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Two-Sided Market Power in Firm-to-Firm Trade*

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Abstract

Global value chains (GVCs) typically involve large firms exerting bargaining power over the terms of trade. We develop a novel theory of international prices accounting for these features of GVCs and illustrate their effect on the pass-through of trade shocks into import prices. We build a new dataset merging transaction-level U.S. import data with balance sheet data for both importers and exporters to evaluate the model's performance. Our estimated model generates more accurate predictions of pair-level price changes following trade shocks than standard models, improving the estimated impact of the 2018 trade war on aggregate U.S. import prices by 40-60%.

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1 Introduction

The recent wave of protectionist trade policies has spurred new interest in the tariff pass-through literature. The extent to which the incidence of import duties falls on domestic consumers depends crucially on what happens to import prices. In the case of the 2018 U.S.-China trade war, these effects were largely unanticipated: While conventional trade theory has long held that the tariffs applied by a large country should cause foreign firms to lower prices, this has been the case only in a few industries, such as steel, whereas the vast majority of sectors saw a near-complete tariff pass-through into import prices, ending in substantial welfare losses for U.S. consumers.¹ What explains these seemingly surprising and heterogeneous patterns? Was the trade war a special episode, or do traditional pricing frameworks miss relevant channels of trade shock transmission? As the uncertainty surrounding trade remains high, a reassessment of theories of tariff incidence becomes a priority for both economists and policymakers.

About 80% of international trade involves global value chains (GVCs) (UNCTAD, 2013). The prevalence of global production networks suggests that theories of international prices need to be built around the key characteristics of GVCs. Prominent among those is that intermediate input purchases involve significant “lock-in” effects, resulting in transaction prices between buyers and suppliers being bilaterally negotiated (Antras, 2015). Moreover, GVCs are dominated by large firms that shape, in part, aggregate trade patterns (Freund and Pierola, 2015; Gaubert and Itskhoki, 2020) and enjoy bargaining power over the terms of trade (Morlacco, 2019).

Despite their empirical relevance, little is known about the price and pass-through implications of two-sided concentration and market power in firm-to-firm trade. This paper contributes to bridging the gap between the theoretical and empirical trade literature with a tractable, partial equilibrium theory of prices in GVCs and novel evidence from U.S. import data. In the model, the scope for two-sided concentration and market power depends on two unobserved (set of) parameters: the bilateral bargaining weights of importers and exporters and the supply elasticity of the exchanged goods. We propose a novel identification strategy for these parameters that exploits the network structure of the data. We then use the model to measure the micro and macro-level implications of two-sided market power for U.S. import prices, using the 2018 trade war as a case study.

We have three main results. First, our estimates of the bilateral bargaining weights and input supply elasticity are consistently inside the range where *two-sided* concentration and bargaining power matter for international prices. Second, we show that our model generates more accurate predictions of pair-level price changes following a tariff shock than standard pricing models in the literature. Third, these micro-level differences matter for the aggregate economy. Specifically, we show that our model improves the estimated impact of the trade war on aggregate U.S. import prices by 40-60%. Overall, our theory improves our understanding of the micro-level determinants of the pass-through elasticities into import prices, thus representing a valuable tool for policy-makers and

¹See, e.g., Fajgelbaum et al. (2020); Flaaen et al. (2020); Amiti et al. (2019); Cavallo et al. (2020)

the optimal design of trade policy.

Section 2 develops the pricing model of GVCs. Each exporter-importer pair negotiates over the price of an intermediate input, taking as given market conditions and negotiated outcomes in other links in the network. Both exporters and importers are large and wield market power over the terms of trade. The source of exporters’ market power is the imperfect substitutability across foreign input varieties, allowing each exporter to exert bargaining power in negotiations, provided it has a substantial share in the importer’s input expenditures. The source of importers’ market power is an upward-sloping exporter’s supply curve: When the marginal unit of input purchased costs more to the exporter than the average unit, the importer can exert bargaining power in negotiations, provided it accounts for a substantial share of the exporter’s total output. The relative bargaining power of the contracting parties depends on their respective bargaining weight and outside option, which we allow varying at the pair level.

Within this framework, the negotiated markup depends on the market share and bargaining power of the contracting parties. Specifically, the markup over the exporter’s marginal costs can be written as a weighted average between an “oligopoly” markup *above* marginal cost and an “oligopsony” markdown *below* marginal cost. When the exporters have full bargaining power, the markup converges to an oligopoly markup increasing in the exporter’s bilateral market share as in more standard Bertrand models (Atkeson and Burstein, 2008; Dhyne et al., 2022). When the importers have full bargaining power, the markup converges to an oligopsony markdown taking values less or equal to one and decreasing in the importer’s bilateral market share (Morlacco, 2019).² The weighting factor is a decreasing function of the importer’s relative bargaining position, which is a function of the importers’ (exogenous) bargaining weight and (endogenous) outside option.

We use our theory to shed new light on the determinants of the pass-through elasticity of trade (cost) shocks into import prices. The flexible pricing framework is able to capture both traditional and novel sources of real rigidities, or lack thereof, in price setting. First, it captures *strategic complementarities* among exporters, a well-known source of incomplete pass-through whereby foreign exporters lower their markups following an import tariff surge due to the threat of trade diversion (Atkeson and Burstein, 2008; Auer and Schoenle, 2016). At the same time, our framework entails a novel source of more-than-complete pass-through of cost shocks into import prices, which is related to *strategic substitutabilities* among importers. In response to the import price increasing following a trade shock, the importer decreases its input demand; in turn, lower importer’s demand reduces the importer’s bilateral market share, leading to a higher markup and pass-through rate. Lastly, an additional source of pass-through variation in our framework is related to a *cost channel*: When the importer’s demand decreases following the tariff surge, the good’s marginal cost decreases lowering prices and pass-through. The absolute and relative strength of the different channels in determining pass-through rates depends on the agents’ relative market shares and bargaining power.

²Note that because the marginal cost increases in output, the equilibrium price can be below marginal costs, as long as it is above average costs. If the supplier’s marginal costs were constant, the markup would be bounded below at one. See Section 2 for more details.

The importance of real rigidities has long been recognized in the international trade and pass-through literature (Gopinath and Itskhoki, 2011; Burstein and Gopinath, 2014; Amiti et al., 2014). Our price theory contributes to this literature by investigating the pass-through implications of endogenous markup negotiations in GVCs. In doing so, we abstract from any source of nominal rigidities, such as the menu cost of changing prices or fixed-price contracts. This choice is motivated by at least two observations: First, nominal rigidities such as menu costs are likely to be more relevant for temporary shocks, such as exchange-rate fluctuations, than permanent shocks, such as tariffs and anti-dumping duties, which are the focus of this paper.³ Second, recent evidence from the U.S.-China trade war shows that short- and long-run tariff pass-through on import prices were not substantially different, suggesting that nominal rigidities may have played a limited role in pass-through determination (Amiti et al., 2020).⁴

Section 3 brings our model to the data. One of the challenges of studying two-sided market power in trade is that detailed information on outcomes of bilateral transactions (e.g., prices and quantities) and the characteristics of contracting parties (e.g., size and market shares) are usually hard to obtain. To this end, we construct a novel dataset containing bilateral price and quantity information for each exporter-importer pair and the firms’ characteristics. Trade data come from the Longitudinal Firm Trade Transactions Database (LFTTD) of the U.S. Census Bureau, which comprises the universe of U.S. import transactions during 1992-2016. Balance sheet information on U.S. importers is retrieved from the Longitudinal Business Database (LBD); equivalent information on foreign exporters comes from the ORBIS database. Finally, we integrate the the above dataset with information on tariff changes at the country-product level, taking advantage of the sizable increase in tariff imposed by the U.S. on selected products and trade partners during the period 2017-2018, for which we use the statutory tariff data from Fajgelbaum et al. (2020).

We first use the data to validate our main theoretical predictions on how bilateral shares are related with import prices. We show that, as predicted by the theory, bilateral prices increase with the exporter’s supplier share and decrease with the importer’s buyer share, both coefficients being statistically and economically significant. In testing these price relationships, we address the standard endogeneity problem involved in regressing prices on market shares. We exploit the trade network structure and construct instruments for the bilateral shares based on shocks to other firms that are (indirectly) connected with the firm-pair through the total input demand and supply.

In our model the extent to which trade shocks are transmitted into import prices is an exact (non-linear) function of the observed firms’ bilateral market shares and parameters that determine the match-specific importer’s relative bargaining weight and the input supply elasticity, which are both unobserved. Due to the non-linearities, (reduced-form) estimates of the tariff pass-through

³We shall notice that our theoretical results extend to any “cost-push” shock to the exporter’s marginal costs. Therefore, our theory can also be used to study the (long-run) effects of exchange-rate pass-through into import prices.

⁴Using the U.S. import data as in this paper, Heise (2019) shows that pass-through rates tend to be higher in long-term relationships, which presumably are more likely to use either implicit or explicit contracts.

elasticities cannot be interpreted structurally, nor they can provide a conclusive test of our theory. Therefore, understanding the firm-level and aggregate price implications of two-sided market power in GVCs requires an estimates of the unobserved parameters.

In Section 4, we estimate these key parameters structurally. Our identification strategy leverages the network structure of our data. We first posit that the bargaining parameters can be written as a log linear function of the vector of observables that is found to correlate with bilateral prices in the preliminary reduced-form exercise. This step allows us to reduce the dimensionality of the vector of unknowns substantially. We recover the vector of interest through a GMM procedure that minimizes the distance between the observed price differences across buyers for a given supplier, product, and year and the price differences implied by the model. The estimated parameters are consistent with two-sided market power playing an essential role for bilateral prices, the bilateral bargaining weights being estimated inside the range where both firms have some price-setting abilities.⁵ Moreover, the estimated exporters' supply elasticity is significantly above zero, a necessary condition for the importer's market share to matter for markups and pass-through.

The estimated model is then used in Section 5 to conduct counterfactual exercises. We first evaluate the model's performance in predicting bilateral price changes during the 2018 trade war. Our model allows us to write the predicted price change as an exact function of observable bilateral market shares and estimated parameters. Moreover, our model tractably nests more standard price frameworks in the trade literature, which corresponds to limit values of our parameters. We thus consider the predicted price changes under two alternative (and more traditional) counterfactual scenarios: a standard Bertrand pricing model, which corresponds to the case where the exporter sets prices and marginal costs are constant (Atkeson and Burstein, 2008), and a bargaining model of wholesalers, which we obtain as a special case of our model where marginal costs are constant (Gopinath and Itskhoki, 2011). We show that our pricing framework generates more accurate predictions of pair-level price changes following a tariff shock than standard pricing models in the literature. The second exercise gauge whether and how these micro-level differences in predicted price changes matter for the aggregate. We show that the differences are substantial: compared to more traditional pricing frameworks, our model improves the estimated effect of the 2018 trade war on U.S. consumer prices by 40-60%.

This paper contributes to several related literatures. First and foremost, it contributes to an extensive literature studying the firm-level determinants of pass-through heterogeneity. 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) show that the exchange-rate pass-through decreases in the exporter's shares and imported share of inputs, while Berman et al. (2012) show that the pass-through is decreasing in the exporter's size. The pricing framework in this paper tractably nests these models, while considering two-sided determinants of pass-through

⁵We find that on average the bilateral bargaining weights are allocated towards the importers. The mean of the bilateral bargaining weights (with 0 when exporters have all the bargaining power and 1 when importers have all the bargaining power) is 0.76 with a standard deviation of 0.09.

heterogeneity. Similar to our model, [Gopinath and Itskhoki \(2010\)](#) and [Goldberg and Tille \(2013\)](#) discuss the pass-through implications of two-sided bargaining. We contribute to this set of papers by theoretically and empirically characterizing the role of bilateral concentration for international prices.

