect of changes in the U.S. statutory import tariffs on the *duty-exclusive* price, which we denote by $\Delta \ln p^{*h}_{ijt}$.[17] Throughout, we assume that changes in statutory tariffs are orthogonal to other demand and supply shocks at the match level.

We regress the observed yearly log changes in the duty-exclusive price, $\Delta \ln p^{*h}_{ijt}$, charged by exporter i from country $c(i)$ to importer j for HS10 product h in year t, on the changes in the statutory tariff rates imposed by the United States government on imports of product h from country c, $\Delta(1 + \tau^h_{c(i)t})$, along with their interactions with the lagged supplier and buyer shares, x^h_{ijt-1} and s^h_{ijt-1}, controls in $\mathbf{X}^h_{ijt}$, and fixed effects:

$$\begin{aligned}\Delta \ln p^{*h}_{ijt} =& \alpha_0 + \alpha_1 \, \Delta \left(1 + \tau^h_{c(i)t}\right) + \alpha_s \, \Delta \left(1 + \tau^h_{c(i)t}\right) \times s^h_{ijt-1} + \alpha_x \, \Delta \left(1 + \tau^h_{c(i)t}\right) \times x^h_{ijt-1} \\ &+ \alpha_{Lx} \, x^h_{ijt-1} + \alpha_{Ls} \, s^h_{ijt-1} + \mathbf{X}^h_{ijt}\gamma + \mathbf{FE} + \epsilon^h_{ijt}.\end{aligned}$$

In these reduced-form regressions, we additionally include the longevity of the $i - j$ relationship as a control variable to account for the fact that, at the bilateral level, older relationships could imply different price changes (e.g., Heise, 2019). To isolate the direct effect of the shock on the bilateral prices, some regressions also control for the change in the

[17] The term $\Delta \ln p^{*h}_{ijt}$ is defined as $\Delta \ln p^{*h}_{ijt} = \Delta \ln p^h_{ijt} - \Delta \ln \vartheta^h_{it}$, where $\Delta \ln p^h_{ijt}$ is log change in the duty-inclusive price. Hence, the pass-through into the duty-exclusive price is $\frac{d \ln p^{*h}_{ijt}}{d \ln \vartheta^h_{it}} = \Phi^h_{ijt} - 1$, where Φ^h_{ijt} is as in (B.2).

quantity that exporter i sells to buyers other than j, $\Delta \ln q^h_{i(-j)t}$, and the weighted average change in the price that suppliers other than i charge to firm j, $\Delta \ln p^{*h}_{ijt}$.

Table 3 reports the estimated reduced-form coefficients from a regression including country-year ($FE_{c(i)t}$), product-year (FE_{ht}), importer-year (FE_{jt}), and exporter (FE_i) fixed effects. Column (1) shows that on average, the tariff pass-through into duty-exclusive prices is negative but small, suggesting weak terms of trade effects of tariffs at the match level. Following a 10 percent increase in the import tariff on product h sold by exporter i, the average exporter reduces the free-on-board price by about 0.6 percent, so that the average pass-through into the price paid by U.S. importers is 99.4 percent. This result is consistent with empirical studies of the recent trade war, which also find instances of near-complete pass-through of Trump tariffs using product-level data. We will return to this result in Section 5, where we relate our study to this empirical literature and we interpret the reduced-form pass-through coefficient in light of our estimated model.

Table 3: Pass-Through and Bilateral Concentration

Dependent Variable: $\Delta \ln p^{*h}_{ijt}$	(1)	(2)	(3)	(4)	(5)	(6)
$\Delta \ln(1+\tau^h_{c(j)t})$	-0.0546	-0.0746	-0.0143	-0.0256	-0.0243	-0.064
	[0.0351]	[0.0352]	[0.0389]	[0.0372]	[0.0371]	[0.0534]
$\Delta \ln(1+\tau^h_{c(j)t}) \cdot s^h_{ijt-1}$		0.167		0.177	0.174	0.0124
		[0.0578]		[0.0709]	[0.0715]	[0.104]
$\Delta \ln(1+\tau^h_{c(j)t}) \cdot x^h_{ijt-1}$			-0.136	-0.167	-0.165	-0.028
			[0.0369]	[0.0427]	[0.0420]	[0.0407]
$\Delta \ln(1+\tau^h_{c(j)t}) \cdot 1\{diff_h\}$						0.0536
						[0.0615]
$\Delta \ln(1+\tau^h_{c(j)t}) \cdot s^h_{ijt-1} \cdot 1\{diff_h\}$						0.221
						[0.168]
$\Delta \ln(1+\tau^h_{c(j)t}) \cdot x^h_{ijt-1} \cdot 1\{diff_h\}$						-0.188
						[0.0635]
Quantity bought by i's other buyers ($\Delta \ln q^h_{i(-j)t}$)	No	No	No	No	Yes	No
Price charged by j's other suppliers ($\Delta \ln p^h_{(-i)jt}$)	No	No	No	No	Yes	No
$FE_{c(i)t} + FE_{ht} + FE_{jt} + FE_i$	Yes	Yes	Yes	Yes	Yes	Yes
Observations	613,000	613,000	613,000	613,000	613,000	613,000
R-squared	0.25	0.25	0.253	0.253	0.254	0.254

Notes: The Table reports the response of duty-exclusive prices to changes in import tariffs during the period 2017-2019. All OLS regressions control for the number of years the firm-pair relationship has last (longevity of the relationship). Lagged supplier share is added as a control in Columns (2), (4)-(6), and lagged buyer share is added as a control in Columns (3)-(6). Column (5) additionally controls for the change in the quantities that exporter i sells to other importers but j, $\Delta \ln q^h_{i(-j)t}$; and the weighted average of the change in prices of other exporters to firm j, $\Delta \ln p^h_{(-i)jt} = \sum_{k \neq i} s^h_{kj(t-1)} \Delta \ln p^h_{kjt}$, with weights given by the relative importance of other exporters ($-i$) in j's imports of product h at the beginning of the period, $s^h_{kj(t-1)}$. $1\{diff_h\}$ is 1 if product h is differentiated. Standard errors are clustered by country and product.

Columns (2)-(4) include the interaction terms between the tariff changes and the supplier share s^h_{ijt} and buyer share x^h_{ijt}. The corresponding coefficients are α_s and α_x, respectively. As discussed in Section 2.4, our theory predicts an unambiguously negative sign on the coefficient α_x, while the expected sign on α_s depends on the bargaining regime: it is positive when importers set prices ($\phi \to 1$), yet it is ambiguous (and most likely negative) when exporters set prices ($\phi \to 0$). Column (2) qualifies the coefficient α_s as positive, meaning that larger suppliers pass-through a higher share of the tariff shock into their export prices, ceteris paribus. Our model would interpret this evidence as suggestive of a high value of the U.S. importers' bargaining power.

Column (3) shows that the pass-through is monotonically decreasing in the buyer share x_{ij}, as expected from our theory whenever there is import market power (i.e., $\theta < 1$). Column (4) includes both interactions and shows similar results to those in Columns (2) and (3).

Column (5) tests our modeling choice of focusing on the direct effect of the shock on import prices, as discussed in Section 2.4. It does so by adding to the list of regressors controls for the price and quantity changes of other links, $\Delta \ln q^h_{i(-j)t}$ and $\Delta \ln p^h_{(-i)jt}$. We find that the estimated coefficients on the tariff shock and associated interaction terms are robust to this inclusion. Moreover, the control variables have an economically negligible impact on the overall pass-through. Overall, this evidence backs our modeling approach.

One could argue that, for commodities and similar "reference-priced" goods, the mechanism in our model should not be nearly as strong. To validate this argument, Column (6) considers heterogeneous effects by product categories by including an additional set of interactions of the main variables of interest and a dummy indicating whether product h is classified as a differentiated good in Rauch (1999). The results show that the heterogeneous effects are entirely driven by the subset of products classified as differentiated. In contrast, the relative firm size is inconsequential for the tariff pass-through into reference-priced goods.

Lastly, Table A.2 in the Appendix reports the effect of tariff shocks on duty-inclusive prices. We find that the main evidence on the interaction terms is unaffected by the price choice.[18]

Discussion The observed co-movement between the pass-through elasticity and the bilateral market shares endorses the predictions of our model with two-sided market power. The negative relationship of the pass-through elasticity with the importer's buyer share indicates

[18]The direct impact of the tariff on duty-inclusive prices in Column 1 of Table A.2 is zero. Hence, it is not one plus the coefficient in Column (1) of Table 3, as one would expect. Fajgelbaum et al. (2020) find a similar result using product-level import data. This is due to the fact that the duty-inclusive unit values of imports are constructed using actual duties collected by U.S. customs rather than imputed from the statutory rate.

the presence of import market power; its positive relationship with the exporter's supplier share suggests that U.S. importers have high bargaining power. However, the inference one could make based on reduced-form evidence alone is limited. In our model, the co-movement of the pass-through elasticity with the bilateral shares is highly non-linear and depends on the unobserved bargaining power. Moreover, the three channels of shock transmission described in Section 2.4 vary at the level of supplier-buyer-product-year, each being influenced by the bilateral shares differently. Hence, reduced-form approaches cannot identify the contribution of the individual channels, nor can they recover the overall tariff pass-through into import prices, as part of the price variation may be absorbed into high-dimensional fixed effects. For these reasons, the following section returns to our model and takes a structural approach to estimate pass-through.

4 Calibration and Estimation

This section describes how we recover the primitive vector $\boldsymbol{\beta} = (\phi, \theta, \rho, \gamma, \nu)$. We focus the structural estimation strategy on the two central parameters in our theory: the relative bargaining power in a given importer-exporter pair and the returns to scale parameter θ, which determines the foreign export supply elasticity and hence import market power.

As a preliminary step, we calibrate the values of the parameters ν, γ and ρ. We set the demand elasticity that importers face downstream ν to 4. We take this value from the estimates of the U.S. downstream import demand elasticity in Broda and Weinstein (2006).[19] We set the importer $j's$ marginal cost elasticity to the foreign input price index to $\gamma = 0.5$, a value which we calibrate to match the share of imported material inputs in all material inputs for the manufacturing sector (see Eldridge and Powers, 2018). Lastly, we set the elasticity of substitution across foreign varieties, ρ, to be 10. This value agrees with the estimates of substitution elasticity from Anderson and van Wincoop (2004) and Edmond et al. (2018), who choose a similar value to match the average markups in the U.S.

4.1 Identification and Estimation of the Parameters θ and ϕ

We first examine the conditions for the identifications of the bargaining power (ϕ) and the return-to-scale parameter (θ). Let Ω_{ijt} denote the information set available to a generic exporter-importer pair $i - j$ during negotiations, which includes the supplier and buyer shares (s^h_{ijt} and x^h_{ijt}) and the calibrated parameters (ν, γ, and ρ). An inspection of equation (2.10) reveals that conditional on the information set Ω_{ijt}, the bilateral markup is only a function of the model primitives ϕ and θ, i.e., $\mu_{ij} = \mu\left(\phi, \theta; \Omega_{ijt}\right)$. The log bilateral price of

[19] Appendix D provides more details on the calibration of this parameter.

product h exchanged between exporter i and importer j in year t can be written as:

$$\ln p_{ijt}^{h} \;=\; \ln \mu\left(\phi, \theta; \Omega_{ijt}\right) + \ln c_{it}^{h} + u_{ijt}^{h}.$$

The log price is equal to the sum of the log markup and the (duty-inclusive) log marginal cost. We write the latter as the sum of an exporter-specific component, $\ln c_{it}^{h}$, common to all importers, and a (conditional) mean-zero i.i.d. term u_{ijt}^{h}, capturing cost differences across the buyers of a given suppliers. This term accounts for unobserved factors driving marginal cost differences across buyers that our model is agnostic about, such as quality differentiation or input customization.