We also contribute to a growing empirical literature on the tariff pass-through elasticities with our data and evidence. While there is burgeoning evidence on the price response to exchange-rate shocks, studies investigating the pass-through of tariffs into import and export prices, particularly those using time-series variation to identify responses, are much scarcer ([Fitzgerald and Haller, 2018](#); [Berthou and Fontagné, 2016](#); [Fontagné et al., 2018](#)). Understanding the sources of (a)symmetries between exchange-rate and tariff pass-through is an important open question in international macroeconomics. The results in this paper can inform on that debate by providing novel insights on the sources of real rigidities in firm-to-firm trade.

This paper also belongs to a trade literature investigating the role of network heterogeneity for firm-level outcomes, particularly markups and prices. [Cajal-Grossi et al. \(2019\)](#) use data on Bangladeshi exporters to show that suppliers' markups are higher on orders produced for relational buyers compared to spot buyers. Using U.S. import transaction data, [Heise \(2019\)](#) shows that the exchange-rate pass-through increases in the longevity of the relationship, rationalizing the finding through a theory in which relationships accumulate relationship capital to lower production costs. Using French export transaction data, [Fontaine et al. \(2020\)](#) show that large multi-product exporters adopt more discriminatory pricing strategies, and that price discrimination is stronger for more differentiated and more durable products. Similarly, [Ignatenko \(2019\)](#) shows that the ability to backwards integrate allows larger buyers to obtain lower input prices in trade data from Paraguay. Our findings resonate with these studies, to which we contribute with a theory of markup and pass-through heterogeneity based on bilateral concentration and market power in firm-to-firm trade.

Our theoretical model belongs to the literature on the role of input-output networks in propagating and amplifying shocks. We most closely relate to studies on the role of firm-level interactions for shock transmission ([Taschereau-Dumouchel, 2018](#); [Acemoglu and Tahbaz-Salehi, 2020](#); [Dhyne et al., 2021, 2022](#)). Our main contribution to this literature is to characterize analytically the role of bilateral oligopolies and firm granularity for the intensive-margin pass-through elasticity of an exporter's cost shock to the negotiated price.

Related to our paper is a recent work by [Grossman and Helpman \(2020\)](#), who develop a bargaining framework of firm-to-firm trade to study the effect of tariff shocks on the organization of supply chains. We see our work as complementary to theirs: While abstracting from the extensive margin channel, our model captures rich(er) pricing and pass-through patterns by allowing for both two-sided market power and granularity. Therefore, our model is useful to characterize the intensive margin price elasticities in all those settings where the trade network can be "held fixed." Our pass-through application shows one such exercise.

2 Theory

This section sets out a theory of prices in firm-to-firm trade with two-sided concentration and market power. The industry consists of multiple foreign exporters (indexed by i) and multiple U.S. importers (indexed by j) of intermediate inputs. We consider a partial equilibrium environment by focusing on the price-setting problem in an importer-exporter ($i - j$) pair. To ease exposition, we assume single-product exporters, such that i denotes both the exporter and the traded variety. We will relax this assumption when we take the model to the data.

2.1 Setup

We let \mathcal{Z}_j denote the set of foreign varieties sourced by importer j , or the importer's *sourcing strategy*. Importer j imperfectly substitutes across foreign input varieties. The foreign intermediate input's quantity and price are defined as:

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

where $\rho > 1$ is the elasticity of substitution between varieties sourced by importer j , q_{ij} is the quantity of variety (exporter) i sourced by importer j , ς_{ij} is the saliency term for exporter i 's variety, and p_{ij} is the price that exporter i and importer j negotiate, which is the focus of our analysis.

We assume that firm (importer) j produces its final output q_j combining the foreign intermediate input with domestic inputs. We let c_j denote firm j 's unit cost, and we denote by $\gamma \in (0, 1]$ the elasticity of firm j 's unit cost with respect to the foreign input price index:

$$\gamma = \frac{d \ln c_j}{d \ln p_j^f} \in (0, 1]. \quad (2)$$

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

$$\nu = -\frac{d \ln q_j}{d \ln p_j} > 1, \quad (3)$$

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

On the exporter side, we let \mathcal{J}_i denote the set of buyers of exporter i 's variety. Exporter i 's total output can be written as $q_i = \sum_{k \in \mathcal{J}_i} q_{ik} = q_{ij} + q_{i(-j)}$, where $q_{i(-j)} \equiv \sum_{k \neq j} q_{ik}$ is total i 's demand by downstream importers other than j . We let c_i denote exporter i 's marginal cost, and let

$$\frac{1 - \theta}{\theta} = \frac{d \ln c_i}{d \ln q_i} \geq 0 \quad (4)$$

denote i 's marginal cost elasticity to total input supply, such that can write firm i 's average costs as θc_i . The parameter $\theta \in (0, 1]$ captures returns to scale of exporter i 's production. When $\theta \in (0, 1)$, the marginal costs are increasing in total output, which means that upstream production features decreasing returns; conversely, when $\theta = 1$, the exporter's marginal costs are constant, which means that production features constant returns. Alternatively, one can interpret θ as firm i 's relevant cost elasticity during negotiations if the exporter's technology features constant returns and some inputs are held fixed during negotiations.

2.2 Price Bargaining

Importer j and exporter i set the bilateral price p_{ij} via bilateral negotiations. For tractability, we assume that the input quantity is pinned down by the importer's demand function, once the price is determined. This assumption resonates with the fact that the contracts governing firm-to-firm relationships in GVCs have limited enforceability and thus are highly incomplete (Antràs, 2020).⁶

To tractably analyze the division of surplus, we invoke the “Nash-in-Nash” solution concept: The price negotiated between firms i and j is the pairwise Nash bargaining solution taking all other bargaining outcomes as given.⁷ We further assume that during negotiations the two firms hold fixed the network of firm-to-firm trade, which means that they do not consider the possibility of renewed search of alternative buyers or suppliers in their outside option, which in our baseline model is given by the “disagreement profits”.⁸

The negotiated price p_{ij} solves:

$$\max_{p_{ij}} (\pi_i(p_{ij}) - \tilde{\pi}_{i(-j)})^{1-\phi_{ij}} (\pi_j(p_{ij}) - \tilde{\pi}_{j(-i)})^{\phi_{ij}}, \quad (5)$$

where $\pi_i(p_{ij})$ and $\pi_j(p_{ij})$ are the profits to the exporter i and the importer j if the negotiations succeed, and $\tilde{\pi}_{i(-j)}$ and $\tilde{\pi}_{j(-i)}$ are the disagreement profits, which are critical objects determining the parties' endogenous bargaining power. The parameter $\phi_{ij} \in (0, 1)$ captures exogenous determinants of the firms' bargaining ability that might influence the outcome of the negotiation process, such as their information structure, their negotiating strategies or time preference mismatches between the parties (Muthoo, 1999). In our notation, a higher ϕ_{ij} denotes higher relative bargaining power of importer j .

We take the first-order condition with respect to (5) and rearrange terms so as to write the bilateral

⁶In Appendix A.2, we consider the case of bargain over quantities. Both the theoretical discussion, and estimation strategy can be easily extended to this case.

⁷The assumption of Nash-in-Nash bargaining is standard in applied studies of bilateral oligopolies, see, e.g., Collard-Wexler et al. (2019) for a discussion. See also Grossman and Helpman (2020) for a recent application in the context of global value chains.

⁸Below, we discuss how the model can be extended to allow the possibility of renewed search to affect the players' outside options.

price p_{ij} as a markup μ_{ij} over the exporter's marginal cost c_i :⁹

$$p_{ij} = \mu_{ij} c_i. \quad (6)$$

The markup μ_{ij} is our object of interest, capturing the effect of bilateral negotiations and market power on prices. It is instructive to characterize μ_{ij} by considering special limit cases first, and eventually the general case. In what follows, we denote by $s_{ij} \equiv \frac{p_{ij} q_{ij}}{\sum_{k \in \mathcal{Z}_j} p_{kj} q_{kj}} \in (0, 1)$ the *exporter's supplier share*, i.e., the share of i 's sales over importer j 's total imports, by $x_{ij} \equiv \frac{q_{ij}}{\sum_{k \in \mathcal{J}_i} q_{ik}} \in (0, 1)$ the *importer's buyer share*, i.e., the share of importer j 's imported units over the total units of the good supplied by exporter i , and by $\tilde{\phi}_{ij} \equiv \frac{\phi_{ij}}{1 - \phi_{ij}} \in \mathbb{R}_+$ the relative (exogenous) bargaining power of j .

Special case: When $\tilde{\phi}_{ij} \rightarrow 0$. When $\tilde{\phi}_{ij} \rightarrow 0$, the bargaining power is concentrated on the exporter's side, and the importer acts as a price taker. In this case, the solution to (5) simplifies to a standard Nash-Bertrand solution, with:

$$\mu_{ij} |_{\tilde{\phi}_{ij} \rightarrow 0} = \mu_{ij}^{oligopoly} \equiv \frac{\varepsilon_{ij}}{\varepsilon_{ij} - 1} \geq 1, \quad (7)$$

$$\varepsilon_{ij} = \rho(1 - s_{ij}) + \tilde{\nu} s_{ij}, \quad (8)$$

where ε_{ij} is a demand elasticity term, and $\tilde{\nu} = 1 - \gamma + \nu\gamma$ is a parameter that depends on the downstream demand elasticity ν and the cost elasticity γ . The demand elasticity ε_{ij} is a function of the supplier share s_{ij} (Atkeson and Burstein, 2008; Dhyne et al., 2022).¹⁰ When this share is infinitesimal ($s_{ij} \rightarrow 0$), the demand elasticity ε_{ij} collapses to ρ , the substitution elasticity across foreign varieties. When the share is close to one ($s_{ij} \rightarrow 1$) the demand elasticity ε_{ij} converges to $\tilde{\nu}$. We note that with $\rho > \tilde{\nu}$, the elasticity (markup) is a decreasing (increasing) function of s_{ij} . That is, larger exporters charge higher markups as long as the input demand elasticity increases in the “upstreamness” of the production stage.¹¹

Special case: When $\tilde{\phi}_{ij} \rightarrow \infty$. When $\tilde{\phi}_{ij} \rightarrow \infty$, the bargaining power is concentrated on the importer's side, such that the exporter acts as a price taker. In this case, the bilateral markup over marginal cost reads:

$$\mu_{ij} |_{\tilde{\phi}_{ij} \rightarrow \infty} = \mu_{ij}^{oligopsony} \equiv \theta \left(\frac{1 - (1 - x_{ij})^{\frac{1}{\theta}}}{x_{ij}} \right) \leq 1. \quad (9)$$

⁹See Appendix A.1 for the detailed derivations of this expression.

¹⁰Note that, unlike standard models, the supplier share is defined at the match level in our model of firm-to-firm trade, rather than at the firm level.

¹¹The condition $\rho > \tilde{\nu}$ is standard in theoretical trade models, and typically validated in empirical work. See, e.g., Atkeson and Burstein (2008); Dhyne et al. (2022).

The markup over *marginal* cost μ_{ij} can be interpreted as the product of θ and a term capturing the markup over the *average* cost.¹² The latter term takes values between one and $1/\theta$, a term larger than unity whenever $\theta < 1$. Therefore, the markup μ_{ij} takes values either equal or below unity. Moreover, μ_{ij} decreases with the importer's buyer share x_{ij} . The intuition is that when marginal costs increase in total output, the cost of the last output unit produced, i.e., the marginal cost of output, is higher than the cost of all the infra-marginal units (and the average cost of output) generating rents accruing to the exporter. Large importers understand the effect of their input demand on the exporters' costs, and they can extract some of these rents by negotiating a markup below marginal cost (and above average cost). The larger the importer, the larger the gap between the average and the marginal cost of output purchased, the lower the negotiated markup. Conversely, when $\theta = 1$, marginal and average costs always coincide, such that full importer's bargaining power always coincides with marginal cost pricing, i.e., $\mu^{oligopsony} = 1 \forall x_{ij} \in [0, 1]$.