The previous specification implies that conditional on the relevant information sets $\boldsymbol{\Omega}_{ijkt} \equiv (\Omega_{ijt}, \Omega_{ikt})$, the expected difference in exporter $i's$ marginal cost across importers j and k is zero, namely, $E_u\left[u_{ijt}^{h} - u_{ikt}^{h}; \boldsymbol{\Omega}_{ijkt}\right] = 0$. Taking the difference of the expected prices that i charges to importers j and k yields the following moment condition:

$$g(\phi, \theta; \boldsymbol{\Omega}_{ijkt}) \equiv E_u\left[\ln p_{ijt}^{h} - \ln p_{ikt}^{h} - \left(\ln \mu\left(\phi, \theta; \Omega_{ijt}\right) - \ln \mu\left(\phi, \theta; \Omega_{ikt}\right)\right); \boldsymbol{\Omega}_{ijkt}\right] = 0, \forall\ i, j, k, t. \tag{4.1}$$

The identification of ϕ and θ relies on this equation. Without loss of generality, first assume that bargaining powers are constant across pairs. Nonparametric identification means that (4.1) cannot hold for two pairs of parameters (ϕ^A, θ^A) and (ϕ^B, θ^B), such that $(\phi^A, \theta^A) \neq (\phi^B, \theta^B)$. Since the oligopoly markup does not depend on the returns to scale parameter θ, the latter parameter is identified only when the oligopsony markup affects prices, hence when $\phi > 0$. The reduced-form evidence in Tables 2 and 3 supports this requirement.

Let's thus focus on the case of bilateral bargaining power $(0 < \phi < 1)$ in what follows. Since the markup equation $\mu\left(\phi, \theta; \cdot\right)$ is strictly monotonic in the two parameters, it is also invertible in each of them. The moment condition in equation (4.1) is invertible in ϕ and θ for the same reason. It follows that observing multiple negotiations between the triple $i - j - k$ over time or multiple exporter-importers pairs for the same year t will suffice for the identification of θ and ϕ if the bargaining weights are restricted to be constant across all exporter-importer pairs.[20]

In the more general case when the bargaining power ϕ vary across $i - j$ pairs, each moment condition in equation (4.1) will contain three unknowns: ϕ_{ij}, ϕ_{ik}, and θ. Since the

[20] Formally, identification relies on the fact that the markup equation (2.10) is nonlinear in the elements of Ω (e.g.,s_{ijt}^{h} and x_{ijt}^{h}). Consider the moment conditions (4.1) for any two years t and $t-1$: their derivatives with respect to the two unknown parameters, e.g., $(\frac{\partial g_{ijkt}}{\partial \theta}, \frac{\partial g_{ijkt}}{\partial \phi})$ and $(\frac{\partial g_{ijkt-1}}{\partial \theta}, \frac{\partial g_{ijkt-1}}{\partial \phi})$, cannot be linearly related. Thus, the full rank condition is always satisfied. Analogously, variation across exporter-importers pairs, e.g., $i - j - k$ and $i - j - l$, within the same year t also ensures identification.

function $g(\phi, \theta; \mathbf{\Omega}_{ijkt})$ is invertible in each of these parameters, then the vector of unknown parameters $(\boldsymbol{\phi}, \theta)$ can also be identified from variation across the various $i - j - k$ pairs and years.

Due to the large number of $i - j$ pairs in our sample, estimating a ϕ_{ij} for each trade pair might be unfeasible. Moreover, our estimation approach does not allow the bargaining parameters to vary both in the cross-section and over time. We thus assume that the bargaining powers ϕ_{ijt} can be written as a the following function of the covariate matrix $\mathbf{X}_{ijt}$:

$$\phi_{ijt} = \frac{\exp\left(\mathbf{X}'_{ijt}\boldsymbol{\kappa}\right)}{1 + \exp\left(\mathbf{X}'_{ijt}\boldsymbol{\kappa}\right)} \in [0, 1], \tag{4.2}$$

where $\boldsymbol{\kappa}$ is an unknown parameter vector. We let $\mathbf{X}_{ijt}$ include variables that likely affect the outcome of the negotiations but are not directly related to the firms' "gains from trade" as defined by equations (2.5) and (2.6). Specifically, we include (i) the longevity of the $i - j$ relationship, (ii) the number of transactions between $i - j$ in a year, (iii) the relative outside option of the two, measured by the ratio of the quantity of the exporter i's sales to buyers other than j in year $t - 1$ over the quantity of the importer j' purchases from suppliers other than i in year $t - 1$, and (iv) an indicator variable of whether the buyer and seller transact multiple HS10 products. Identification of the parameter vector $\boldsymbol{\kappa}$ follows the same intuition just presented for the identification of $\boldsymbol{\phi}$.

The moment condition (4.1) is estimated via generalized method of moments (GMM),

$$\min_{\{\boldsymbol{\phi}, \theta\}} \mathbf{g}(\boldsymbol{\phi}, \theta) \ \mathbf{Z}' \ \mathbf{W} \ \mathbf{Z} \ \mathbf{g}(\boldsymbol{\phi}, \theta)', \tag{4.3}$$

where $\mathbf{g}(\boldsymbol{\phi}, \theta)$ stacks all moment conditions in (4.1) across all $i - j - k$ pairs and years and $\mathbf{W}$ is the optimal weighting matrix. One issue we may encounter in the estimation is that $E_u\left[u^h_{ijt} - u^h_{ikt}; \mathbf{\Omega}_{ijkt}\right] \neq 0$ if the difference $u^h_{ijt} - u^h_{ikt}$ reflects unobserved (cost) heterogeneity across buyers j and k, thus creating an endogeneity problem insofar as such heterogeneity is correlated with the vector of covariates $\mathbf{X}$ and the bilateral shares ($s_{ijt}, s_{ikt}, x_{ijt}$, and x_{ikt}).

To address this endogeneity concern, we first include fixed effects in the estimation, by demeaning $\mathbf{g}(\boldsymbol{\phi}, \theta)$ by HS10 product, year, and buyer averages. As a result, idiosyncratic variations in these variables are not transmitted to the difference of random cost terms $u^h_{ijt} - u^h_{ikt}$, thereby limiting endogeneity concerns to time-varying pair-specific shocks. We also employ instrumental variables in estimation. We build a vector of instruments $\mathbf{Z}$ by exploiting information on the network structure, similar to the approach used in Table 2. The vector $\mathbf{Z}$ includes the total number of exporters and importers in the HS10 product-year, and the mean and the median of the distributions of bilateral shares x^h_{ijt} and s^h_{ijt} in each year, excluding the shares of the involved pairs $i-j$ and $i-k$. These instruments are correlated with the endogenous explanatory variables through the level of competition within an HS10 product-year, but they are not correlated with the specific dealing between pairs $i-j$ and $i-k$, allowing for the identification of the model primitives.

4.2 Estimation Results

We estimate equation (4.3) using data between 2001 and 2016. The years between 2017 and 2019 are excluded as we will focus on this time window to validate the model out-of-sample in Section 5, where we take advantage of the tariff shocks observed in those years. Since the bargaining parameter ϕ enters the markup equation as $\bar{\phi} \equiv \frac{\phi}{1-\phi}$, the GMM procedure focuses on estimating $\bar{\phi}$ to avoid potential convergence issues for ϕ close to 1.

Table 4 shows the results. Panel A reports the calibrated parameters, while Panel B presents the GMM estimates. We impose a constant ϕ in Columns (1) and (2); Columns (3) and (4) are the more general specifications where the parameter ϕ_{ij} is given as in equation (4.2). We show results both with (Columns (1) and (3)) and without (Columns (2) and (4)) fixed effects. Our preferred specification is Column (4), which features match-varying parameters and include product, importer, and year fixed effects.

The vector of unknown parameters is always precisely estimated. Columns (1) and (2) find an estimate of the relative importer's bargaining power equal to 3.03 and 2.06, respectively, depending on the inclusion of fixed effects in estimation. The implied average value of the importer's bargaining power is 0.77 and 0.67, respectively. The returns to scale parameter $\hat{\theta}$ is estimated below one, at 0.5 and 0.44. Columns (3) and (4) show that the estimate of $\hat{\theta}$ is not largely affected by our treatment of the bargaining terms: in the specifications where we allow the latter to vary across pairs, we estimate $\hat{\theta}$ equal to 0.56, still well below one. Across specifications, the implied value of the foreign export supply elasticity, computed as $\hat{\theta}/(1-\hat{\theta})$, ranges between 0.8 and 1.3, indicating the existence of import market power.

Moving to the estimates of the vector $\hat{\boldsymbol{\kappa}}$, we find that longer relationships are associated with more bargaining power on the importer's side. Conditional on the longevity of the relationship, more frequent transactions between the exporter and the importer decrease significantly the importer's bargaining power, even though this effect vanishes when we include fixed effects. The importer's bargaining power always decreases with the relative outside option, as measured by the ratio between the quantity of past sales and purchases outside the relationship: the larger the exporter's trade volume in the previous year (excluding sales to j) relative to the past importer's trade volumes (excluding purchases from i), the lower the bargaining power of the importer. Lastly, transacting multiple products with an exporter increases the bargaining power of the importer.

Table 4: Estimated Model Primitives

Panel A: Calibrated parameters		
$\hat{\nu}$	$\hat{\gamma}$	$\hat{\rho}$
4	0.5	10

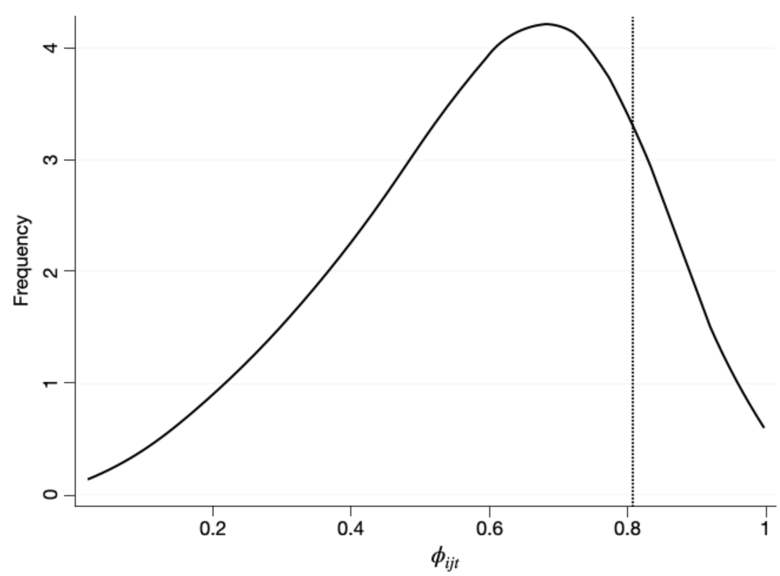
Panel B: Estimated parameters (GMM estimation)				
	(1)	(2)	(3)	(4)
Relative bargaining power ($\hat{\bar{\phi}} = \frac{\hat{\phi}}{1-\hat{\phi}}$)	3.305	2.063		
	[0.146]	[0.0849]		
Returns to Scale ($\hat{\theta}$)	0.497	0.443	0.553	0.56
	[0.0044]	[0.0064]	[0.0092]	[0.0093]
Age of the relationship ($\hat{\kappa}_1$)			0.0265	0.462
			[0.0349]	[0.0672]
Number of transactions ($\hat{\kappa}_2$)			-0.270	0.005
			[0.0325]	[0.0139]
Relative outside option ($\hat{\kappa}_3$)			-0.164	-0.189
			[0.0266]	[0.0263]
Multiple HS10 ($\hat{\kappa}_4$)			0.039	0.190
			[0.0411]	[0.0377]
Constant ($\hat{\kappa}_0$)			2.939	0.815
			[0.3329]	[0.1319]
Fixed Effects	-	$FE_h + FE_j + FE_t$	-	$FE_h + FE_j + FE_t$
Observations	2,547,000	2,547,000	2,547,000	2,547,000

Panel C: Implied bargaining powers ($\hat{\phi}$)				
Mean	0.768	0.674	0.886	0.812
St. Dev.	-	-	0.067	0.101

Notes: Panel A shows the value of the calibrated parameters for the price elasticity if downstream demand, ν, the cost elasticity to foreign input prices, γ, and elasticity of substitution across foreign varieties, ρ. Panel B reports the results from the GMM estimation. Columns (1) and (2) show results from the estimation where we impose a constant $\bar{\phi}$ across bilateral pairs. Columns (3) and (4) are the results from estimating the vector $\boldsymbol{\kappa}$ from equation (4.2) and the return to scale parameter θ. We show results both with and without fixed effects. Our preferred specification is in Column (4). Panel C reports the distribution of the implied bargaining parameter ϕ_{ij} under the estimated parameters; for Columns (1) and (2), we simply report the implied estimate of ϕ, which we compute from the GMM estimate of $\bar{\phi}$ as $\phi = \bar{\phi}/(\bar{\phi}+1)$. In all specifications, the vector of instruments include: (1) total number of exporters in an HS10, (2) total number of importers in an HS10, (3) mean and median of the distribution of bilateral shares x^h_{ijt} and s^h_{ijt}, excluding the shares of the involved pairs $i-j$ and $i-k$. Standard errors are robust.