General case: When $\tilde{\phi}_{ij} \in \mathbb{R}_+$. The following proposition characterizes the Nash-in-Nash solution in the general case where both the importer and the exporter have some bargaining power.

Proposition 1. *The bilateral markup negotiated by exporter i and importer j when j 's relative bargaining power is $\tilde{\phi}_{ij} \in \mathbb{R}_+$ is*

$$\mu_{ij} = (1 - \omega_{ij}) \cdot \mu_{ij}^{oligopoly} + \omega_{ij} \cdot \mu_{ij}^{oligopsony}, \quad (10)$$

where $\omega_{ij} \equiv \frac{\tilde{\phi}_{ij} \lambda_{ij}}{\tilde{\phi}_{ij} \lambda_{ij} + \varepsilon_{ij} - 1} \in (0, 1)$, $\lambda_{ij} \equiv \frac{s_{ij}(\tilde{\nu} - 1)}{1 - \hat{\pi}_j} \geq 0$, and $\hat{\pi}_{j(-i)} \equiv \frac{\tilde{\pi}_{j(-i)}}{\pi_j}$.

In the general case, the markup μ_{ij} can be written as a weighted average between the oligopoly markup in equation (7) and the oligopsony markdown in equation (9). The weighting factor ω_{ij} is an increasing function of $\tilde{\phi}_{ij} \lambda_{ij}$, the product of the exogenous bargaining term ($\tilde{\phi}_{ij}$), and a term (λ_{ij}) that increases in the buyer's outside option $\hat{\pi}_{j(-i)} \equiv \frac{\tilde{\pi}_{j(-i)}}{\pi_j} = (1 - s_{ij})^{\frac{1-\nu}{1-\rho} \gamma}$. We refer to $\tilde{\phi}_{ij} \lambda_{ij}$ as the *effective* buyer's bargaining position. The larger the $\tilde{\phi}_{ij} \lambda_{ij}$, the larger ω_{ij} , hence the closer is the bilateral markup μ_{ij} to the oligopsony markup.

Notice that, for given levels of ω_{ij} , the markup in equation (10) depends on the two shares s_{ij} and x_{ij} only through their effect on $\mu_{ij}^{oligopoly}$ and $\mu_{ij}^{oligopsony}$, respectively. While the weight ω_{ij} itself depends on the supplier's share s_{ij} , we show in the Appendix that in the relevant range of the parameter space it is relatively inelastic to the level of the supplier's share, such that we can reasonably approximate $\frac{d \ln \omega_{ij}}{d \ln s_{ij}} \simeq 0$. It follows that the markup in the general case inherits the properties of that in the special cases: it increases in the exporter's share s_{ij} and it decreases in the importer's share x_{ij} . Section 3.4 brings these predictions to the data, and shows that they are largely satisfied in the context of U.S. firm-to-firm imports.

¹²Note that this follows from the fact that average costs are equal to θc_i .

Discussion

The model’s results hold under general specifications of technology and market structure upstream and downstream. The important assumption in deriving equation (10) is that both importers and exporters take as given aggregate market conditions, such as aggregate downstream demand or upstream input prices, such that the negotiated price and quantity affects the firms’ profits only through their effect on the firms’ marginal costs. These effects are governed by the vector of elasticities $\beta = \{\rho, \gamma, \nu, \theta\}$. Our baseline model keeps cross-sectoral parametric heterogeneity to a minimum by letting these elasticities be constant across firms. While this choice is motivated by the data used in estimation, the analysis can be readily extended to heterogeneity in all parameters, provided relevant variation is available for identification.

In our baseline model, we maintain the assumption that the network of firm-to-firm trade is fixed during negotiations. That is, we assume that players do not consider renegotiations in case of disagreement such that the disagreement payoffs coincide with the firms’ profits originating from other (pre-existing) network nodes. In Appendix A.3, we show that our Proposition 1 holds even when renegotiations are allowed. Specifically, we let ϱ_{ij} and ς_{ij} denote the profits of buyer j and the total cost of exporter i in the case of a disagreement, respectively. We show that the generalized model yields an equilibrium price that is very similar to equation (10), with two notable differences. The first is that the term λ_{ij} in equation (10) is now a function of the (unobserved) importer’s outside option ϱ_{ij} . The second is that the oligopsony markup is now a function of the (unobserved) exporter’s outside option ς_{ij} . Two observations follow: First, conditional on the unobserved terms ϱ_{ij} and ς_{ij} , the main qualitative insights of this section do not change in the case of more flexible assumptions on the players’ outside option. Second, unless data is available to estimate the factors ϱ_{ij} and ς_{ij} , it would be unfeasible to conduct quantitative analyses in the more general case. For this reason, we maintain the assumption of fixed network throughout the paper.

2.3 Pass-Through

In this section we investigate how bargaining and bilateral concentration affect the pass-through elasticity of cost shocks into import prices. We consider a permanent “cost-push” shock to the exporter’s cost c_i , which we denote by ϑ_i . In the empirical exercises below, we will think of ϑ_i as an import tariff or an anti-dumping tax imposed by the U.S. on individual foreign exporters. We illustrate the effects of this cost shock by studying its pass-through elasticity into the negotiated price p_{ij} , namely $\Phi_{ij} \equiv \frac{d \ln p_{ij}}{d \ln \vartheta_i}$.

By definition, an exporter-level shock affects the negotiated prices and quantities of all exporter i ’s U.S. buyers. This means that when the pair $i - j$ negotiate over the new price, full efficiency would require considering how the shock affects the negotiated outcome of all downstream buyers of firm i , which would be quite impractical with many of them.¹³ Consistent with our assumption

¹³Intuitively, by affecting the price (and quantities) in other nodes in the network, a given shock may affect the

of Nash-in-Nash bargaining, we assume that when exporter i and importer j negotiate over the new bilateral price, they take as given both prices and quantities of all other pairs. In substance, this means focusing on the direct effect of the shock on the negotiated price p_{ij} .¹⁴

We log-differentiate equations (6) and (10) to write the log change in price, $d \ln p_{ij}$, as:

$$d \ln p_{ij} = \Gamma_{ij}^s d \ln s_{ij} + \Gamma_{ij}^x d \ln x_{ij} + d \ln c_i + d \ln \vartheta_i, \quad (11)$$

where $\Gamma_{ij}^s \equiv \frac{\partial \ln \mu_{ij}}{\partial \ln s_{ij}} > 0$ denotes the partial elasticity of bilateral markups with respect to the exporter's supplier share s_{ij} , which is a function of the supplier share and parameters $(\Gamma_{ij}^s = \Gamma^s(s_{ij}, \tilde{\phi}_{ij}; \beta))$, while $\Gamma_{ij}^x \equiv \frac{\partial \ln \mu_{ij}}{\partial \ln x_{ij}} < 0$ is the partial elasticity of bilateral markups with respect to the importer's buyer share x_{ij} , a function of the buyer share and parameters $(\Gamma_{ij}^x = \Gamma^x(x_{ij}, \tilde{\phi}_{ij}; \beta))$.¹⁵

Using the definitions of the two bilateral shares, we can write:

$$d \ln s_{ij} = -(\rho - 1)(1 - s_{ij}) d \ln p_{ij} \quad (12)$$

$$d \ln x_{ij} = -\varepsilon_{ij}(1 - x_{ij}) d \ln p_{ij}, \quad (13)$$

where ε_{ij} is as in equation (8). In turn, the change in exporter i 's marginal costs as a function of the log price change is:

$$d \ln c_i = -\frac{1 - \theta}{\theta} x_{ij} \varepsilon_{ij} d \ln p_{ij}. \quad (14)$$

Substituting equations (12) to (14) into (11), we derive the following proposition:

Proposition 2. *The pass-through of a shock ϑ_i to the bilateral price p_{ij} when $d \ln q_{iz} = 0 \forall z \neq j$ is given by:*

$$\Phi_{ij} \equiv \frac{d \ln p_{ij}}{d \ln \vartheta_i} = \frac{1}{1 + \Gamma_{ij}^s(\rho - 1)(1 - s_{ij}) + \Gamma_{ij}^x \varepsilon_{ij}(1 - x_{ij}) + \frac{1 - \theta}{\theta} x_{ij} \varepsilon_{ij}}. \quad (15)$$

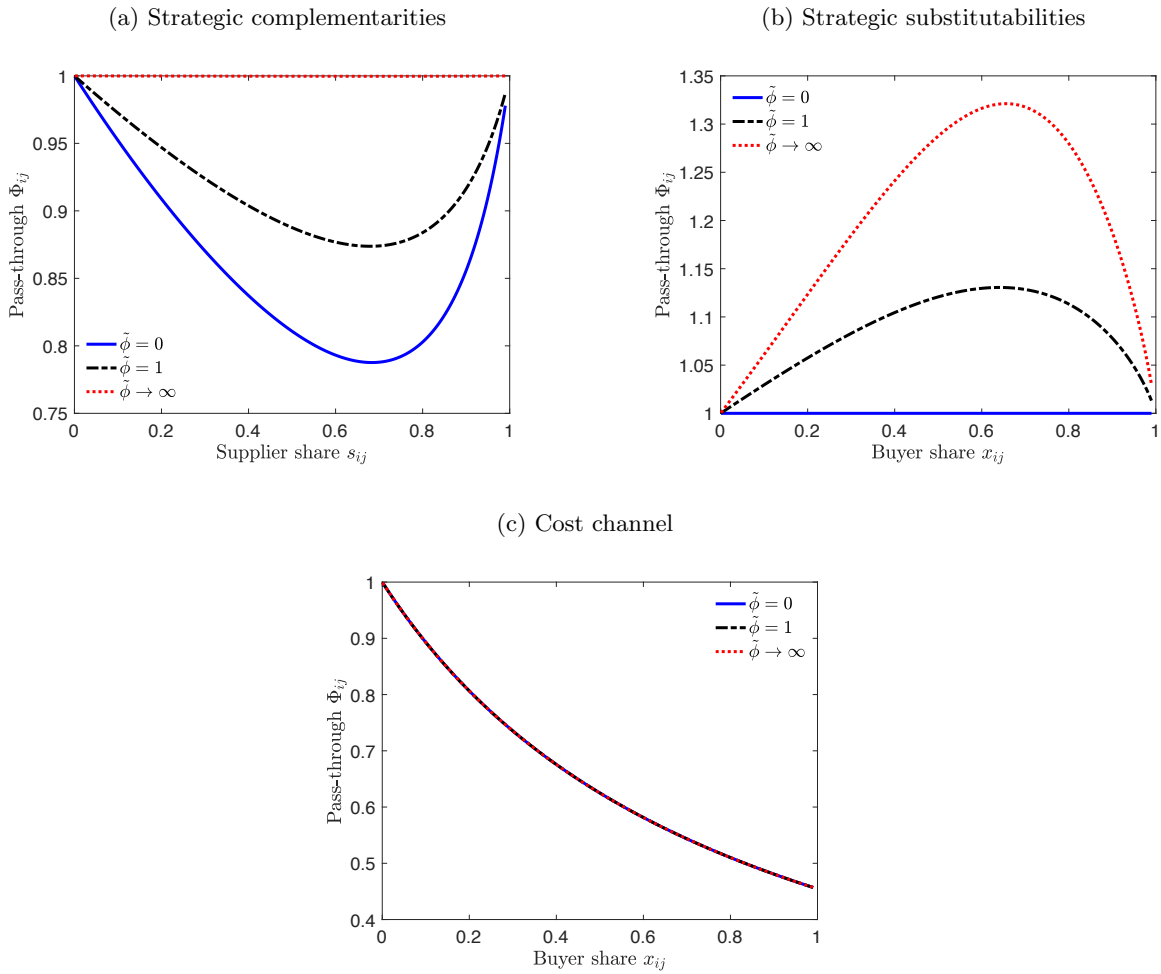
Equation (15) indicates that just like the markup, the import price pass-through elasticity in a bargaining model with bilateral market power can be written as a function of the bilateral shares s_{ij} and x_{ij} , the relative bargaining power $\tilde{\phi}_{ij}$, and the parameter vector $\beta = \{\gamma, \nu, \rho, \theta\}$. The three terms in the denominator of equation (15) captures three different forces affecting the import price pass-through elasticities in our model. We illustrate each of these forces in the following paragraphs.

price $i - j$ through changes in importer j 's buyer share and bargaining position more generally. Equation (27) in Appendix A.4.2 consider how the pass-through formula would change once these indirect effects are considered; it shows that the more general pass-through formula can be derived by solving a complex system of equations for each supplier i , which shows the impracticability of considering the full effects of the shock in bilateral negotiations.