Panel C reports moments of the implied distribution of $\hat{\phi}_{ijt}$, which we construct from equation (4.2) given the estimated $\hat{\boldsymbol{\kappa}}$ and the matrix of covariates $\mathbf{X}_{ijt}$. For comparison, Columns (1) and (2) reports the implied constant parameter $\hat{\phi}$ implied by the estimated coefficient in Panel B. The results show robust evidence that U.S. importers have disproportionate leverage in price negotiation. The mean estimated bargaining power of U.S. importers is 0.81 with a standard deviation of 0.10 in our preferred specification. That is, the bargaining power of U.S. importers is about four times as high as that of their foreign counterparts. Figure 2 showcases this variation by plotting the empirical probability density function associated to the estimated bargaining powers: the density is left-skewed, with values of ϕ above 0.5 being more likely.[21]

Figure 2: Density of the Estimated Importer's Bargaining Powers



Notes: The figure shows the estimated density of the bargaining parameters $\hat{\phi}_{ijt}$, computed as: $\hat{\phi}_{ijt} = \exp(\mathbf{X}'_{ijt}\hat{\boldsymbol{\kappa}})/(1 + \exp(\mathbf{X}'_{ijt}\hat{\boldsymbol{\kappa}}))$ where the vector $\hat{\boldsymbol{\kappa}}$ is taken from Table 4, Column (4). A value of $\phi = 0$ indicates full exporter's bargaining power; $\phi = 1$ means full importer's bargaining power.

5 Counterfactual Exercises

This section investigates our theoretical implications about the determinants of tariff incidence. We perform two exercises. First, we derive and test our theory's counterfactual predictions about how pair-level prices would change if a given trade policy were to be implemented. We do so in Section 5.1, using the 2018 U.S. trade war as a test bed of our theory. Section 5.2 uses our estimated model to shed light on the effect of the tariffs on the

[21] To satisfy U.S. Census disclosure requirements in producing this graph we drop observations below the 5th and above the 95th percentile. We choose a Gaussian kernel and appropriate bandwidth.

aggregate U.S. import prices.

5.1 Pass-Through on Bilateral Prices

We first test the model's ability to predict the pair-level price responses to the surges in import tariffs observed during the period 2017-2019. We compare, ex post, the model's predictions in 2017 about what would happen if tariffs were to change to what actually happened in 2018 and 2019 when the tariffs did change.

We let $\Delta \ln p_{ijt}^h$ denote the realized change in the duty-inclusive bilateral price of HS10 product h between U.S. importer j and exporter i, while $\widehat{\Delta \ln p_{ijt}^h}$ is the model predicted price changes following a tariff surge of the observed level. We construct the latter term from equation (2.15) duly amended to accommodate multiple products. That is, $\widehat{\Delta \ln p_{ijt}^h}$ is equal to:

$$\widehat{\Delta \ln p_{ijt}^h} = \Phi_{ijt}^h(s_{ijt}^h, x_{ijt}^h; \hat{\boldsymbol{\beta}}) \cdot \Delta \ln T_{it}^h, \tag{5.1}$$

which is the product of the observed change in the import tax levied by the U.S. government on exporter i and product h, denoted as $\Delta \ln T_{it}^h$, and the model-predicted pass-through elasticity $\Phi_{ijt}^h = \Phi(s_{ij}^h, x_{ij}^h; \boldsymbol{\beta})$, written as a function of the estimated parameter vector $\hat{\boldsymbol{\beta}} = (\hat{\boldsymbol{\phi}}, \hat{\theta}, \hat{\rho}, \hat{\gamma}, \hat{\nu})$, and the observed bilateral shares.

We compare our model's performance with that two alternative pricing frameworks in the international literature, which our theory tractably nests. The first is a standard Nash-Bertrand model (e.g., Dhyne et al., 2022), henceforth model "B", which our model nests as the limit case where the exporter sets prices unilaterally ($\phi_{ij} = \phi = 0 \; \forall i, \; j$) and production is constant returns ($\theta = 1$). The second model is a bargaining model of wholesalers like the one in Gopinath and Itskhoki (2011), henceforth model "Bgn", which is one where importers and exporters negotiate over the input price ($0 \leq \phi_{ij} \leq 1$), but there's a continuum of importers, such that there is no scope for import market power. We nest this model as the case where the exporter's technology exhibits constant returns ($\theta = 1$).[22] Our pass-through theory suggests that in both the Bertrand "B" model and the Bargaining "Bgn" model, only the strategic complementarity channel matters for cost pass-through, these two models differing only up to the markup elasticity term Γ_{ijt}^s. We run the following regressions:

$$\Delta \ln p_{ijt}^h = \beta^m \widehat{\Delta \ln p_{ijt}^h}^m + \gamma_{jt} + \rho_{ht} + \delta_{ct} + u_{ijt}^h \text{ for } m = \{Base, B, Bgn\}, \tag{5.2}$$

where $\widehat{\Delta \ln p_{ijt}^h}^m$ denotes the predicted log price changes under model m, with $m = \{Base, B, Bgn\}$. We consider the estimated coefficient $\hat{\beta}^m$ as our measure of goodness-of-fit of the different

[22] When evaluating the bargaining model, we re-estimate the bilateral bargaining parameters as done in Section 4, while imposing $\theta = 1$.

Table 5: Tests of Model's Predictions

	Observed price change						Observed sales change		
	OLS			IV			OLS		
	Baseline ($m = Base$)	Bertrand ($m = B$)	Bargaining ($m = Bgn$)	Baseline ($m = Base$)	Bertrand ($m = B$)	Bargaining ($m = Bgn$)	Baseline ($m = Base$)	Bertrand ($m = B$)	Bargaining ($m = Bgn$)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Predicted change	0.392	0.0202	0.0401	0.783	0.458	0.429	0.551	0.258	0.226
percent	[0.145]	[0.028]	[0.028]	[0.377]	[0.224]	[0.208]	[0.226]	[0.150]	[0.135]
Country-Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry-Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Importer-Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	613,000	613,000	613,000	613,000	613,000	613,000	613,000	613,000	613,000
R-squared	0.123	0.123	0.123	0.002	0.002	0.041	0.149	0.145	0.144
KPF stat				50.8	58.0	49.1			

Notes: The first three columns of the table report the OLS coefficient of specification (5.2), where the observed changes in log prices are regressed on the model predicted changes in log prices. Columns (4)-(6) report the IV coefficient where we use the statutory tariff changes at the exporter-product level as an IV. The last three columns report the OLS coefficient where the observed changes in log sales are regressed on the model predicted changes in log sales. For the IV specifications, the last row shows the Kleinbergen-Paap F statistics.The columns with $m = Base$ represent our baseline model where importers and exporters negotiate over the input price ($0 < \phi_{ij} < 1$), and production is decreasing returns ($\theta < 1$). Estimates of $\widehat{\phi_{ijt}}$ and $\hat{\theta}$ are taken from Table 4, Column 4. Columns with $m = B$ represent the case in which importers are price-takers ($\phi_{ij} \to 0$) and production is constant returns ($\theta = 1$). Columns with $m = Bgn$ represent the case in which both importers and exporters have bargaining power ($\phi_{ij} \in (0, 1)$), but production is constant returns ($\theta = 1$). We consider a value of ϕ_{ij} which we estimate from the same GMM routine presented in Section 4, where we impose $\theta = 1$. Standard errors are clustered by country and product.

models. Under the null that our model is the true data-generating process, and that there are no shocks affecting prices other than the tariff changes, the coefficient $\hat{\beta}^{Base}$ should be equal to one, while the coefficients $\hat{\beta}^{B}$ and $\hat{\beta}^{Bgn}$ should be less than one. More generally, the higher the model m's coefficient $\hat{\beta}^{m}$, the stronger the model's goodness of fit. The first three columns in Table 5 report the results from this exercise. We find that the coefficient on our baseline model is much larger than that of alternative models, suggesting that a pricing model with bilateral bargaining and two-sided market power outperforms existing pricing theories in predicting the price response to a given tariff shock.

A key empirical challenge of a similar goodness-of-fit tests is that other shocks, beside tariff ones, may have occurred over the period of interest. Insofar as much of the variation in prices derives from a structural response to other contemporaneous shocks, we may reject models not because of their poor performance in predicting the price response to tariff changes, but because the model's counterfactual predictions are agnostic about these other shocks. An additional challenge with our exercise is that the observed duty-inclusive prices are constructed using actual duties collected by U.S. customs, whereas the predicted price changes are imputed from the statutory tariff changes.

For this reason, we follow Adão et al. (2022) and consider an alternative "IV" test of the model's counterfactual predictions. The test consists of running a regression similar to specification (5.2), where we instrument the model predicted price changes by the statutory tariff changes hitting exporter i selling product h at time t. In doing so, we isolate the correlation between the model predicted price changes and the fraction of the observed price changes that are attributable to changes in the statutory tariffs. Under the null that the model's counterfactual predictions about price changes are correct, we should expect a coefficient of exactly one. Columns (4) to (6) in Table 5 report the IV coefficients. We find that only in our model one cannot reject the null of an IV coefficient equal to one at standard significance level. This result further strengthens our argument that accounting for two-sided market power, and in particular market power on the side of importers, is crucial in understanding movements in international prices.

Lastly, we extend our OLS exercise to evaluate the models' performance in predicting bilateral sales changes. While our model is primarily about prices, it can deliver predictions about how the overall volume of trade between exporter i and importer j changes as a result of the shock. The model-implied change in import values is given by

$$\widehat{\Delta \ln r_{ijt}^h} = \left(1 - \varepsilon_{ijt}^h\right) \widehat{\Delta \ln p_{ijt}^h},$$

where $\frac{d \ln r_{ijt}^h}{d \ln p_{ijt}^h} = 1 - \varepsilon_{ijt}^h$ is the revenue price elasticity. We regress the observed changes in sales volumes on the model predicted sales changes and report the results in the last three columns in Table 5. While the differences across models are smaller than when considering bilateral price changes, our model's forecast ability is the highest even with respect to trade volumes.

5.2 The Aggregate Effect of Tariffs

The hallmark of quantitative trade models is to assess the economic consequences of trade policies, such as the effect of trade policy on the terms of trade or welfare. Measuring welfare requires strong assumptions on the demand and supply side of the domestic economy and is beyond the scope of this paper. Nevertheless, our estimated model can yield predictions for tariff incidence on aggregate import prices, a key metric of a country's terms of trade and welfare.

We extend our partial equilibrium framework to define a price index for imported goods. We assume a homothetic demand for imported goods, so that we can compute the first-order approximated change in the import price index as a weighted aggregate of bilateral price changes:

$$\Delta \ln P_F = \sum_{h,i,j} \psi_{ij}^h \widehat{\Delta \ln p_{ij}^h}, \tag{5.3}$$

where ψ_{ij}^h is the share of the transaction involving $i - j$ match and product h over total U.S. imports, and where the terms $\widehat{\Delta \ln p_{ij}^h}$ are the model-implied price changes due the tariff shock computed as in equation (5.1).

Table 6: Aggregate Pass-through Under Counterfactual Scenarios

Model	Description	Bargaining	Import Market Power	$\Delta \ln P_F$
(1)	Two-Sided Market Power	Yes	Yes	0.045
(2)	No Import Market Power	Yes	No	0.123
(3)	No Bargaining	No	Yes	0.035
(4)	No Import Market Power & No Bargaining	No	No	0.098

Notes: This Table reports the model-implied changes in aggregate import prices computed from equation (5.3). Row (1) reports the change in aggregate import price in our estimated model. Row (2) reports the estimate from a model where we counterfactually set $\theta = 1$ to mute import market power. Row (3) sets $\phi = 0$ to mute bilateral bargaining while imposing price-taking importers. Row (4) sets $\theta = 1$ and $\phi = 0$ at the same time.

Table 6 shows that our estimated model attributes a 4.5 percent increase in the import price index to the recent trade war. The weighted average tariff change during the trade war period was 12 percent in our sample.[23] A simple back-of-the-envelope calculation thus reveals that the aggregate tariff pass-through on U.S. import prices was about 38 percent, suggesting that most of the incidence of Trump tariffs fell onto foreign exporters.