¹⁴We validate this assumption in the next section, where we show that the effect of the exporter-level shock into the bilateral price is unchanged regardless of whether or not the quantities of other U.S. buyers are "controlled for" in estimation.

¹⁵See Appendix A.4.1 for details about the expressions for Γ_{ij}^s and Γ_{ij}^x . Note that in deriving these elasticities, we use the approximation $\frac{\partial \ln(1 - \omega_{ij})}{\partial \ln s_{ij}} = \frac{\partial \ln(\omega_{ij})}{\partial \ln s_{ij}} \simeq 0$.

Figure 1: Pass-through Elasticities: Channels



Strategic Complementarities among exporters The first term in the denominator of equation (15) reflects the strategic complementarities among exporters, a standard source of incomplete pass-through (Burstein and Gopinath, 2014; Amiti et al., 2014, 2018). Focusing on this channel, the pass-through formula would reduce to $\Phi_{ij}^{SC} = \frac{1}{1+\Gamma_{ij}^s(\rho-1)(1-s_{ij})} \in (0, 1)$.

Panel 1a of Figure 1 plots Φ_{ij}^{SC} for different values of the supplier share and relative bargaining power. Following a cost shock such as a tariff surge, the exporter reduces its markup to prevent the buyer from substituting away from its variety, leading to an *incomplete* pass-through of the tariff shock into the price. The response of import prices to cost shocks is *U-shaped* in the supplier share (Goldberg and Tille, 2013; Auer and Schoenle, 2016). When the exporter’s supplier share is either infinitesimal ($s_{ij} \rightarrow 0$) or very large ($s_{ij} \rightarrow 1$), the scope for strategic complementarities in pricing is reduced, leading to a lesser impact of the shock on the negotiated markup (and price). What’s more, the scope for strategic complementarities decreases in the importer’s relative bargaining power, with $\lim_{\tilde{\phi}_{ij} \rightarrow \infty} \Gamma_{ij}^s = 0$, such that $\lim_{\tilde{\phi}_{ij} \rightarrow \infty} \Phi_{ij}^{SC} = 1 \forall s_{ij}$.

Strategic Substitutabilities among importers The second term in the denominator of equation (15) reflects the strategic substitutabilities among importers. In our context, strategic substitutabilities among importers arise due to increasing exporter’s marginal costs: When the input demand from other buyers is low (i.e., when $q_{i(-j)}$ is low), the firm j ’s buyer share (x_{ij}) is high, leading to a lower negotiated markup and a more j ’s purchases of firm i ’s goods, q_{ij} . Focusing on this channel, the pass-through expression simplifies to $\Phi_{ij}^{SS} = \frac{1}{1+\Gamma_{ij}^x \varepsilon_{ij}(1-x_{ij})} \geq 1$.

Panel 1b of Figure 1 shows that the importers’ strategic substitutability channel is a source of more-than-complete pass-through into import prices. Intuitively, a tariff surge lowers firm j ’s demand of the input and its the buyer share x_{ij} , leading to a higher bilateral markup. Firm j ’s buyer share is less sensitive to changes in its own demand when the share is either infinitesimal ($x_{ij} \rightarrow 0$) or very large ($x_{ij} \rightarrow 1$), leading to a *hump-shape* response with respect to x_{ij} . Unlike the previous case, the scope for strategic complementarities *increases* in the importer’s relative bargaining power, with $\lim_{\tilde{\phi}_{ij} \rightarrow 0} \Gamma_{ij}^x = 0$, such that $\lim_{\tilde{\phi}_{ij} \rightarrow 0} \Phi_{ij}^{SS} = 1 \forall s_{ij}$.

Cost channel The third and last term in the denominator of equation (15) captures the fact that the negotiated price responds to changes in the exporter’s marginal cost triggered by the shock. We refer to this channel as the cost channel, which we can isolate as $\Phi_{ij}^C = \frac{1}{1+\frac{1-\theta}{\theta} x_{ij} \varepsilon_{ij}}$. When the price increases due to the shock, a standard demand effect leads the importer to demand less of exporter i ’s variety. When the technology of the exporter exhibits decreasing returns ($\theta < 1$), the lower demand decreases the marginal cost, lowering the price. The more the importer’s demand accounts for in the exporter’s output, the more substantial the cost (and price) reduction, the lower the pass-through. Therefore, as seen in Panel 1c of Figure 1, the cost channel acts as a source of incomplete pass-through of shocks into import prices. Notably, the strength of the cost channel does not depend on the importer’s relative bargaining power.

Discussion

All things considered, the figure that emerges is one where a large range of values of the pass-through elasticity Φ_{ij} are admissible. Figure 2 in Appendix A.4.1 displays the contour plots of Φ_{ij} for different values of the relative bargaining power, namely $\tilde{\phi}_{ij} \in \{0, 1, \infty\}$. We make two remarks based on this figure. First, when both markups and cost channels are considered, the passthrough elasticity always takes value below unity, namely, the pass-through is mostly incomplete. Even though in our model the strategic substitutability channel amplifies the pass-through of the cost shock on the price, possibly leading to more-than-complete pass-through rates, it can be shown that the cost channel always prevails over the strategic substitutability one, hence the result. Second, holding the bilateral market shares fixed, the pass-through elasticity increases in the degree of importer’s bargaining power. This result stems from the fact that while the cost channel is independent on the value of $\tilde{\phi}_{ij}$, the scope for strategic substitutability, and the degree of pass-through thereof, increases in $\tilde{\phi}_{ij}$.

In some empirical settings, researchers may want to focus on the role of markups changes in determining the pass-through elasticities. This is feasible empirically whenever changes in marginal costs can be controlled for in estimation.¹⁶ Figure 3 in Appendix A.4.1 displays similar contour plots of Φ_{ij} , focusing solely on the markup channels. When only the markup changes are considered, the pass-through elasticity takes values both below and above unity, depending on the relative strength of the strategic complementarities and strategic substitutabilities channels.

Proposition 2 provides a useful way of summarizing the response of border prices to cost-push shocks, providing some predictions on how they vary over the two observable bilateral shares and the unobservable bilateral bargaining power. In particular, our theory predicts that the pass-through elasticity is non-monotonic in the supplier share s_{ij} , decreasing in the buyer share x_{ij} , and increasing in the buyer’s bargaining power $\tilde{\phi}_{ij}$. In the following section(s), we bring this predictions to the data to empirically test its ability to rationalize the behavior of import prices.

3 Data and Stylized Facts

3.1 Data sources

One of the challenges of studying two-sided market power is that detailed information on outcomes of bilateral transactions (i.e., prices and quantities) between importers and exporters and on characteristics of contracting parties (e.g., size and market shares) are usually hard to obtain. We confront this challenge by constructing a novel dataset matching the U.S. Census Linked/Longitudinal Firm Trade Transaction Database (LFTTD) with the Longitudinal Business Dataset (LBD), the Census

¹⁶Because marginal costs are not observed, this can be done by including exporter-(product-)time fixed effects in the regressions, provided that the shock varies at the buyer (or destination country) level. This approach would not be feasible in our case, given our focus on U.S. buyers and exporter-level shocks.

of Manufacturers (CM), and the ORBIS dataset.

The LFTTD dataset contains information on the universe of cross-border trade transactions between U.S. importers and foreign exporters during 1992-2016. This dataset is constructed from custom declaration forms collected by the U.S. Customs and Border Protection (CBP). 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. Notably, for each transaction, the LFTTD includes a manufacturing ID (MID) identifying relevant foreign exporter characteristics, including nationality, name, address, and city.

We combine the LFTTD data with ORBIS data, a worldwide firm-level dataset maintained by Bureau van Dijk. This dataset includes comprehensive information on listed and unlisted companies' financials, such as revenues, assets, employment, cost of materials, and wage bills, among others. Most importantly, ORBIS provides information on both firms' names and addresses, making it possible to construct an ORBIS-MID variable that can be matched with the LFTTD-MID of the foreign exporter (Alvarez et al., 2019).¹⁷

Information about the domestic activity of U.S. importers is collected from the LBD. The LBD provides information on employment and payroll for U.S. establishments covering all industries and all U.S. States. 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 ID.

We complement the above merged dataset with data on trade tariffs, focusing on the surge in U.S. tariffs in the context of the 2018 trade war. The import tariffs imposed by the U.S. on selected products and trade partners have experienced a sizable increase after several decades of low and stable tariff rates. The statutory tariff data we use is from Fajgelbaum et al. (2020) and we identify the set of HS8 products subject to increases in tariffs in 2018, the set of countries affected for each product, the effective application dates for the tariff changes, and the percentage point tariff increases.

3.2 Measuring key variables of the model

We measure the key variables of the model exploiting the unique features of our data described above. To do so, we introduce multiple products to the model, where a product is defined at the HS 10-digit level and is denoted by h . We assume that when a firm imports multiple foreign input

¹⁷See Appendix B.1 for more details on the construction of the MID variable.

bundles, it combines them in a Cobb-Douglas fashion. Equation (2) thus becomes:

$$\alpha_j^h \gamma = \frac{d \ln c_j}{d \ln p_j^{f,h}} \in (0, 1], \quad (16)$$

where α_j^h is the (observed) Cobb-Douglas share of the HS10 input h on j 's total imports of intermediates.

We define the exporter's supplier share for product h as $s_{ij}^h = \frac{p_{ij}^h q_{ij}^h}{\sum_{k \in \mathcal{Z}_j^h} p_{kj}^h q_{kj}^h}$, where \mathcal{Z}_j^h is the set of firm j 's suppliers of input h . We construct the numerator of this share by summing up 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 $x_{ij}^h \equiv \frac{q_{ij}^h}{q_i^h}$ is defined in terms of quantities. We assume that firm i 's production consists of product-destination specific production lines, and define the denominator q_i^h as exporter i 's total export quantity of product h sold to the U.S.

3.3 Selection and summary statistics

We use the following criteria to construct our estimation sample. To ensure that the selection of foreign exporters represented in the ORBIS dataset covers a sizable fraction 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 select transactions between foreign exporters and U.S. importers for which we observe the foreign exporter's sales, wage bill, and material input costs. We focus on bilateral trade transactions at "arm's length," that is, where there is no ownership relationship between the exporter and importer. To do so, we leverage the information on ownership relationships from both the LFTTD and ORBIS.¹⁸ Further, we select exporters that sell a given product (HS10) to two or more U.S. importers. To ensure we have enough variation within each estimation category, we focus on country-product pairs in which there are at least three exporters.

We report the summary statistics on our sample in Table 1. Panel A reports the statistics on the intensive margin of trade, specifically on the bilateral prices and market shares, where the latter are constructed at the firm-HS10 product level. Dispersion in bilateral prices is very large, as expected with this type of data (Fontaine et al., 2020; Heise, 2019). Concentration among importers and exporters is substantial: The average exporter has a supplier share of 15%, with substantial heterogeneity across exporters; the average buyer share is about 30%, with substantial heterogeneity across observations. Both the high degree of dispersion in pair-level prices and the granularity of importers and exporters are consistent with the assumptions of our pricing framework.

¹⁸See Appendix B.3 for details.

Table 1: Summary statistics

Variable	Mean	Std.
Panel A. Intensive Margin		
s_{ijt}^h	0.15	0.22
x_{ijt}^h	0.28	0.30
$\ln p_{ijt}^h$	3.52	2.48
Panel B. Extensive Margin		
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
Age of the relationship	3.05	2.71

Note: 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 ; Age of the relationship is measured by the number of years since the exporter first served the importer with product h . The sample excludes related party transactions and covers the period of 2001-2016.

Panel B reports the statistics on the extensive margin, showing evidence of both granularity and market power of firms in international trade. Both 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, 2020).

3.4 Stylized facts

This section shows that the features of our two-sided trade dataset reflect in large part our modeling assumptions and predictions. Our model emphasizes the role of two bilateral shares, s_{ij} and x_{ij} , in determining both the level and changes of bilateral prices, p_{ij} . In particular, our model could rationalize variation in prices and pass-through elasticities only insofar as there is substantial variation in these bilateral market shares. If the network of firm-to-firm trade only consists of one-to-one matches, then both bilateral shares s_{ij} and x_{ij} would equal one and there would be no role for concentration to play in determining prices.

In Appendix C.1 we report the fraction of U.S. imports—both in terms of the number of links and in terms of import value—accounted for by four mutually exclusive groups: one-to-one linkages where the exporter and the importer only trades with the other, one-to-many linkages where the exporter supplies to other importers but the importer only buys from the exporter, many-to-one linkages where the exporters supply only to one importer but the importer buys from multiple exporters, and

many-to-many linkages in which exporters and importers have multiple trading partners. We show that many-to-many linkages account for more than 40 percent in terms of import value, and the share goes up to more than 90 percent once we include links that are characterized as one-to-many and many-to-one linkages.

We then turn to our main theoretical prediction of Proposition 1, which says that, conditional on the exporter’s marginal cost, the bilateral price is increasing in the exporter share s_{ij} and decreasing in the importer share x_{ij} . We take this prediction to the data by considering the following specification that exploits the variation in prices across firm-pairs within a market, as defined by a HS10 product-year:

$$\ln p_{ijt}^h = \beta_s s_{ijt}^h + \beta_x x_{ijt}^h + \beta \mathbf{X}_{ijt}^h + v_{ijt}^h, \quad (17)$$

where \mathbf{X}_{ijt}^h represents the set of control variables. In one specification we include FE_i , FE_j , and FE_{ht} as exporter, importer, and product-time fixed effects, and in another specification we include FE_{iht} and FE_{jht} as exporter-product-time and importer-product-time fixed effects, respectively. The more stringent specification aims to control for unobserved variation in exporters’ marginal costs via fixed effects. We additionally control for variables that are potentially related to the parties’ relative bargaining power, such as: the longevity of the relationship, the relative age of the importer and the exporter, the ratio between the total number of exporters for importer j over the total number of importers of exporter i , a dummy equal to 1 if the parties transact more than one HS10 product, and the total number of transactions of the $i - j$ pair. The residual component v_{ijt}^h captures the unexplained dispersion of prices within a given relationship.¹⁹ Our coefficients of interest are β_s and β_x , which we expect having a positive and negative sign, respectively.

One well-known challenge in running regressions like (17) is that it involves regressing prices on market shares, which themselves are a function of prices, leading to endogeneity bias in ordinary least squares (OLS) specifications (Bresnahan, 1989). We therefore take an instrumental variable (IV) approach and construct instruments for exporter’s and importer’s bilateral shares. We exploit the structure of the network and build IVs that are correlated with the bilateral shares through shocks on other firms that are neither the exporter nor the importer of focus. 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 from both OLS and IV regressions.

As expected from the theory, we find that bilateral prices increase with the exporter’s supplier share and decrease with the importer’s buyer share. The first three columns report the results from the

¹⁹As a prior step, in Appendix C.2 we follow Fontaine et al. (2020) and consider a specification similar to (17) but without regressing on the bilateral shares. We analyze how much variation in bilateral prices is explained by product-specific components (captured by exporter-product-time fixed effects), by importer-specific components (captured by importer fixed effects), and relationship-specific components (captured by the residual term). We find that almost 90 percent of the variation in prices within exporter-product-time pairs are explained by the residual term, and only around 12 percent attributed to importer-specific components.

Table 2: Bilateral concentration and match-specific residual.

	$FE_i + FE_j + FE_{ht}$			$FE_{iht} + FE_{jht}$		
	OLS (1)	OLS (2)	IV (3)	OLS (4)	OLS (5)	IV (6)
s_{ijt}^h	0.226*** [0.00611]	0.227*** [0.00609]	0.519*** [0.0339]	0.442*** [0.0133]	0.442*** [0.0133]	0.397*** [0.00819]
x_{ijt}^h	-0.567*** [0.00994]	-0.566*** [0.00995]	-0.100*** [0.0187]	-0.673*** [0.0152]	-0.673*** [0.0152]	-0.586*** [0.00909]
Age of the relationship		-0.00702*** [0.000971]	-0.0433*** [0.00199]		0.00122 [0.00101]	-0.00342*** [0.00124]
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 $\left(s_{ijt}^h\right)$			9,347			31,500
SWF stat $\left(x_{ijt}^h\right)$			6,885			41,240

Notes: The first three columns report the results from specification (17). The last three columns report the results from an alternative specification where we have exporter-product-time and importer-product-time 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 F stat and SW F stat. The age of the relationship is measured as the number of years the firm-pair has been trading with each other. Significance: * 0.10, ** 0.05, and *** 0.01.

specification in which we control for exporter, importer, and product-time fixed effects. The last three columns report the results from the more stringent specification in which we add exporter-product-time and importer-product-time fixed effects, to control for the unobserved marginal costs of the exporters and the unobserved demand conditions of the importer. In both sets of specifications, the coefficients on both the exporter's and importer's bilateral shares are both statistically and economically significant. We find that 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.

Appendix C.3 explores how the bilateral shares affect pass-through elasticities. We follow [Fajgelbaum et al. \(2020\)](#) by taking the set of changes in tariffs on U.S. imports that occurred during 2017-2018 and analyze how these tariff changes affect bilateral prices. Columns (1)-(3) of Table 7 show results when we regress bilateral prices solely on the change in tariff. Despite the fact that we use annualized prices that are recorded at the level of the exporter-importer-product triplet while [Fajgelbaum et al. \(2020\)](#) use monthly prices at the country-product level, we find pass-through elasticities that are consistent with their findings: duty-inclusive prices have an elasticity close to one on the applied tariff changes that are instrumented by the changes in statutory rates, and the pass-through coefficient is significantly lower than one when regressing duty-inclusive prices on the statutory tariff rates. We then interact the tariff changes on the two bilateral shares. Our theory

predicts that the pass-through elasticity is non-monotonic in the supplier share s_{ij} , and decreasing in the buyer share x_{ij} . The regression results are broadly consistent with these predictions: the effect of the supplier share on the magnitude of the price changes is insignificant, and the coefficient on the interaction term of tariff changes and the buyer shares is significantly below zero.

While it is reassuring that the estimated pass-through elasticities behave as expected, Appendix C.3 does not provide conclusive evidence of our theory, which predicts a non-linear role of the bilateral shares that is hard to capture with reduced-form regressions. Moreover, the other important variable of interest—the bilateral bargaining power is not observed in the data and needs to be estimated. Therefore, we come back to the comparison between the empirical price changes and the model predicted price changes in Section 5, after we estimate the parameters of the model.

4 Calibration and Estimation

This section describes how we recover the primitive parameters, $\beta = \{\rho, \gamma, \nu, \theta\}$, together with the bilateral bargaining terms, ϕ_{ijt} . As a preliminary step, we fix the values of the parameters ν, γ and ρ externally. We set the demand elasticity that importers face downstream, namely ν , to 4. We take this value from the estimates of the U.S. downstream import demand elasticity in Soderbery (2018), who follows the methodology in Feenstra (1994); Broda and Weinstein (2006).²⁰ We also set the importer j 's marginal cost elasticity to the foreign input price index to $\gamma = 0.5$. We calibrate this elasticity from the share of imported material inputs in all material inputs for the manufacturing sector (see Eldridge and Powers, 2018). We last set the elasticity of substitution across foreign varieties, ρ , to be 10. The number is motivated by the survey of Anderson and van Wincoop (2004) which finds that the elasticity of substitution across goods within sectors ranges from around 5 to 10, depending on the level of aggregation. It is also within the range of estimates used by Edmond et al. (2018) that match the average markups in the U.S.

Given the parameters $\{\nu, \gamma, \rho\}$, in the remainder of the Section we describe how we use the newly constructed dataset to recover the return-to-scale parameter θ and the bilateral bargaining terms, ϕ_{ijt} . We focus the empirical analysis on these two objects as they are the critical ones that set our theory apart from existing ones in the literature.

4.1 Estimation of parameters θ and ϕ_{ij}

We first assume that the bilateral bargaining terms $\tilde{\phi}_{ijt}$ can be written as a monotonic function of a vector of covariates \mathbf{X}_{ijt} :

$$\tilde{\phi}_{ijt} = f(\mathbf{X}_{ijt} \mid \boldsymbol{\kappa}), \quad (18)$$

²⁰Appendix D.1 provides more details on the calibration.

where $\boldsymbol{\kappa}$ is an unknown parameter vector governing the function $f(\cdot)$. In the baseline estimation, we posit that $f(\cdot)$ is log-linear in all the covariates, i.e., $f(\mathbf{X}_{ijt} | \boldsymbol{\kappa}) = \exp(\mathbf{X}'_{ijt}\boldsymbol{\kappa})$. Consistent with the reduced-form evidence on bilateral prices, the vector of covariates \mathbf{X}_{ijt} includes all those (control) variables that are relevant for prices likely through the bargaining power of the firms. These variables include: (1) the longevity of the relationship, (2) the parties' relative age, (3) the relative size of the two's network, measured by the ratio between the number of importers buying from the exporter and the number of exporters selling to the importer, (4) an indicator variable of whether the buyer and seller transact multiple HS10 products, and (5) the total number of transactions that occurred between $i - j$.

Given the structure of equation (18), the log bilateral prices of product h can be written as:

$$\ln p_{ijt}^h = \ln \mu_{ijt}^h(\boldsymbol{\kappa}, \theta) + \ln c_{it}^h, \quad (19)$$

where we express the bilateral markup $\mu_{ijt}^h(\boldsymbol{\kappa}, \theta)$ as a function of the unknown parameters to be estimated, $(\boldsymbol{\kappa}, \theta)$, and we set the (unobserved) exporter's marginal cost of product h , c_{it}^h , constant across the exporter i 's buyers, in line with our theory.²¹

For a generic variable y , we define the operator $\Delta^{jk} \ln y_{ijkt}^h \equiv \ln y_{ijt}^h - \ln y_{ikt}^h$ as the log difference in y between the pair $i - j$ and $i - k$.²² For estimation, we construct moments by taking the price differences across importers within a exporter-product-year, namely

$$g_{ijkt}^h(\vec{\kappa}, \theta) = \Delta^{jk} \ln p_{ijkt}^h - \Delta^{jk} \ln \mu_{ijkt}^h(\boldsymbol{\kappa}, \theta). \quad (20)$$

Under the assumption that $c_{ijt}^h = c_{it}^h \forall j$ we obtain $\mathbb{E}_{jk} [g_{ijt}^h(\vec{\kappa}, \theta)] = 0$, which defines our moment condition.