To explore the sources of incomplete aggregate pass-through, Row (2) to (4) show the counterfactual change in aggregate prices when shutting down the two critical channels focus of this paper: bargaining and import market power. Row (2) sets $\phi = 0$ to mute bilateral bargaining; Row (3) sets $\theta = 1$ to mute import market power; Row (4) mutes both channels at the same time.

Without import market power, and hence the terms-of-trade channel, the aggregate price change is 12.3 percent, corresponding to complete pass-through. Without bargaining, import prices would increase by 3.5 percentage points, the aggregate pass-through being 30 percent. Finally, a model that imposes price-setting exporters and no import market power would expect an aggregate price change of almost 10 percent, with an aggregate pass-through of 83 percent.

Table 6 suggests that import market power is quantitatively essential to understand the aggregate incidence of tariffs. Abstracting from it leads to overshooting tariff pass-through on aggregate import prices by about 60 percent, or eight percentage points. At the same time, ignoring the U.S. importers' high bargaining power would lead to underestimating the aggregate tariff pass-through by 8 percent, or one percentage point.

Reduced-Form vs. Structural Pass-Through. The estimated model indicates that the aggregate pass-through of Trump tariffs was largely incomplete, at 38 percent. This result is

[23]The average statutory tariff rate increased from 2.6 percent to 16.6 percent. In our data, the weighted average tariff increase across $i-j$ matches between 2017 and 2019 is 12 percent. Source: USITC and authors' calculations.

at odds with the almost complete pass-through implied by the reduced-form exercise of Table 3 in Section 3.4. At the same time, Table 6 indicates that a full pass-through is obtained in a model without import market power, or $\theta = 1$, seemingly indicating that a simple bargaining model with $\theta = 1$ could rationalize the reduced-form result.

However, the analysis in this paper has demonstrated that this conclusion is inaccurate, inasmuch that both bargaining and import market power are essential for understanding price patterns. The cross-sectional reduced-form patterns in Tables 2 and 3 can only be rationalized by a model where bargaining power and market power is two-sided. The exercise in Table 5 leverages time-series variation to show that models that abstract from two-sided market power are consistently rejected in the data. Moreover, we discussed earlier that while the reduced-form exercise in Section 3.4 shows evidence consistent with the theoretical predictions, one should take caution in trying to interpret the reduced-form estimates structurally.

One potential explanation for the substantial discrepancy between the reduced-form and the structural estimate of pass-through is that the former may, in part, absorb movements in the exporters' marginal costs into the fixed effects. The reason is that when import market power is shut down, so are the endogenous responses of the exporter's marginal cost to changes in tariffs, via the terms-of-trade channel. The reduced-form specification (2.15) includes exporter and product-year fixed effects. Insofar as the bulk of changes in marginal cost happens at the product-year level, these high-dimensional fixed effects may sweep away a substantial portion of price variation due to the terms-of-trade channel. The results in Table 6 show that muting import market power would substantially inflate the pass-through elasticity.

Policy Implications. We conclude with a brief discussion of the implications of our study for policy. Our theory shows that the tariff pass-through varies substantially across matches, and depends on the characteristics of the trade relationship. This observation alone is directly relevant for policymakers, especially in light of the growing popularity of policies targeting individual firms.[24] Our study has also implications for policymakers interested in maximizing the welfare impact of tariffs. Conventional trade theories suggest that a country should impose import tariffs in response to its import market power (Broda et al., 2008). Our theory extends these insights to trade in GVCs, suggesting that the welfare effect of tariffs is maximized in industries where import market power is high, yet the importers' bargaining power is low.

[24] A recent example of policy targeted to individual firms is the 292 percent tariff imposed by the United States on a particular jet produced by the Canadian Bombardier.

6 Conclusions

A key aspect of GVCs is that importers and exporters have market power and negotiate bilaterally over transaction prices. This paper explores the implications of these features of GVCs for international prices and tariff incidence while contributing a quantitative theory of prices in firm-to-firm trade and novel empirical evidence from U.S. import data. Using a combination of reduced-form and structural methods, we show compelling evidence that the high import market power and bargaining power of U.S. importers are critical to understanding the incidence of the recent trade war on the U.S. economy.

In particular, our study suggests that the aggregate pass-through of Trump tariffs may be lower than previously thought, due to the substantial market power of U.S. importers, which implies substantial cost (and price) reductions following a trade shock. Traditional reduced-form approaches to estimating pass-through might miss similar terms-of-trade gains by partially absorbing them into high-dimensional fixed effects. Our results indicate that a structural model might also help understanding tariff incidence.

Our theory has important implications for questions beyond the pass-through of trade shocks. In related work, we show how bargaining and two-sided market power affect the relationship between industry concentration and aggregate markups, with implications for the impact of globalization on global market power (Alviarez et al., 2022). Our theory could also shed light on the relationship between prices, trade volumes, and taxes in an interconnected world economy. For instance, it could gauge the inflationary effects of a Russian gas embargo (Bachmann et al., 2022). Lastly, one could use our theory to study the impact of competition shocks in one country on a competitor country's terms of trade, a relevant question for gauging the scope for international cooperation over competition policy (Gaubert et al., 2021). Examining these questions in connection to two-sided market power may be promising avenues for future research.

References

Acemoglu, D., Carvalho, V. M., Ozdaglar, A., and Tahbaz-Salehi, A. (2012). The Network Origins of Aggregate Fluctuations. *Econometrica*, 80(5):1977–2016.

Acemoglu, D. and Tahbaz-Salehi, A. (2020). Firms, Failures, and Fluctuations. *NBER Working Paper, w27565*, (November).

Adão, R., Donaldson, D., and Costinot, A. (2022). Putting Quantitative Trade Models to the Test: Evidence from the Trump Tariffs. *mimeo*.

Alviarez, V., Fioretti, M., Kikkawa, K., and Morlacco, M. (2022). Concentration and markups in international trade. *mimeo*.

Alviarez, V., Handley, K., and Ho, S.-J. (2019). The employment effects of multinational corporations. *mimeo*.

Amiti, M., Itskhoki, O., and Konings, J. (2014). Importers, exporters, and exchange rate disconnect. *The American Economic Review*, 104(7):1942–1978.

Amiti, M., Redding, S. J., and Weinstein, D. E. (2019). The impact of the 2018 tariffs on prices and welfare. *Journal of Economic Perspectives*, 33(4):187–210.

Anderson, J. E. and van Wincoop, E. (2004). Trade Costs. *Journal of Economic Literature*, 42(3):691–751.

Antràs, P. (2020). Conceptual aspects of global value chains. *The World Bank Economic Review*.

Antràs, P. and Chor, D. (2013). Organizing the global value chain. *Econometrica*, 81(6):2127–2204.

Antràs, P. and Staiger, R. W. (2012). Offshoring and the role of trade agreements. *American Economic Review*, 102(7):3140–83.

Atkeson, A. and Burstein, A. (2008). Trade Costs, Pricing to Market, and International Relative Prices. *American Economic Review*, 98(5):1998–2031.

Auer, R. A. and Schoenle, R. S. (2016). Market structure and exchange rate pass-through. *Journal of International Economics*, 98:60–77.

Bachmann, R., Baqaee, D., Bayer, C., Kuhn, M., Löschel, A., Moll, B., Peichl, A., Pittel, K., Schularick, M., et al. (2022). What if? the economic effects for germany of a stop of energy imports from russia. *ECONtribute Policy Brief*, 28:2022.

Barrot, J. N. and Sauvagnat, J. (2016). Input Specificity and the Propagation of Idiosyncratic Shocks in Production. *Quarterly Journal of Economics*, 131(3):1543 – 1592.

Berman, N., Martin, P., and Mayer, T. (2012). How do different exporters react to exchange rate changes? *The Quarterly Journal of Economics*, 127(1):437–492.

Bernard, A. B., Dhyne, E., Magerman, G., Manova, K., and Moxnes, A. (2022). The origins of firm heterogeneity: A production network approach. *Journal of Political Economy*, 130(7):1765–1804.

Bernard, A. B., Jensen, J. B., Redding, S. J., and Schott, P. K. (2007). Firms in international trade. *Journal of Economic Perspectives*, 21(3):105–130.

Bernard, A. B., Moxnes, A., and Saito, Y. U. (2019). Production networks, geography, and firm performance. *Journal of Political Economy*, 127(2):639–688.

Boehm, C. E., Flaaen, A., and Pandalai-Nayar, N. (2019). Input linkages and the transmission of shocks: Firm-level evidence from the 2011 tōhoku earthquake. *Review of Economics and Statistics*, 101(1):60–75.

Broda, C., Limao, N., and Weinstein, D. E. (2008). Optimal tariffs and market power: the evidence. *American Economic Review*, 98(5):2032–65.

Broda, C. and Weinstein, D. E. (2006). Globalization and the Gains from Variety. *The Quarterly Journal of Economics*, 121(2):541–585.

Burstein, A. and Gopinath, G. (2014). International prices and exchange rates. *Handbook of International Economics*, 4:391.

Carvalho, V. M., Nirei, M., Saito, Y. U., and Tahbaz-Salehi, A. (2021). Supply chain disruptions: Evidence from the great east japan earthquake. *The Quarterly Journal of Economics*, 136(2):1255–1321.

Cavallo, A., Gopinath, G., Neiman, B., and Tang, J. (2020). Tariff passthrough at the border and at the store: evidence from us trade policy. *American Economic Review: Insights*.

Chipty, T. and Snyder, C. M. (1999). The role of firm size in bilateral bargaining: A study of the cable television industry. *Review of Economics and Statistics*, 81(2):326–340.

Crawford, G. S. and Yurukoglu, A. (2012). The welfare effects of bundling in multichannel television markets. *American Economic Review*, 102(2):643–85.

Dhyne, E., Kikkawa, A. K., and Magerman, G. (2022). Imperfect competition in firm-to-firm trade. *Journal of the European Economic Association*.

Di Giovanni, J., Levchenko, A. A., and Mejean, I. (2014). Firms, Destinations, and Aggregate Fluctuations. *Econometrica*, 82(4):1303–1340.

Draganska, M., Klapper, D., and Villas-Boas, S. B. (2010). A larger slice or a larger pie? an empirical investigation of bargaining power in the distribution channel. *Marketing Science*, 29(1):57–74.

Eaton, J., Eslava, M., Jinkins, D., Krizan, C., Kugler, M., and Tybout, J. (2012). A search and learning model of export dynamics. *Mimeo, Penn State University*.

Edmond, C., Midrigan, V., and Xu, D. Y. (2018). How Costly Are Markups? *NBER Working Paper, w24800*.

Eldridge, L. and Powers, S. (2018). Imported Inputs to U.S. Production and Productivity: Two decades of Evidence. *BLS Working Papers.*

Fajgelbaum, P. D., Goldberg, P. K., Kennedy, P. J., and Khandelwal, A. K. (2020). The return to protectionism. *The Quarterly Journal of Economics*, 135(1):1–55.

Flaaen, A. B., Hortaçsu, A., and Tintelnot, F. (2020). The production relocation and price effects of us trade policy: the case of washing machines. *American Economic Review.*

Fontaine, F., Martin, J., and Mejean, I. (2020). Price Discrimination Within and Across EMU Markets: Evidence from French Exporters. *Journal of International Economics.*

Fontaine, F., Martin, J., and Mejean, I. (2022). Frictions and adjustments in firm-to-firm trade. *mimeo.*

Gaubert, C. and Itskhoki, O. (2021). Granular comparative advantage. *Journal of Political Economy*, 129(3):871–939.

Gaubert, C., Itskhoki, O., and Vogler, M. (2021). Government policies in a granular global economy. *Journal of Monetary Economics*, 121:95–112.

Goldberg, L. S. and Tille, C. (2013). A bargaining theory of trade invoicing and pricing. *NBER Working Paper, w18985.*

Goldberg, P. K. and Hellerstein, R. (2008). A structural approach to explaining incomplete exchange-rate pass-through and pricing-to-market. *American Economic Review*, 98(2):423–29.

Gopinath, G. and Itskhoki, O. (2011). In search of real rigidities. *NBER Macroeconomics Annual*, 25(1):261–310.

Grassi, B. (2018). IO in I-O : Competition and Volatility in Input-Output Networks. *mimeo.*

Grennan, M. (2013). Price discrimination and bargaining: Empirical evidence from medical devices. *American Economic Review*, 103(1):145–77.

Grossman, G. M. and Helpman, E. (2020). When tariffs disturb global supply chains. *NBER Working Paper, w27722.*

Heise, S. (2019). Firm-to-firm relationships and price rigidity theory and evidence. *mimeo.*

Horn, H. and Wolinsky, A. (1988). Bilateral Monopolies and Incentives for Merger Author. *RAND Journal of Economics*, 19(3):408–419.

Huang, H., Manova, K., and Pisch, F. (2021). Firm heterogeneity and imperfect competition in global production networks. *mimeo.*

Johnson, H. G. (1953). Optimum tariffs and retaliation. *The Review of Economic Studies*, 21(2):142–153.

Kamal, F. and Krizan, C. (2013). Decomposing aggregate trade flows: New evidence from u.s. traders. *Working paper, Center for Economics Studies, U.S. Census Bureau.*

Kamal, F. and Monarch, R. (2018). Identifying foreign suppliers in u.s. import data. *Review of International Economics*, 26(1):117–139.

Kamal, F. and Sundaram, A. (2012). Buyer-seller relationships in international trade: Do your neighbors matter. *Mimeo, Center for Economics Studies, U.S. Census Bureau.*

Lee, R. S. and Fong, K. (2013). Markov-Perfect Network Formation: An Applied Framework for Bilateral Oligopoly and Bargaining in Buyer-Seller Networks. *mimeo.*

Magerman, G., De Bruyne, K., Dhyne, E., and Van Hove (2016). Heterogeneous firms and the micro origins of aggregate fluctuations. *National Bank of Belgium Working Paper Series*, (312).

Martin, J., Mejean, I., and Parenti, M. (2020). Relationship stickiness and economic uncertainty. *mimeo.*

Monarch, R. (2022). ''it's not you, it's me": Prices, quality, and switching in us-china trade relationships. *Review of Economics and Statistics*, 104(5):909–928.

Morlacco, M. (2019). Market Power in Input Markets : Theory and Evidence from French Manufacturing. *mimeo.*

Pierce, J. R. and Schott, P. K. (2009). A concordance between ten-digit u.s. harmonized system codes and sic/naics product classes and industries. *NBER Working Paper, 15548.*

Rauch, J. E. (1999). Networks versus markets in international trade. *Journal of International Economics*, 48:7–35.

UNCTAD, O. W. (2013). Implications of global value chains for trade, investment, development and jobs. *Joint report of the OECD, WTO, UNCTAD for G20 Leaders' Summit*, 6.

A Additional Tables and Figures

Table A.1: Fixed-Effect Decomposition of Price Dispersion

	(1)	(2)
Panel A. Overall price dispersion		
Controls		-0.0006
$FE_h + FE_t$	0.5190	0.5200
FE_i	0.3360	0.3360
FE_j	0.0630	0.0628
Match residual	0.0818	0.0818
Panel B. Within exporter-product dispersion		
Controls		0.001
FE_j	0.115	0.115
Match residual	0.885	0.884

Notes: The table reports the results of a statistical decomposition exercise based on OLS regressions on the following estimating equation:

$$\ln p^h_{ijt} = FE_i + FE_j + FE_{ht} + \beta \boldsymbol{X}^h_{ijt} + \varepsilon^h_{ijt}$$

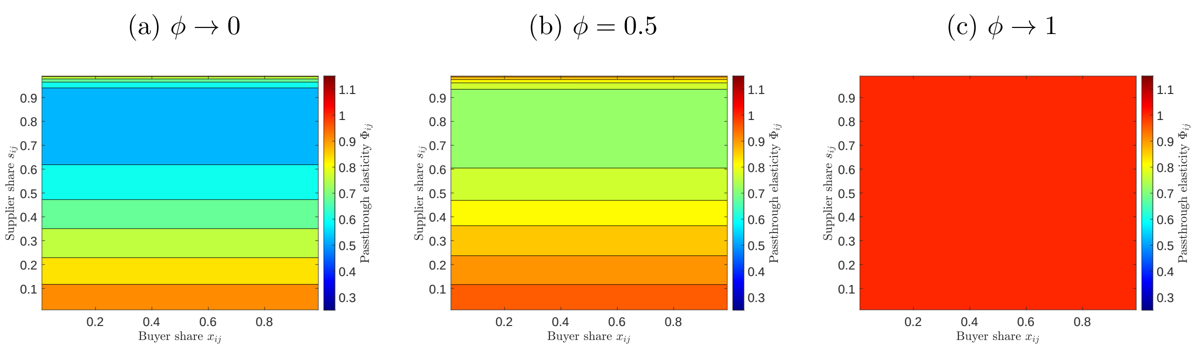
over the period 2001-2016. Controls used in Column (2) include the value of the transaction, the longevity of the relationship measured by the number of years since the exporter serves the importer with a given HS10 product, and the relative network of the exporter and importer, measured as the ratio of the number of importers the exporters supplies to, and the number of exporters the importers source from within a given HS10 product. Number of observations: 9,568,000; R^2 : 0.92.

Table A.2: Pass-Through and Bilateral Concentration with Duty-Inclusive Prices

Dependent Variable: $\Delta \ln p^h_{ijt}$	OLS					
	(1)	(2)	(3)	(4)	(5)	(6)
$\Delta \ln(1+\tau^h_{c(j)t})$	-0.0024	-0.0243	0.0327	0.0206	0.022	0.0181
	[0.0358]	[0.0370]	[0.0406]	[0.0403]	[0.0403]	[0.0512]
$\Delta \ln(1+\tau^h_{c(j)t}) \cdot s^h_{ijt-1}$		0.183		0.187	0.185	-0.0116
		[0.0573]		[0.0717]	[0.0726]	[0.102]
$\Delta \ln(1+\tau^h_{c(j)t}) \cdot x^h_{ijt-1}$			-0.120	-0.152	-0.150	-0.0241
			[0.0374]	[0.0427]	[0.0423]	[0.0408]
$\Delta \ln(1+\tau^h_{c(j)t}) \cdot 1\{diff_h\}$						-0.0159
						[0.0647]
$\Delta \ln(1+\tau^h_{c(j)t}) \cdot s^h_{ijt-1} \cdot 1\{diff_h\}$						0.274
						[0.171]
$\Delta \ln(1+\tau^h_{c(j)t}) \cdot x^h_{ijt-1} \cdot 1\{diff_h\}$						-0.171
						[0.0636]
Price changes at other links ($\Delta \ln q^h_{i(-j)t}$)	No	No	No	No	Yes	No
Quantity changes at other links ($\Delta \ln p^h_{(-i)jt}$)	No	No	No	No	Yes	No
$FE_{c(i)t} + FE_{ht} + FE_{jt} + FE_i$	Yes	Yes	Yes	Yes	Yes	Yes
Observations	613,000	613,000	613,000	613,000	613,000	613,000
R-squared	0.25	0.25	0.25	0.25	0.25	0.25

Notes: The Table reports the response of prices to changes in import tariffs during the period 2017-2019. The dependent variable is the after-duty unit prices. All regressions control for the number of years the firm-pair relationship has last (longevity of the relationship). Lagged supplier share is added as a control in Columns (2), (4)-(6), and lagged buyer share is added as a control in Columns (3)-(6). Column (5) additionally controls for the change in the quantities that exporter i sells to other importers but j, $\Delta \ln q^h_{i(-j)t}$; and the weighted average of the change in prices of other exporters to firm j, $\Delta \ln p^h_{(-i)jt} = \sum_{k \neq i} s^h_{kj(t-1)} \Delta \ln p^h_{kjt}$, with weights given by the relative importance of other exporters $(-i)$ in j's imports of product h at the beginning of the period, $s^h_{kj(t-1)}$. Standard errors are clustered by country and product.

Figure A.2: Pass-Through Elasticities when $\theta = 1$: Comparative Statics

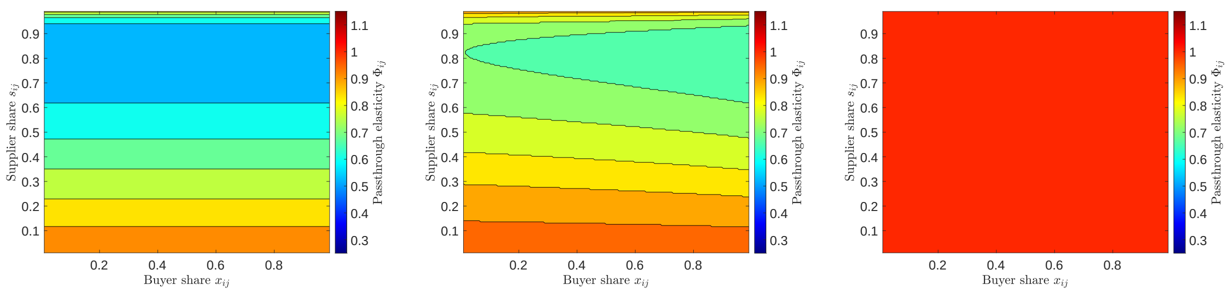


Notes: The figure displays the theory-implied values of the pass-through elasticity Φ_{ij} as a function of the two bilateral shares s_{ij} and x_{ij} and the importer's bargaining power ϕ. Panel (a) sets the importer's bargaining parameter equal to $\phi = 0$; Panel (b) sets it to $\phi = 0.5$; Panel (c) sets it to $\phi = 1$. For the other parameters, we use $\gamma = 0.5$, $\rho = 10$, $\nu = 4$, and $\theta = 0.56$.

Figure A.1: Pass-Through Elasticities: Channels

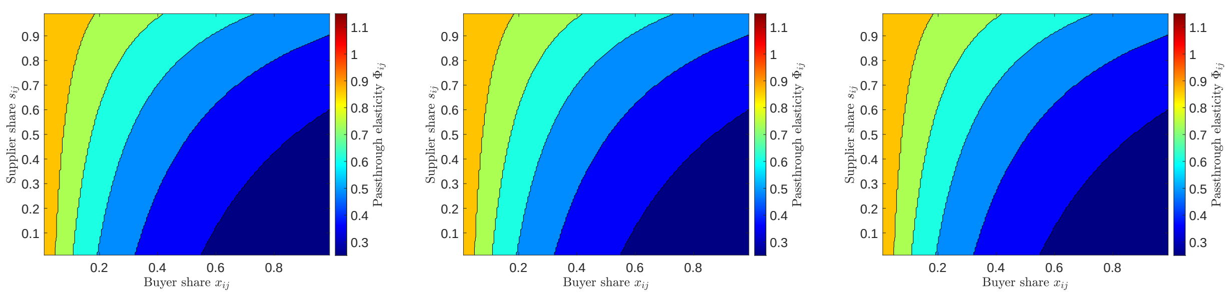
Strategic Complementarity Channel

(a) $\phi \to 0$ (b) $\phi = 0.5$ (c) $\phi \to 1$



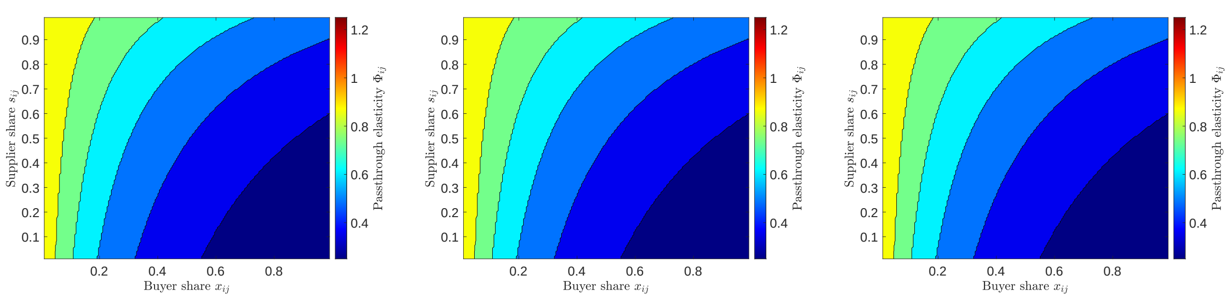
Strategic Substitutability Channel

(d) $\phi \to 0$ (e) $\phi = 0.5$ (f) $\phi \to 1$



Terms-of-Trade Channel

(g) $\phi \to 0$ (h) $\phi = 0.5$ (i) $\phi \to 1$



Notes: The figure displays the degree of price pass-through, Φ_{ij}, as a function of the two bilateral shares s_{ij} and x_{ij} and the importer's bargaining power ϕ. For other parameters, we use $\gamma = 0.5$, $\rho = 10$, $\nu = 4$, and $\theta = 0.7$. The top three panels focuses on the strategic complementarity channel, defined as $\Phi^{SC} \equiv \frac{1}{1+\Gamma^{s}_{ij}(\rho-1)(1-s_{ij})}$; the second row shows the strategic substitutability channel, defined as $\Phi^{SS}_{ij} \equiv \frac{1}{1+\Gamma^{x}_{ij}\varepsilon_{ij}(1-x_{ij})}$, while the third row plots the terms-of-trade channel, defined as $\Phi^{TT}_{ij} \equiv \frac{1}{1+\frac{1-\theta}{\theta}x_{ij}\varepsilon_{ij}}$. The overall pass-through of a cost shock into the import price can be approximated as $\Phi_{ij} \simeq \Phi^{SC}_{ij} \cdot \Phi^{SS}_{ij} \cdot \Phi^{TT}_{ij}$.