One issue we may encounter in the estimation is that the residuals $g_{ijkt}^h(\vec{\kappa}, \theta)$ may also reflect unobserved (cost) heterogeneity across buyers j and k , thus creating an endogeneity problem if such heterogeneity is correlated with the vector of covariates \mathbf{X} and the bilateral shares. To address the endogeneity concern, we include in the estimation procedure a vector of instrumental variables \mathbf{Z} , which satisfies the conditions of being correlated with the vector of covariates \mathbf{X} and the bilateral shares, but uncorrelated with unobserved cost differentials. The vector \mathbf{Z} includes the total number of exporters in the HS10 product-year, the total number of importers in the HS10 product-year, and the mean and the median of the distributions of bilateral shares x_{ijt}^h and s_{ijt}^h 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 are not correlated with the specific dealing between pairs $i - j$ and $i - k$.

Importantly, one can show identification of both $\boldsymbol{\kappa}$ and θ from the structure of pair-level prices in

²¹We consider the possibility of within seller-product differences in marginal costs across buyers below, when discussing the identification strategy.

²² $\Delta^{jk} a_{ijt} = a_{ijt} - a_{ikt}$, where both j and k are importers of firm i .

equation (6). Identification of $\boldsymbol{\kappa}$ can be established from the fact that the weighting factor in the price, ω_{ijt} , is monotonically increasing in $\tilde{\phi}_{ijt}$. One can also show that according to the definition of equation (9) for any given $\mu_{ij}^{oligopsony}$, there exists a unique θ . We operationalize the estimation by solving for the following minimization problem:

$$\min_{\boldsymbol{\kappa}, \theta} g(\boldsymbol{\kappa}, \theta) \mathbf{Z}' \mathbf{W} \mathbf{Z} g(\boldsymbol{\kappa}, \theta)', \quad (21)$$

where \mathbf{W} is a weighting matrix.

4.2 Estimation results

We report in Table 3 the calibrated and estimated model’s parameters. Panel A shows the value of the calibrated parameters. Panel B reports the results of the GMM estimation that estimates the values of the vector $\boldsymbol{\kappa}$ and the scale parameter θ .²³ Results in Panel B show that the vector of parameters $\boldsymbol{\kappa}$, as well as the return to scale parameter, θ , are precisely estimated and with the expected sign. Longer relationships are associated with lower buyer’s bargaining power, a result that is in line with Heise (2019), who finds that older relationships exhibit a higher responsiveness of prices to exchange rate shocks. We find that conditional on longevity, more frequent transactions between the exporter and the importer increase the importer’s bargaining power; and the higher the relative experience of the exporter, the lower the bargaining power of the importer. The relative network—as measured by the ratio between the number of importers buying from the exporter and the number of exporters selling to the importer—represents the relative outside options of firms. We find that the more connected the exporter is relative to the importer, the less bargaining power the importer has. Finally, transacting multiple products with an exporter increases the bargaining power of the importer. On the estimate of θ , we find strong evidence of decreasing returns to scale, with θ well below one at 0.43.

With the estimated $\boldsymbol{\kappa}$ vector at hand and the matrix of covariates \mathbf{X}_{ijt} , we can fit an exponential function and construct the vector of bilateral bargaining power parameters. Panel C shows two moments of the distribution of the constructed ϕ_{ij} . On average, the U.S. importers tend to have a larger share of the bargaining power against the foreign exporter with the mean of ϕ_{ij} being 0.76 with a standard deviation of 0.09.

²³In Appendix D.2 we report the analogous results where we estimate $\boldsymbol{\kappa}$ and θ without using instruments, consistent with the assumption that the exporter’s marginal cost to produce a given HS10 is the same across U.S. importers.

Table 3: Model parameters

Panel A: Calibrated parameters		
ν		4
γ		0.5
ρ		10
Panel B: Estimated parameters (GMM estimation)		
$\boldsymbol{\kappa}$	Coef.	Std. Err.
Age of the relationship	-0.1502***	0.0158
Number of transactions	0.0802***	0.0050
Relative age	-0.1440***	0.0241
Relative network	-0.1909***	0.0100
Multiple HS10	0.1831***	0.0280
Constant	0.7479***	0.0538
θ	0.4278***	0.0780
Observations	1,376,000	
Panel C: Implied bargaining parameter		
	Mean	Std. Dev.
ϕ_{ij}	0.7636	0.0863

Notes: Panel A shows the value of the calibrated parameters for the price elasticity of 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 that chooses the vector $\boldsymbol{\kappa}$ and the return to scale parameter θ . The vector of covariates \mathbf{X}_{ijt} include (1) longevity of the $i-j$ relationship, (2) number of transactions have occurred between $i-j$; (3) relative age of firm i over firm j ; (4) relative network size of firm i over firm j ; and (5) an indicator variable of whether the firm-pair transact multiple HS10 products. 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_{ijt}^h and s_{ijt}^h , excluding the shares of the involved pairs $i-j$ and $i-k$. Standard errors are robust. Panel C reports the distribution of the implied bargaining parameter ϕ_{ij} under the estimated parameters.

5 Counterfactual Exercises

In this section, we take the estimated model and study the role of two-sided market power on the price pass-through of cost shocks.

5.1 Pass-through on bilateral prices

We first evaluate the model's ability to predict the import price responses to the surges in import tariffs in the context of the 2018 trade war. We do so by comparing the realized price changes at the bilateral pair level ($d \ln p_{ijt}^h$) with the predicted price changes ($d \widehat{\ln p_{ijt}^h}$) before and after the trade cost surge. The term $d \ln p_{ijt}^h$ can be easily computed from our data as the observed log change in the bilateral prices at the exporter i -importer j -HS10 product-level between 2017 and 2018. We construct the predicted price changes $d \widehat{\ln p_{ijt}^h}$ from equation (15), duly amended to accommodate

multiple products, namely $\widehat{d \ln p_{ijt}^h} = \Phi_{ijt}^h \cdot d \ln \vartheta_{it}^h$, where $d \ln \vartheta_{it}^h$ is the observed (log) change in the import tax applied to exporter i and product h .²⁴

To further assess our model’s performance, we compare its ability to predict price changes to that of more traditional pricing frameworks in the literature, which our theory tractably nests. We consider two popular alternatives: The first is the standard Bertrand (B) model (e.g., [Atkeson and Burstein, 2008](#)), which corresponds to the case where the exporter sets prices unilaterally ($\tilde{\phi}_{ij} \rightarrow 0$), and upstream production exhibits constant returns ($\theta = 1$). As the second alternative, we consider the bargaining price-setting model of wholesalers (Bgn) (e.g., [Gopinath and Itskhoki \(2010\)](#)), where importers and exporters negotiate over the input price ($\tilde{\phi}_{ij} \in \mathbb{R}_+$), but production exhibits constant returns ($\theta = 1$) so there is no scope for the importer to wield market power.

We denote by $\widehat{d \ln p_{ijt}^h}^m$ the predicted log price changes under model m , where $m = \{Baseline, B, Bgn\}$. We then run the following regression:

$$d \ln p_{ijt}^h = \beta_m \widehat{d \ln p_{ijt}^h}^m + \gamma_j + \rho_h + \delta_t + u_{ijt}^h \text{ for } m = \{Baseline, B, Bgn\}. \quad (22)$$

We consider the estimated coefficient $\hat{\beta}^m$ as the measure of goodness-of-fit of the different models: The higher $\hat{\beta}^m$, the more the observed changes in prices co-move with the predicted ones.

We report the results in Table 4. We find that our baseline model performs better in predicting observed price changes compared to models in which importer’s buyer share does not play a role. This result highlights the need of jointly accounting for two-sided bargaining and market power as in our model, in analyzing the determinant of pair-specific prices and pass-through.

5.2 Two-Sided Market Power and Aggregate Import Prices

To gauge the impact of cost shocks on aggregate prices, we extend our partial equilibrium framework and define a price index for imported goods and final goods. We assume that final demand can be written as an aggregate of a bundle of domestic goods and a bundle of imported goods. The imported goods bundle is an aggregate of the output of U.S. importers. We assume that these aggregations are done through homothetic demand. Assuming away the changes prices of domestic goods and other general equilibrium effects, one can write down the first-order approximated change in the price of final goods, P , as

$$d \ln P = s_{FH} d \ln P_F, \quad (23)$$

where s_{FH} is the share of goods sold by U.S. importers in the final consumption bundle and P_F is the price index of importers’ output bundle. The change in this importers’ output price index is written as

²⁴Note that the term Φ_{ijt}^h only depends on the observed importer’s and exporter’s bilateral shares and the estimated parameters.

Table 4: Responses of bilateral price on model predicted price changes

	$(m = Base)$		$(m = B)$		$(m = Bgn)$	
	(1)	(2)	(3)	(4)	(5)	(6)
$d \ln \hat{p}_{ijt}^{h,m}$	0.762*** [0.113]	0.673*** [0.190]	0.406*** [0.0588]	0.294** [0.119]	0.364*** [0.0483]	0.288*** [0.0989]
Seller-HS10 Fixed Effects	No	Yes	No	Yes	No	Yes
Observations	955,000	955,000	955,000	955,000	955,000	955,000
R^2	0.002	0.367	0.002	0.367	0.002	0.367

Notes: Table reports the OLS coefficient of specification (22) where the observed changes in log prices are regressed on the model predicted changes in log prices. We consider three different models and U.S. tariff changes during the period 2017-2018 as the shock. 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 ($\theta < 1$). Columns with $m = B$ represent the case in which importers are price-takers ($\phi_{ij} \rightarrow 0$) and production is constant returns ($\theta = 1$). Columns with $m = Bgn$ represent the case in which both importers and exporters have bargaining power ($\phi_{ij} \rightarrow 1$), but production is constant returns ($\theta = 1$). Standard errors are clustered by country and industry. Significance: * 0.10, ** 0.05, and *** 0.01.

$$d \ln P_F = \sum_j s_j d \ln p_j, \quad (24)$$

where s_j is the share of firm j 's output among all importers. We approximate the changes in the output price of importers by their cost changes, hence we obtain

$$d \ln p_j = \gamma \sum_{i \in \mathcal{Z}_j} s_{ij} \Psi_{ij} d \ln \vartheta_i. \quad (25)$$

Equations (23) to (25) show that one can compute the effects of import tariff shocks $d \ln \vartheta_i$ on final goods price index by using the bilateral pass-through elasticity Ψ_{ij} . As shown in the section above, these pass-through elasticities produce different predictions on bilateral price changes depending on the assumptions made in the model. To investigate how these differences in the bilateral pass-through elasticities generate different predictions on how aggregate prices respond, we consider the import tariff changes during the period of 2017-2018 and compute aggregate price changes of $d \ln P$ and $d \ln P_F$. We illustrate how bilateral market power affect these predictions by first computing the price changes under our baseline model ($m = Base$) and then comparing these with the price changes under alternative scenarios of $m = AB$ and $m = GI$. We note that across all specifications of the model, only the bilateral pass-through elasticities Ψ_{ij} are allowed to differ and all other parameters and shares are the same.

6 Conclusions

Understanding movements in international prices is a central question in international economics. The trade models commonly used to assess the effect of trade policy on prices typically postulate that prices are set unilaterally by exporters in anonymous markets governed by market-clearing conditions. A key feature of international trade, however, is that transactions between importers and exporters are typically resolved via bilateral negotiations where both importers and exporters exert some bargaining power.