B Theory Appendix

B.1 Derivation of Equation (2.10)

Here we outline the derivation of equation (2.10). We solve for the first-order conditions of (2.4) by first listing each of its four elements $\left\{\pi_i, \pi_j, \tilde{\pi}_{i(-j)}, \tilde{\pi}_{j(-i)}\right\}$, and then taking derivatives with respect to p_{ij}.

Profits of firm i Firm i's profit under a successful negotiation can be expressed as

$$\pi_i = p_{ij}q_{ij} + \sum_{k \neq j} p_{ik}q_{ik} - \theta c_i q_i,$$

while the outside profit of firm i can be expressed as

$$\tilde{\pi}_{i(-j)} = \sum_{k \neq j} p_{ik}q_{ik} - \theta \tilde{c}_i \sum_{k \neq j} q_{ik},$$

where the marginal cost upon a failed negotiation, $\tilde{c}_i$, can be obtained as follows, from equation (2.3):

$$\tilde{c}_i = c_i \left(1 - x_{ij}\right)^{\frac{1-\theta}{\theta}}.$$

Therefore, the gains from trade for exporter i, that is, $GFT_i\left(p_{ij}\right) \equiv \pi_i - \tilde{\pi}_{i(-j)}$, can then be expressed as

$$\begin{aligned} GFT_i\left(p_{ij}\right) := \pi_i - \tilde{\pi}_{i(-j)} =& p_{ij}q_{ij} - \theta c_i q_i \left[1 - \left(1 - x_{ij}\right)^{\frac{1}{\theta}}\right] \\ =& p_{ij}q_{ij} - \theta c_i q_{ij} \left[\frac{1 - \left(1 - x_{ij}\right)^{\frac{1}{\theta}}}{x_{ij}}\right] \\ =& q_{ij}\left(p_{ij} - c_i \mu_{ij}^{oligopsony}\right), \end{aligned}$$

where $\mu_{ij}^{oligopsony} \equiv \theta \left(\frac{1-(1-x_{ij})^{\frac{1}{\theta}}}{x_{ij}}\right)$.

The derivative of the profit π_i with respect to p_{ij} is

$$\frac{d\pi_i}{dp_{ij}} = q_{ij}\left(1 - \varepsilon_{ij} + \varepsilon_{ij}\frac{1}{p_{ij}}c_i\right).$$

Profits of Firm j Firm j's profit under a successful negotiation can be expressed as

$$\begin{aligned}\pi_j &= (p_j - c_j)q_j, \\ &= (\mu_j - 1)\, c_j^{1-\nu} \mu_j^{-\nu} D_j\end{aligned}$$

where D_j is the exogenous demand shifter firm j faces. The derivative of this profit with respect to p_{ij} is

$$\frac{d\pi_j}{dp_{ij}} = (1-\nu)\,(\mu_j - 1)\, q_{ij}.$$

The outside profit of firm j under a failed negotiation is

$$\tilde{\pi}_{j(-i)} = (\mu_j - 1)\, \tilde{c}_j^{1-\nu} \mu_j^{-\nu} D_j,$$

where firm j's marginal cost under a failed negotiation, $\tilde{c}_j$, is expressed as

$$\tilde{c}_j = c_j \,(1 - s_{ij})^{\frac{\gamma}{1-\rho}}\,.$$

Therefore, the gains from trade for importer j, that is, $GFT_j\,(p_{ij}) \equiv \pi_j - \tilde{\pi}_{j(-i)}$, can be expressed as

$$GFT_j(p_{ij}) := \pi_j - \tilde{\pi}_{j(-i)} = (\mu_j - 1)\, c_j q_j \left[1 - (1 - s_{ij})^{\frac{1-\nu}{1-\rho}\gamma}\right].$$

First Order Conditions We now solve for the first-order conditions. Note that the two outside profits $\tilde{\pi}_{i(-j)}$ and $\tilde{\pi}_{j(-i)}$ do not depend on the price p_{ij}, hence we treat them as constants. Hence,

$$\begin{aligned}FOC = 0 =& \frac{d}{dp_{ij}} \left(\pi_i - \tilde{\pi}_{i(-j)}\right)^{1-\phi} \left(\pi_j - \tilde{\pi}_{j(-i)}\right)^{\phi} \\ 0 =& \frac{d\pi_i}{dp_{ij}} + \bar{\phi}\left(\pi_i - \tilde{\pi}_{i(-j)}\right) \left(\pi_j - \tilde{\pi}_{j(-i)}\right)^{-1} \frac{d\pi_j}{dp_{ij}}.\end{aligned}$$

Plugging in the terms calculated above, we obtain the following price equation:

$$p_{ij} = \left((1 - \omega_{ij})\, \frac{\varepsilon_{ij}}{\varepsilon_{ij} - 1} + \omega_{ij} \mu_{ij}^{oligopsony} \right) c_i,$$

where

$$\omega_{ij} = \frac{\bar{\phi}\lambda_{ij}}{\bar{\phi}\lambda_{ij}+1}$$
$$\lambda_{ij} = \frac{\nu-1}{\varepsilon_{ij}-1}\cdot\frac{\gamma s_{ij}}{\Delta^s_{ij}},$$

where $\Delta^s_{ij} \equiv \left(1-(1-s_{ij})^{\frac{\gamma(1-\nu)}{1-\rho}}\right)$ is a factor determining the gains from trade for importer j.

B.2 Quantity Bargaining

In Section 2 we characterized the pricing equation under which firms bargain over prices. Here we characterize the analogous pricing equation when firms bargain over quantities. Instead of (2.4), we now have the following Nash bargaining problem

$$\max_{q_{ij}} \left(\pi_i - \tilde{\pi}_{i(-j)}\right)^{\phi} \left(\pi_j - \tilde{\pi}_{j(-i)}\right)^{1-\phi}.$$

As in Section 2.1, we solve for the first-order conditions taking as given firm i's unit cost c_i. We obtain the following optimal price:

$$p_{ij} = \left(\left(1-\omega^q_{ij}\right)\frac{\varepsilon^q_{ij}}{\varepsilon^q_{ij}-1} + \omega^q_{ij}\mu^{oligopsony}_{ij}\right)c_i,$$

where the term ω^q_{ij} is the effective importer's relative bargaining power in this model:

$$\omega^q_{ij} \equiv \frac{\frac{1}{\nu}\bar{\phi}\lambda^q_{ij}}{\frac{1}{\nu}\bar{\phi}\lambda^q_{ij}+1} \in (0,1),$$

with $\lambda^q_{ij} = \frac{\varepsilon^q_{ij}}{\varepsilon^q_{ij}-1}\frac{s_{ij}(\tilde{\nu}-1)}{1-\hat{\pi}_{j(-i)}}$ and $\left(\varepsilon^q_{ij}\right)^{-1} = \frac{1}{\rho}\left(1-s_{ij}\right) + \left(1-\gamma+\frac{1}{\nu}\gamma\right)s_{ij}$. The price above has a similar structure as in equation (2.10). It is a weighted average between a standard oligopoly (Cournot) markup, $\frac{\varepsilon^q_{ij}}{\varepsilon^q_{ij}-1}$, and the markup term $\mu^{oligopsony}_{ij}$. The oligopoly markup depends in this case on the elasticity ε^q_{ij}, which is a harmonic weighted average of elasticities ν and ρ as in Atkeson and Burstein (2008).

B.3 Weighting Factor ω_{ij}

We now explore the overall effect of the share s_{ij} on the weighting factor ω_{ij}. First, we find that:

$$\begin{aligned}
\lim_{s_{ij}\to 0} \lambda_{ij} &= \lim_{s_{ij}\to 0} \frac{\nu-1}{\varepsilon_{ij}-1} \cdot \frac{\gamma s_{ij}}{\Delta_{ij}^{s}} \\
&= \frac{\nu-1}{\rho-1} \cdot \lim_{s_{ij}\to 0} \frac{\gamma s_{ij}}{\Delta_{ij}^{s}} \\
&= \frac{\nu-1}{\rho-1} \cdot \lim_{s_{ij}\to 0} \frac{\gamma}{\frac{\gamma(1-\nu)}{1-\rho}\left(1-s_{ij}\right)^{\frac{\gamma(1-\nu)}{1-\rho}-1}} \\
&= \frac{\nu-1}{\rho-1} \cdot \frac{1-\rho}{1-\nu} \\
&= 1.
\end{aligned}$$

Similarly,

$$\begin{aligned}
\lim_{s_{ij}\to 1} \lambda_{ij} &= \lim_{s_{ij}\to 1} \frac{\nu-1}{\varepsilon_{ij}-1} \cdot \frac{\gamma s_{ij}}{\Delta_{ij}^{s}} \\
&= \frac{\nu-1}{\gamma(\nu-1)} \cdot \lim_{s_{ij}\to 1} \frac{\gamma s_{ij}}{\Delta_{ij}^{s}} \\
&= \frac{1}{\gamma} \cdot \gamma \\
&= 1.
\end{aligned}$$

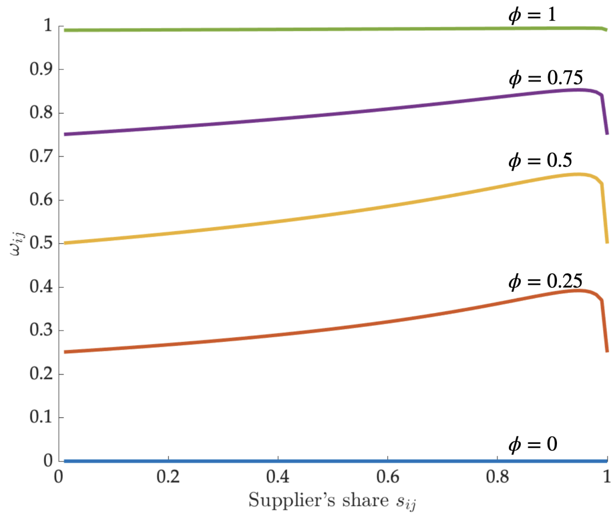
Hence, to a first order approximation around $s_{ij} \to 0$ and $s_{ij} \to 1$, the term λ_{ij} is equal to one such that the weighting factor ω_{ij} converges to ϕ.

The following figure plots ω_{ij} as a function of s_{ij} for different values of the bargaining parameter $\phi = \{0, 0.25, 0.5, 0.75, 1\}$. It shows that for intermediate levels of the exporter's supplier share, the term λ_{ij} is positive and acts as to reinforce the importer's bargaining weight. This effect is present only when ϕ is strictly between 0 and 1, hence when market power is bilateral.

B.4 Generalized Outside Option

Here we consider a model in which we impose less structure on the firms' outside options. In particular, we assume that in the case of a failed negotiation the total profit of the importer j decreases to ϱ_{ij}, and the exporter i's total cost changes to σ_{ij} in addition to the exporter i losing its sales to j. We let these factors that determine the outside options vary at the pair-level so that they can flexibly capture the value of renegotiating with other firms they

Figure B.1: Weighting Factor ω_{ij} : Sensitivity Analysis



Notes: The Figure plots the weighting factor $\omega_{ij} = \frac{\frac{\phi}{1-\phi}\lambda_{ij}}{\frac{\phi}{1-\phi}\lambda_{ij}+1}$ as a function of the exporter's supplier share s_{ij} for different values of the importer's bargaining power ϕ. For producing these graphs, we fixed the parameter vector $\{\rho, \gamma, \nu\} = \{10, 0.5, 4\}$, which are the same values we will use in estimation in Section 4.

already source from or sell to, or the value of additionally sourcing from or sell to firms that were previously not connected. As the term σ_{ij} also captures the degree of returns to scale in the technology of firm i, in this section we set $\theta = 1$. Under this generalized setup, we can write the changes in firm i and j's profits as follows:

$$\begin{aligned} \pi_i - \tilde{\pi}_{i(-j)} =& p_{ij}q_{ij} - c_i q_i + \sigma_{ij} \\ \pi_j - \tilde{\pi}_{j(-i)} =& \pi_j - \varrho_{ij}. \end{aligned}$$

The first order conditions under these changes in profits yield:

$$p_{ij} = \left(\underbrace{\frac{1}{\bar{\phi}\bar{\lambda}_{ij} + 1}}_{1-\bar{\omega}_{ij}} \frac{\varepsilon_{ij}}{\varepsilon_{ij} - 1} + \underbrace{\frac{\bar{\phi}\bar{\lambda}_{ij}}{\bar{\phi}\bar{\lambda}_{ij} + 1}}_{\bar{\omega}_{ij}} \frac{1}{x_{ij}} \left(1 - \frac{\sigma_{ij}}{c_i q_i}\right) \right) c_i,$$

where $\bar{\lambda}_{ij} = \frac{1}{\varepsilon_{ij}-1} \frac{(\tilde{\nu}-1)s_{ij}}{1-\frac{\varrho_{ij}}{\pi_j}}$. The equation above has the same structure as that of equation (2.10), with two differences. The first difference is in the weight term $\bar{\omega}_{ij}$. If the importer j's profit does not decrease as much upon a failed negotiation (high $\frac{\varrho_{ij}}{\pi_j}$)—perhaps due to the importer renegotiating with the other suppliers—then it would result in the importer having a larger bargaining power through a larger weight $\bar{\omega}_{ij}$. The second difference is in the markup when the importer has all the bargaining power, $\frac{1}{x_{ij}}\left(1-\frac{\sigma_{ij}}{c_i q_i}\right)$. To compare with equation (2.9)—its counterpart in Section 2.2—let us first consider the case where the technology of the supplier i exhibits constant returns to scale and where there are no renegotiations. Under this case, the reduction in firm i's total cost upon a failed negotiation (losing the importer j as a buyer), $1-\frac{\sigma_{ij}}{c_i q_i}$, would equal the share the buyer j accounts for in firm i's output, x_{ij}. Firm i would then have marginal cost pricing, as what equation (2.9) implies under $\theta = 1$. When firm i's technology exhibits decreasing returns, then the reduction in the total cost of firm i upon a failed negotiation, $1-\frac{\sigma_{ij}}{c_i q_i}$, would be larger than the importer j's buyer share, x_{ij}. In this case, the supplier charges a positive markup which is decreasing in the buyer share x_{ji}, as also implied by equation (2.9). Further, when there are renegotiations allowed, then that may further depress the total cost of firm i upon a failed negotiation with buyer j, σ_{ij}. Taken together, both terms ϱ_{ij} and σ_{ij} allow one to flexibly capture the outside options the two firms have in the bilateral relationship.

B.5 Efficient Bargaining

This section discusses an alternative configuration of the bargaining game between exporter i and importer j. We assume that upon matching, the firm-pair first chooses the quantity of the input to be exchanged that maximizes the joint surplus, then bargain over the price that determines how much share of the joint surplus each firm receives.

The revenue generated by the firm-pair can be summarized by the following function:

$$R(q_{ij}) = p_j q_j - \tilde{p}_j \tilde{q}_j,$$

where $p_j q_j$ is importer j's total sales to downstream buyers if firm j trades with firm i, while $\tilde{p}_j \tilde{q}_j$ is its total sales if the negotiations with firm i would fail. In both cases, we take as given the markup firm j charges on its output, μ_j, and the demand shifter it faces downstream. Thus, the term $R(q_{ij})$ captures the extra sales of firm j that are attributable to the match with exporter i. Similarly, the cost incurred by the firm-pair is given by the cost to produce firm i's good that are sold to firm j, which we can write as:

$$C(q_{ij}) = \theta c_i q_i - \theta \tilde{c}_i \tilde{q}_i.$$

The first term, $\theta c_i q_i$, denotes firm i's total cost of production and the second term, $\theta \tilde{c}_i \tilde{q}_i$, denotes its total cost of production when it is not matched with firm j.

Combining the above elements, the total surplus generated by the firm-pair can be written as $R(q_{ij}) - C(q_{ij})$. The quantity of the good traded by the firm-pair can be found as

$q_{ij} = \arg\max R(q_{ij}) - C(q_{ij})$. This efficient level of quantity traded, q_{ij}, is achieved when there is no double marginalization in the firm-pair, i.e., when firm i charges a price that is equal to its average cost of production. The total surplus consists of the profits firm j generates from its output markup μ_j that it charges in the downstream market. Once the efficient level of quantity q_{ij} is chosen, the two firms Nash bargain over the price of the good p_{ij} that dictates the division of the total surplus between the two firms. We assume that the price p_{ij} maximizes the following Nash product:

$$\max_{p_{ij}} \left(p_{ij}q_{ij} - C(q_{ij})\right)^{1-\phi} \left(R(q_{ij}) - p_{ij}q_{ij}\right)^{\phi},$$

where $\phi \in (0,1)$ denotes the importer's bargaining power and the functions $R(q_{ij})$ and $C(q_{ij})$ are both evaluated at the efficient quantity q_{ij}.

Standard derivations lead to the following expression for the equilibrium price

$$p_{ij} = (1-\phi)\frac{R(q_{ij})}{q_{ij}} + \phi\frac{C(q_{ij})}{q_{ij}},$$

which is written as the weighted average between the average importer's revenues downstream attributable to the match and the average exporter's costs attributable to the match. The weight equals to the firms' bargaining power. We then rewrite the above optimal price to express the optimal markup. In particular, we consider a bilateral markup over firm i's average cost, μ_{ij}^{AC}. Combining with the terms $R(q_{ij})$ and $C(q_{ij})$ evaluated at the efficient level of quantity, q_{ij}, we obtain the following markup over the average cost:

$$\mu_{ij}^{AC} = (1-\phi)\underbrace{\mu_j\frac{1}{\gamma}\frac{1-(1-s_{ij})^{\frac{1-\tilde{\nu}}{1-\rho}}}{s_{ij}}}_{\mu_{ij}^{R}} + \phi\underbrace{\frac{1-(1-x_{ij})^{\frac{1}{\theta}}}{x_{ij}}}_{\mu_{ij}^{C}}. \tag{B.1}$$

The markup over the average cost is expressed as the weighted average of two extreme case markups. The term μ_{ij}^{R} represents the bilateral markup when the supplier has all the bargaining power ($\phi \to 0$). When the supplier has all the bargaining power, all the total surplus of the firm-pair is taken by the supplier. Hence, the markup μ_{ij}^{R} is set so that it generates the efficient quantity q_{ij} while the buyer j does not charge any markup on its output (and does not receive any profits). Importantly, the markup is increasing in the supplier share s_{ij}, and is set so that the price moves along the average revenue curve. The term μ_{ij}^{C} represents the bilateral markup when the buyer has all the bargaining power ($\phi \to 1$). In this case, the buyer j extracts all the total surplus generated by the firm-pair. This markup μ_{ij}^{C} is decreasing in the buyer share x_{ij}, and is set so that the price moves along the average cost curve.

Given the markup in equation (B.1), we discuss additional restrictions on the parameters. We have already assumed $\rho > \tilde{\nu}$ in the main text, and this restriction guarantees that μ_{ij}^{R} is increasing in the supplier share s_{ij}. The lower bound of μ_{ij}^{R} is $\mu_j \frac{\nu-1}{\rho-1}$ and is realized when $s_{ij} \to 0$. To ensure that the supplier always charges a price above its average cost, one needs to impose a restriction of $\mu_j \frac{\nu-1}{\rho-1} > 1$. If firm j engages in monopolistic competition downstream and charges a markup of $\mu_j = \frac{\nu}{\nu-1}$, then the condition becomes $\nu > \rho - 1$. Finally, to ensure that the bilateral markup μ_{ij}^{AC} is decreasing in the bargaining parameter ϕ, one needs to additionally impose the following condition: $\theta\nu > \rho - 1$. Taken together, if one assumes that firm j engages in monopolistic competition downstream and that the condition of $\theta\nu + 1 > \rho > \tilde{\nu}$ holds, then the markup over average cost in an efficient bargaining protocol exhibits similar patterns with respect to the bilateral shares and the bargaining parameter to the markup considered in the main text: The bilateral markup increasing in the supplier share, decreasing in the buyer share, and decreasing in the bargaining parameter ϕ.

B.6 Pass-Through

B.6.1 Derivation of Proposition 2

Let's write the optimal (duty-inclusive) price setting equation as:

$$\ln p_{ij} = \ln \mu_{ij} + \ln c_i + \ln \vartheta_i,$$

where $\ln \mu_{ij} = \ln \mu(s_{ij}, x_{ij}; \boldsymbol{\beta})$. Taking a full log-differential yields:

$$d \ln p_{ij} = \Gamma_{ij}^{s} \cdot d \ln s_{ij} + \Gamma_{ij}^{x} d \ln x_{ij} + d \ln c_i + d \ln \vartheta_i,$$

where we defined as $\Gamma_{ij}^{s} \equiv \frac{d \ln \mu_{ij}}{d \ln s_{ij}^{f}}$ the partial elasticity of the bilateral markup with respect to the supplier share s_{ij}, and as $\Gamma_{ij}^{x} \equiv \frac{d \ln \mu_{ij}}{d \ln x_{ij}}$ the partial elasticity of the bilateral markup with respect to the buyer share x_{ij}. The pass-through elasticity of a shock $d \ln \vartheta_i$ is thus:

$$\Phi_{ij} \equiv \frac{d \ln p_{ij}}{d \ln \vartheta_i} = \Gamma_{ij}^{s} \cdot \frac{d \ln s_{ij}}{d \ln \vartheta_i} + \Gamma_{ij}^{x} \frac{d \ln x_{ij}}{d \ln \vartheta_i} + \frac{d \ln c_i}{d \ln \vartheta_i} + 1.$$

The different terms are derived as follows. First, it is easy to show that the elasticity of the exporter's supplier share s_{ij} with respect to the shock can be derived as

$$\frac{d \ln s_{ij}}{d \ln \vartheta_{ij}} = (1 - \rho) (1 - s_{ij}) \left[\frac{d \ln p_{ij}}{d \ln \vartheta_i} + \epsilon_{\cdot j} \right],$$

where $\epsilon_{\cdot j} \equiv \frac{d \ln p_{\cdot j}}{d \ln \vartheta_i}$ is the elasticity of competitors' sellers prices to the shock. The elasticity of the importer's buyer share x_{ij} is instead equal to

$$\frac{d \ln x_{ij}}{d \ln \vartheta_{ij}} = -(1 - x_{ij}) \left[\varepsilon_{ij} \frac{d \ln p_{ij}}{d \ln \vartheta_i} + \epsilon_{i\cdot} \right],$$

where $\epsilon_{i\cdot} \equiv \frac{d \ln q_{i-j}}{d \ln \vartheta_i}$ is the elasticity of competitors' buyers quantities to the shock.