This paper bridges the gap between the theoretical and empirical trade literature with a novel pricing framework of GVCs and novel evidence for U.S. imports. Our partial equilibrium framework is tractable and quantifiable; it provides a formula for the pass-through elasticity of tariff shocks at the importer-exporter level as an exact function of a few sufficient statistics: the importer's and exporter's market shares, which are observed, and the relative bargaining weights, which are unobserved. To bring the model to the data, this paper constructs a novel two-sided trade dataset where firm-to-firm trade data are matched to bilateral characteristics of both importers and exporters. This paper also develops a novel identification strategy for the Nash bargaining weights and the input supply elasticity, two key (sets of) parameters determining the scope of two-sided concentration and market power for bilateral markups and pass-through elasticity.

We show that in the context of the 2018 trade war, our model generates more accurate predictions of pair-level price changes following a tariff shock than standard pricing models in the literature. These micro-level differences matter for the aggregate economy. Specifically, we show that our model improves the estimated impact of the trade war on aggregate U.S. import prices by 40-60%. Overall, our theory improves our understanding of the micro-level determinants of the pass-through elasticities into import prices, thus representing a valuable tool for policy-makers and the optimal design of trade policy.

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A Derivations and Additional Theoretical Results

A.1 Derivation of equation (6)

Here we outline the derivation of equation (6). We solve for the first-order conditions of (5) by first listing each of its four elements $\{\pi_i, \pi_j, \tilde{\pi}_{i(-j)}, \tilde{\pi}_{j(-i)}\}$, 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

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

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

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

The outside profit of firm i under a failed negotiation 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 (4):

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

Therefore, the term $\pi_i - \tilde{\pi}_{i(-j)}$ can then be expressed as

$$\pi_i - \tilde{\pi}_{i(-j)} = q_{ij} \left(p_{ij} - c_i \mu_{ij}^{oligopsony} \right),$$

where

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

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

$$\pi_j = (\mu_j - 1) c_j^{1-\nu} \mu_j^{-\nu} D_j,$$

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

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

Therefore the term $\pi_j - \tilde{\pi}_{j(-i)}$ can then be expressed as

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

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,

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

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

$$\begin{aligned} \omega_{ij} &= \frac{\tilde{\phi}_{ij} \lambda_{ij}}{\varepsilon_{ij} - 1 + \tilde{\phi}_{ij} \lambda_{ij}} \\ \lambda_{ij} &= \frac{s_{ij} (\tilde{\nu} - 1)}{1 - \hat{\pi}_{j(-i)}}. \end{aligned}$$

Note that the term $\hat{\pi}_{j(-i)}$ represents the ratio of firm j 's profits,

$$\hat{\pi}_{j(-i)} \equiv \frac{\tilde{\pi}_{j(-i)}}{\pi_j} = (1 - s_{ij})^{\frac{1-\nu}{1-\rho} \gamma}.$$

A.1.1 Weighting Factor ω_{ij}

We now explore the overall effect of the share s_{ij} on the weighting factor ω_{ij} . The latter is an increasing function of $\tilde{\phi}_{ij} \lambda_{ij}$, the product of the exogenous bargaining term ($\tilde{\phi}_{ij}$), and a term (λ_{ij}) that increases in the buyer's outside option $\hat{\pi}_{j(-i)} \equiv \frac{\tilde{\pi}_{j(-i)}}{\pi_j} = (1 - s_{ij})^{\frac{1-\nu}{1-\rho} \gamma}$; the latter is a decreasing

function of the supplier's share s_{ij} . At the same time, ω_{ij} depends on the share s_{ij} through the demand elasticity ε_{ij} .

While it is complex to obtain an analytical characterization of the elasticity of ω_{ij} with respect to s_{ij} , we can

A.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 (5), we now have the following Nash bargaining problem

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

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:

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

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

$$\begin{aligned} \omega_{ij}^q &\equiv \frac{\frac{1}{\nu} \tilde{\phi}_{ij} \lambda_{ij}}{1 - \left(\varepsilon_{ij}^q \right)^{-1} + \frac{1}{\nu} \tilde{\phi}_{ij} \lambda_{ij}} \in (0, 1) \\ \left(\varepsilon_{ij}^q \right)^{-1} &= \frac{1}{\rho} (1 - s_{ij}) + \left(1 - \gamma + \frac{1}{\nu} \gamma \right) s_{ij}. \end{aligned}$$

The price above has a similar structure as in equation (10). It is a weighted average between a standard oligopoly (Cournot) markup, $\frac{\varepsilon_{ij}^q}{\varepsilon_{ij}^q - 1}$, and the markup term $\mu_{ij}^{oligopsony}$. The oligopoly markup depends in this case on the elasticity ε_{ij}^q , which is a harmonic weighted average of elasticities ν and ρ as in [Atkeson and Burstein \(2008\)](#).

A.3 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 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:

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

The first order conditions under these changes in profits yield:

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

where $\bar{\lambda}_{ij} = \frac{(\tilde{\nu}-1)s_{ij}}{1 - \frac{\varrho_{ij}}{\pi_j}}$. The equation above has the same structure as that of equation (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, $\frac{1}{x_{ij}} \left(1 - \frac{\varsigma_{ij}}{c_iq_i}\right)$. To compare with equation (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), $1 - \frac{\varsigma_{ij}}{c_iq_i}$, 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 (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, $1 - \frac{\varsigma_{ij}}{c_iq_i}$, 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 (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.

A.4 Pass-through

A.4.1 Derivation of Proposition 2

We consider the elasticity of bilateral price p_{ij} with respect the cost shock of ϑ_{ij} , where one can write

$$\Phi_{ij} \equiv \frac{d \ln p_{ij}}{d \ln \vartheta_{ij}} = \Gamma_{ij}^s \frac{d \ln s_{ij}}{d \ln \vartheta_{ij}} + \Gamma_{ij}^x \frac{d \ln x_{ij}}{d \ln \vartheta_{ij}} + \frac{1 - \theta}{\theta} \frac{d \ln q_i}{d \ln \vartheta_{ij}} + 1.$$

The elasticity of the exporter's supplier share s_{ij} , $\frac{d \ln s_{ij}}{d \ln \vartheta_{ij}}$, can be derived as

$$\frac{d \ln s_{ij}}{d \ln \vartheta_{ij}} = (1 - \rho) (1 - s_{ij}) \frac{d \ln p_{ij}}{d \ln \vartheta_{ij}}.$$

The elasticity of the importer's buyer share x_{ij} , $\frac{d \ln x_{ij}}{d \ln \vartheta_{ij}}$, can be derived as

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

where in this derivation we have assumed that firm i 's sales to other buyers do not respond to the shock ϑ_{ij} .

The term $\Gamma_{ij}^s = \frac{\partial \ln \mu_{ij}}{\partial \ln s_{ij}}$ is computed as

$$\Gamma_{ij}^s = (1 - \omega_{ij}) \cdot \frac{\mu^{oligopoly}}{\mu_{ij}} \left[\frac{\partial \ln (1 - \omega_{ij})}{\partial \ln s_{ij}} + \Gamma_{ij}^{s,oligopoly} \right] + \omega_{ij} \cdot \frac{\mu^{oligopsony}}{\mu_{ij}} \cdot \frac{\partial \ln \omega_{ij}}{\partial \ln s_{ij}},$$

where $\Gamma_{ij}^{s,oligopoly} \equiv \frac{\partial \ln \mu_{ij}^{oligopoly}}{\partial \ln s_{ij}}$. Approximating $\frac{\partial \ln (1 - \omega_{ij})}{\partial \ln s_{ij}} = \frac{\partial \ln (\omega_{ij})}{\partial \ln s_{ij}} \simeq 0$, we can write

$$\Gamma_{ij}^s = (1 - \omega_{ij}) \cdot \frac{\mu^{oligopoly}}{\mu_{ij}} \Gamma_{ij}^{s,oligopoly}$$

where

$$\Gamma_{ij}^{s,oligopoly} = \frac{1}{\varepsilon_{ij} - 1} \frac{\rho - \varepsilon_{ij}}{\varepsilon_{ij}}.$$

Note that with full supplier's bargaining power we get $\omega_{ij} \rightarrow 0$ and $\mu_{ij} \rightarrow \mu^{oligopoly}$ so that $\Gamma_{ij}^s = \Gamma_{ij}^{s,oligopoly}$. On the other hand, with full buyer's bargaining power, we find $\omega_{ij} \rightarrow 1$ and $\Gamma_{ij}^s \rightarrow 0$.

Similarly, the term $\Gamma_{ij}^x = \frac{\partial \ln \mu_{ij}}{\partial \ln x_{ij}}$ is computed as

$$\Gamma_{ij}^x = \omega_{ij} \cdot \frac{\mu^{oligopsony}}{\mu_{ij}} \Gamma_{ij}^{x,oligopsony}$$

where

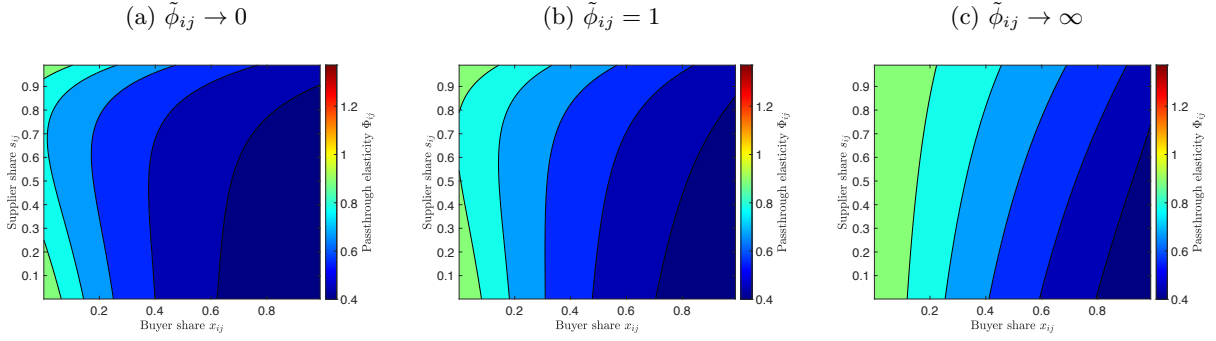
$$\Gamma_{ij}^{x,oligopsony} \equiv \frac{\partial \ln \mu_{ij}^{oligopsony}}{\partial \ln x_{ij}} = \frac{(1 - x_{ij})^{\frac{1-\theta}{\theta}}}{\mu_{ij}^{oligopsony}} - 1.$$

Note that, with full supplier's bargaining power we get $\omega_{ij} \rightarrow 0$ and $\mu_{ij} \rightarrow \mu^{oligopoly}$ so that $\Gamma_{ij}^x = 0$. On the other hand, with full buyer's bargaining power, we find $\omega_{ij} \rightarrow 1$ and $\Gamma_{ij}^x \rightarrow \Gamma_{ij}^{x,oligopsony}$.

Putting all together, one can obtain the pass-through elasticity as in equation (15).

Figure 2 plots the pass-through elasticities for values of $x_{ij} \in [0, 1]$, $s_{ij} \in [0, 1]$ and $\tilde{\varphi}_{ij} \in \{0, 1, \infty\}$.