Similarly, the marginal cost elasticity to the shock can be derived as:

$$\frac{d \ln c_i}{d \ln \vartheta_i} = \frac{d \ln c_i}{d \ln q_i} \frac{d \ln q_i}{d \ln \vartheta_i} = \frac{1 - \theta}{\theta} \left(-\varepsilon_{ij} x_{ij} \frac{d \ln p_{ij}}{d \ln \vartheta_i} + (1 - x_{ij}) \epsilon_{i\cdot} \right).$$

Given the markup equation in (2.10), and approximating $\omega_{ij} \simeq \omega$ as a constant, we can write

$$\Gamma_{ij}^{s} \equiv \frac{d \ln \mu_{ij}}{d \ln s_{ij}} = \frac{(1 - \omega) \mu_{ij}^{oligopoly}}{(1 - \omega) \cdot \mu_{ij}^{oligopoly} + \omega \cdot \mu_{ij}^{oligopsony}} \frac{d \ln \mu_{ij}^{oligopoly}}{d \ln s_{ij}}.$$

where

$$\frac{d \ln \mu_{ij}^{oligopoly}}{d \ln s_{ij}} = \frac{1}{\varepsilon_{ij} - 1} \frac{\rho - \varepsilon_{ij}}{\varepsilon_{ij}}$$

Now, $\varepsilon_{ij} = \rho (1 - s_{ij}) + \tilde{\nu} s_{ij}$, so:

$$\begin{aligned} \frac{d \ln \varepsilon_{ij}}{d \ln s_{ij}} &= \frac{d \ln \varepsilon_{ij}}{d s_{ij}} s_{ij} \\ &= \frac{\varepsilon_{ij} - \rho}{\varepsilon_{ij}}. \end{aligned}$$

Similarly, we find that:

$$\Gamma_{ij}^{x} \equiv \frac{d \ln \mu_{ij}}{d \ln x_{ij}} = \frac{\omega \mu_{ij}^{oligopsony}}{(1 - \omega) \cdot \mu_{ij}^{oligopoly} + \omega \cdot \mu_{ij}^{oligopsony}} \frac{d \ln \mu_{ij}^{oligopsony}}{d \ln x_{ij}}.$$

where

$$\frac{d \ln \mu_{ij}^{oligopsony}}{d \ln x_{ij}} = \frac{(1 - x_{ij})^{\frac{1}{\theta} - 1}}{\mu_{ij}^{oligopsony}} - 1.$$

B.6.2 Generalized Pass-Through Elasticity

The direct pass-through elasticity of equation (2.15) is obtained by assuming that quantities and prices of other nodes do not respond to the shock on the cost of firm i. In other words, we obtained equation (2.15) by turning off the indirect effects that operate through changes in other importers' demand and through changes in the supplier's overall scale. In this section we explore these indirect effects and consider a pass-through elasticity Ψ_{ij}, that incorporates both the direct and indirect effects.

The point of departure from the derivations in Appendix B.6.1 is where we derive the elasticity of the importer's buyer share, $\frac{d\ln x_{ij}}{d\ln\vartheta_i}$. Taking into account that the cost shock on firm i, ϑ_i, can affect quantities sold to other buyers through the price changes, we obtain

$$\begin{aligned}\frac{d\ln x_{ij}}{d\ln\vartheta_i} &= -\varepsilon_{ij}\left(1-x_{ij}\right)\frac{d\ln p_{ij}}{d\ln\vartheta_i} - \sum_{z\in\mathcal{J}_i,z\neq j} x_{iz}\frac{d\ln q_{iz}}{d\ln\vartheta_i} \\ &= -\varepsilon_{ij}\left(1-x_{ij}\right)\frac{d\ln p_{ij}}{d\ln\vartheta_i} + \sum_{z\in\mathcal{J}_i,z\neq j} x_{iz}\varepsilon_{iz}\frac{d\ln p_{iz}}{d\ln\vartheta_i}\end{aligned}$$

Using the above, we obtain the pass-through Ψ_{ij} that can be expressed as

$$\Psi_{ij} = \Phi_{ij} + \Phi_{ij}\left(\Gamma^x_{ij} - \frac{1-\theta}{\theta}\right)\sum_{z\in\mathcal{J}_i,z\neq j} x_{iz}\varepsilon_{iz}\frac{d\ln p_{iz}}{d\ln\vartheta_i}.$$

The final term in the above equation, $\frac{d\ln p_{iz}}{d\ln\vartheta_i}$, is the elasticity of the cost shock on the price of the $i-z$ pair, and can be replaced with Ψ_{iz}. Therefore, we obtain a system of equations that solve for the set of elasticities Ψ_{ij}, for each supplier i:

$$\Psi_{ij} = \Phi_{ij} + \Phi_{ij}\left(\Gamma^x_{ij} - \frac{1-\theta}{\theta}\right)\sum_{z\in\mathcal{J}_i,z\neq j} x_{iz}\varepsilon_{iz}\Psi_{iz}. \tag{B.2}$$

The first term in equation (B.2) captures the direct effect of the cost shock on the price of the pair of focus, as defined in equation (2.15). The second term captures the indirect effects through which the cost shock affects price p_{ij}. First, a cost shock on firm i will shift the price that firm i charges to another buyer z, p_{iz}. The magnitude of this effect is captured by Ψ_{iz}, which is to be solved for. The change in price p_{iz} will change the quantity sold, q_{iz}, which its magnitude captured by ε_{iz}. Then, the change in quantities will induce the change in buyer share x_{ij} (of which magnitude is captured by x_{iz}). This change in the buyer share x_{ij} will alter the price p_{ij}, both through the change in markup $\left(\Gamma^x_{ij}\right)$ and through the change in i's scale $\left(\frac{1-\theta}{\theta}\right)$. These additional shifts in the price p_{ij} work as additional cost shocks on firm i, hence the term Φ_{ij}.

C Data Appendix

C.1 Merging Foreign Exporter ID with ORBIS Data

The matching between ORBIS and LFTTD is possible since ORBIS contains names and addresses for the large majority of firms in the dataset, which we can use to construct the equivalent of the MID in the LFTTD. In this section we describe some of the instructions provided by the U.S. Census on how to construct the MID variable and then we provide an overview of the matching procedure.

The general procedure to construct an manufacturing ID using its name and address is as follows. The first two characters of the MID are the iso code of the country of origin of the goods, the only exception being Canada, for which each code corresponds to a Canadian Province. The next six characters of the MID are formed by the first three letters of the first and second words of the company name, or by the first three letters if the name of the company has a single word. The MID uses the first four numbers of the largest number on the street address line. Finally, the last three characters are formed by the first three alpha characters from the city name.[25]

The matching is conducted as follows. First, we match the name part of the MID in LFTTD with the name part in ORBIS. Second, we construct a location matching score for the MID based on an indicator variable which is equal to 1 if the city of the exporter as reported in LFTTD corresponds to the set of cities reported in ORBIS. Finally, we construct a product matching score based on an indicator variable which checks whether the NAICS6 industry classification in ORBIS corresponds to the HS6 code product recorded in the customs data, using the concordance developed by Pierce and Schott (2009). We drop from the sample all MIDs assigned to a firm in ORBIS whose location and product matching scores are less than 90 percent. We also drop from the matched data any firm in ORBIS with less than five transactions in total, to eliminate spurious exporters from the database.

The LFTTD MID variable has recently been used in academic research papers to identify

[25] Other general rules also apply. For example, english words such as "a," "an," "and," "the," and also hyphens are excluded from consideration in the company's name. Common prefixes such as "OOO," "OAO," "ISC," or "ZAO" in Russia, or "PT" in Indonesia, are also ignored for the purpose of constructing the MID. The next six characters of the MID are formed by the first three letters of the first and second words of the company name, or by the first three letters if the name of the company has a single word. In constructing the MID, all punctuation, such as commas, periods, apostrophes, as well as single character initials are to be ignored.

importer-exporter relationships (see Eaton et al., 2012; Kamal and Sundaram, 2012; Kamal and Krizan, 2013; Kamal and Monarch, 2018; Monarch, 2022). There are some challenges associated with its use, regarding the uniqueness and accuracy in the identification of foreign exporters. We can overcome some of those limitations since we can directly assess the uniqueness of the MID in our Census-ORBIS matched data. That is, we observe when a given MID corresponds to more than one company in ORBIS and we proceed to exclude these observation from the dataset unless these companies are part of the same corporation as measured by ORBIS ownership linkages. Another common concern in using MID as an identifier of foreign exporters is that, they can reflect intermediaries rather than the actual exporter.[26] Since we observe the NAICS code of the firms in ORBIS, we have excluded retailers and wholesalers from the matched Census-ORBIS dataset.

C.2 Related Party Trade Measured by ORBIS

One of the main advantages of the ORBIS dataset is the scope and accuracy of its ownership information: It details the full lists of direct and indirect subsidiaries and shareholders of each company in the dataset, along with a company's degree of independence, its global ultimate owner and other companies in the same corporate family. This information allows us to build linkages between affiliates of the same firm, including cases in which the affiliates and the parent are in different countries. We specify that a parent should own at least 50 percent of an affiliate to identify an ownership link between the two firms.

Merging U.S. Census and ORBIS datasets has been possible by matching the name and address of the U.S. based firms in the U.S Business Register and in ORBIS. This has been accomplished by applying the latest probabilistic record matching techniques and global position data (GPS), together with extensive manual checks, which has allowed us to achieve a large rate of successful matches. This dataset allows us to identify the U.S. firms and establishments that are part of a larger multinational operation—either majority-owned U.S. affiliates of foreign multinational firms or U.S. parent firms that have majority-owned operations overseas. Therefore, we can assess whether the trade transactions take place with parents or majority owned affiliates without relying in the related party trade indicator. The related party indicator may generate false-positives since the ownership threshold for related-party trade used in generating the indicator is 6 percent or higher for imports, well below the level required for majority ownership or that would confer sufficient control rights.

[26] The law requires the importer to declare the MID of the manufacturer exporter, not the intermediary, but complacency of this rule is hardly enforceable.

C.3 Sample Selection

To prepare the data for the analysis, we follow a three-steps procedure. First, we dropped transactions lacking critical information for the data analysis. Specifically, we drop transactions where: (i) the import value or quantity was zero or missing; (ii) the U.S. importer is not featured in the LBD dataset; (iii) the foreign exporter's manufacturing I.D. is considered 'invalid' since it either contains less than three characters or has a number as the first character; (iv) the importer and exporter belong to the same business group. We also exclude transactions involving H.S. chapters 98 and 99, referring to special classification provisions and temporary legislation, and in the energy sector (H.S. chapter 27). We also remove transactions whose unit values (transaction value over quantity shipped) lie below the 1st or above the 99th percentile of the price distribution of the associated HS10 product-country pair.

Second, we collapsed all transactions for a given buyer-seller-HS10 product within a given year. Even if customs data are recorded at the transaction level, we decided to collapse the information annually rather than monthly since the number of buyer-seller-HS10 triplets transacting in two consecutive months or the same month in two consecutive years is much smaller.

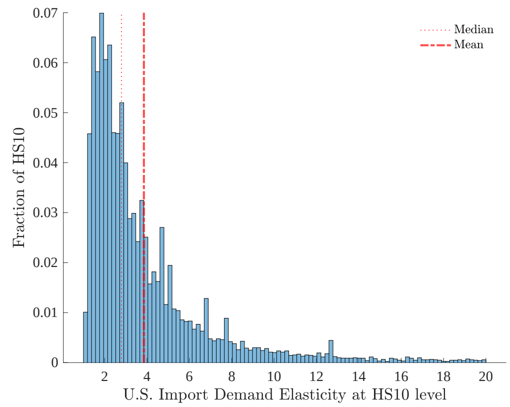
Our third and final cleaning step is needed for our estimation strategy. For the structural analysis in Section 4, we only keep buyer-seller-HS10 triplets that transact in two or more consecutive years, and we only consider sellers that transact a given HS10 product with multiple trade partners. The restriction of having numerous buyers per seller arises from the identification strategy we pursue to identify the model's parameters. Our final sample covers about 34 percent of U.S. imports. This number is primarily due to the exclusion of related-party trade, accounting for around 40 percent of U.S. imports. An additional 24 percent of imports are dropped by excluding non-consecutive buyer-seller-HS10 triplets, keeping sellers with multiple trading partners, and excluding the energy sector. The remaining restrictions affect a small share of imports.

D Estimation Appendix

D.1 Downstream Demand Elasticity (ν)

Let's consider a model where importer j sells its output q_j to downstream customers in different countries. A representative consumer in each country maximises utility by choosing a composite of domestic and imported goods. The sub-utility derived from the composite imported good will be given by a CES aggregation across imported varieties with a good-importer specific elasticity of substitution given by σ_g. Broda and Weinstein (2006) provide estimates of the elasticity σ_g at the HS10 good g-level in U.S. import data. The plot below shows the distribution of these elasticities. We base the calibration of the elasticity ν in our model on these estimates. We consider a value of 4 for ν, close to the mean value of 3.85, which we see as a conservative choice.

Figure D.1: Downstream Demand Elasticity



Notes: The figure displays the estimates of the import demand elasticity σ_g from Broda and Weinstein (2006). The mean and median value of σ_g^{US} is 3.85 and 2.8, respectively. Estimates are truncated above at 20, and below at 1.