Figure 2: Pass-through elasticities: Contour plot



The figure shows that when both markups and cost channels are included, the pass-through elasticity takes value below unity, namely, the pass-through is generally incomplete. Notably, the pass-through elasticity decreases in the importer’s buyer share, due to the cost channel always prevailing over the strategic substitutability channel; the pass-through elasticity is instead *u-shaped* in the exporter’s supplier share.²⁵

In some settings, researchers may find it useful or desirable to focus on the role of markups changes in determining the pass-through elasticities. This is feasible empirically whenever changes in marginal costs can be controlled for in estimation. In such cases the pass-through elasticity is given by:

$$\Phi_{ij}|_{d \ln c_i=0} = \frac{1}{1 + \Gamma_{ij}^s (\rho - 1) (1 - s_{ij}) + \Gamma_{ij}^x (1 - x_{ij}) \varepsilon_{ij}}. \quad (26)$$

Figure 3: Pass-through elasticities: Markup channel

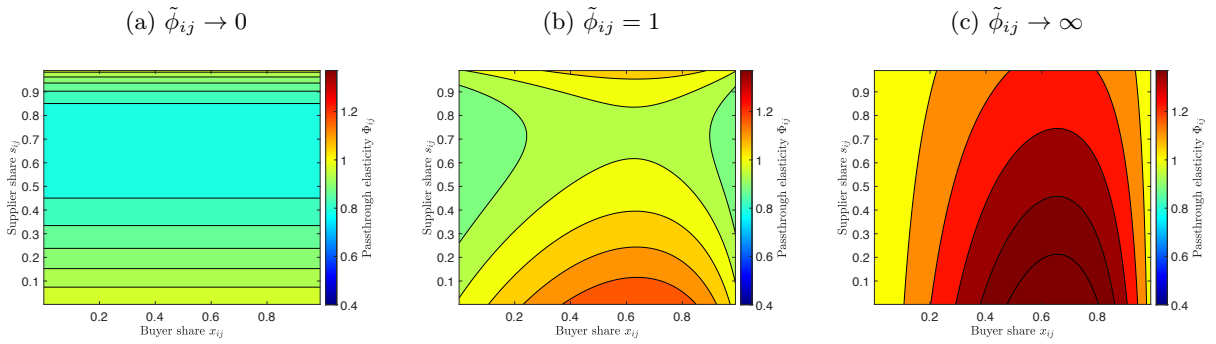


Figure 3 plots the pass-through elasticities for values of $x_{ij} \in [0, 1]$, $s_{ij} \in [0, 1]$ and $\tilde{\phi}_{ij} \in \{0, 1, \infty\}$, in settings where marginal cost changes can be controlled for. The figure shows that when only the markup channel is considered, the pass-through elasticity takes values both below and above unity,

²⁵To see this, note that while the cost channel increases linearly in the importer’s share, the markup channel decreases less than linearly in the importer’s share due to its offsetting effect on Γ_{ij}^x .

due to the contribution of the strategic complementarities and strategic substitutabilities channel. In this case, the elasticity of the pass-through to buyer's and supplier's share varies depending on the values of x_{ij} , s_{ij} and $\tilde{\phi}_{ij}$. Notably, when market power on both sides of the market is allowed for, high pass-through rates are more frequent than in models where market power is concentrated on the exporter's side only.

A.4.2 Generalized pass-through elasticity

The direct pass-through elasticity of equation (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 (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 A.4.1 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

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

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

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

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 :

$$\Psi_{ij} = \Phi_{ij} + \Phi_{ij} \left(\Gamma_{ij}^x - \frac{1 - \theta}{\theta} \right) \sum_{z \in \mathcal{J}_i, z \neq j} x_{iz} \varepsilon_{iz} \Psi_{iz}. \quad (27)$$

The first term in equation (27) captures the direct effect of the cost shock on the price of the pair of focus, as defined in equation (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 $\left(\Gamma_{ij}^x\right)$ 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} .

B Data Appendix

B.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 between LFTTD and ORBIS using the constructed MID.

The general procedure to construct an identified code for a manufacturer using its name and address is as follows. (1) The first two characters of the MID are formed by the iso code of the actual country of origin of the goods, being the only exception to the rule Canada, for which each Canadian Province has their own code. (2) 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. (3) The MID uses the first four numbers of the largest number on the street address line. (4) Finally, the last three characters are formed by the first three alpha characters from the city name.²⁶

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%. 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.

²⁶Other general rules also apply. For example, english words such as “a,” “an,” “and,” “the,” and also hyphens are ignored from 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.

The LFTTD MID variable has recently been used in academic research papers to identify importer-exporter relationships (see Eaton et al., 2012; Kamal and Sundaram, 2012; Kamal and Krizan, 2013; Kamal and Monarch, 2018; Monarch, 2020). 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.²⁷ Since we observe the NAICS code of the firms in ORBIS, we have excluded retailers and wholesalers from the matched Census-ORBIS dataset.

B.2 AD dataset

We collect information on firm-level cost shocks incurred by foreign suppliers by focusing on the AD duties imposed by the U.S. government on these foreign suppliers. For each case activated by the U.S. government, the Federal Register publishes announcements that contain the date when the AD investigation was initiated, which U.S. firms were the petitioner for the case, date of AD duty activation, the list of 10-digit Harmonized System codes of the products covered in the case, the names of foreign exporters subject to the AD duties and their corresponding rates, and if the AD case has closed, the date of revocation.

Similar information is collected by Bown (2016), and the key difference is that we cover all AD cases from 1994 to 2020, whereas the dataset of Bown (2016) covers only up to the year 2016. We take the list of all the past and present AD cases from the U.S. International Trade Commission (USITC) website.²⁸ For each case, we then manually collect the relevant information from the official documents published by the International Trade Administration (ITA) on the Federal Register website.²⁹

B.3 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

²⁷The law requires the importer to declare the MID of the manufacturer exporter, not the intermediary, but complacency of this rule is hardly enforceable.

²⁸See http://www.usitc.gov/trade_remedy/documents/orders.xls. The file we use is the one downloaded on October 27th, 2020.

²⁹See <https://www.federalregister.gov/>.

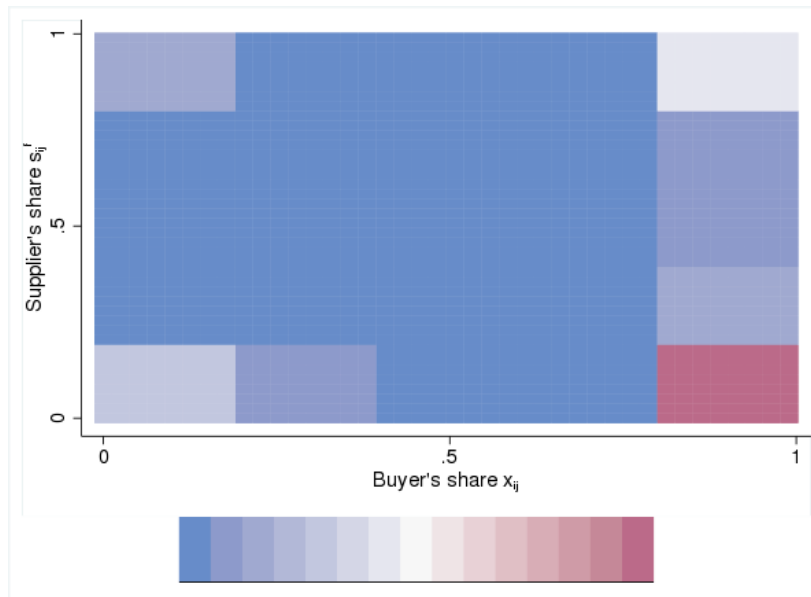
different countries. We specify that a parent should own at least 50% of an affiliate to identify an ownership link between the two firms.

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% or higher for imports, well below the level required for majority ownership or that would confer sufficient control rights.

B.4 Distribution of the two bilateral shares s_{ij} and x_{ij}

In Figure 4 we plot a heat map that shows the joint distribution of the two bilateral shares, s_{ij} and x_{ij} . The figure reveals that importer-exporter relationships are not concentrated in one particular corner of the graph, namely in regions where relationships can be represented by models with one-sided heterogeneity. There are significant number of relationships where either or both supplier and buyer shares are close to 0 or 1, but in order to analyze all the combinations of the two bilateral shares one needs a model with two-sided heterogeneity and market power.

Figure 4: Joint distribution of the exporter’s supplier share (s_{ij}) and the importer’s buyer share (x_{ij})



Notes: The figure displays the share of importer-exporter-HS10 observations, with respect to the exporter’s supplier share (s_{ij}) and importer’s buyer share (x_{ij}).

C Additional Empirical Results

C.1 Structure of U.S. import transactions

Here we show that many-to-many matches account for a significant share in U.S. imports. We classify all firm-to-firm linkages that are at the arm’s length relationship in the U.S. import transaction data into four mutually exclusive groups. The first group is the set of one-to-one linkages, where the exporter and the importer only trades with the other. The second is the set of one-to-many linkages, where the exporter supplies to other importers but the importer only buys from the exporter. The third is the set of many-to-one linkages, where the exporters supply only to one importer but the importer buys from multiple exporters. Finally, the last set is the set of many-to-many linkages in which exporters and importers have multiple trading partners. We report the results of the decomposition in Table 5. The table shows that in most of the linkages, either the exporter or the importer, or both of the firms have relationships with other firms. In particular, we find that linkages that can be classified as many-to-many linkages account for around a quarter of the transactions in terms of numbers and around 43% in terms of import value.

Table 5: Prevalence of many-to-many linkages

	1:1	1:m	m:1	m:m
% of links	0.19	0.11	0.47	0.24
% of import value	0.07	0.05	0.45	0.43

Note: The table shows the economic relevance of four mutually exclusive subsets of exporter-importer-HS10 product triplets: (1:1) both in the pair have no other partners; (1:m): importer has only one exporter but the exporter has multiple importers; (m:1): exporter has only one importer but the importer has multiple exporters; (m:m): both in the pair have multiple partners.

C.2 Relationship-specific components in bilateral prices

Our model puts emphasis on the role of bilateral bargaining in determining bilateral prices. The resulting price equation illustrates how variables that are determined at the pair-level, such as the exogenous bargaining parameter ϕ_{ij} and the endogenous bilateral shares s_{ij} and x_{ij} are key in explaining the variations in bilateral prices. Here we empirically investigate this theoretical insight by exploring what variables can explain the variations in bilateral prices.

In particular, here we show that firm-level or product-level components cannot capture the full dispersion in bilateral prices. In presenting this fact, we follow Fontaine et al. (2020) and consider the following statistical decomposition of price dispersion:

$$\ln p_{ijt}^h = FE_i + FE_j + FE_{ht} + \beta \mathbf{X}_{ijt}^h + \varepsilon_{ijt}^h, \quad (28)$$

where \mathbf{X}_{ijt}^h represents the set of control variables, FE_i is an exporter fixed effect, FE_j is an importer fixed effect, and we also control for product-time fixed effects FE_{ht} . This type of two-way fixed effect equations can only be estimated on the largest connected set (LCS), which corresponds to the largest sample where buyers are connected through their shared suppliers, and suppliers are connected through the set of common buyers.³⁰ Our sample satisfies the two critical requirements: (i) all exporters and importer have multiple partners, and (ii) each importer shares at least one exporter with another importer, and each exporter shares at least one customer with another exporter. Therefore the largest connected set component is the entire sample.

The results are presented in Table 6, where in column (1) we only control for the fixed effects and in column (2) we add a set of relevant controls. In column (1), the set of fixed effects captures more than 91% of the observed price dispersion, and this result is not affected by the inclusion of controls. The results in Panel A show that more than half of the overall price dispersion (52%) is attributed to the HS10-year fixed effects. The exporter fixed effects—which capture the unobserved product heterogeneity and market power differences across exporters—account for almost 34% of the variance, whereas the importer fixed effects—which capture the unobserved heterogeneity in

³⁰This is because firm fixed effect are estimated relative to a reference firm, with a different reference firm for each connected set. It is therefore meaningless to compare importer and exporter fixed effects across sets.

good valuation among importers and differences in importers’ firm-level market power—account for a much smaller share of the variance (6%). The remaining component, the match residual accounts for about 8% of the price dispersion. Very similar patterns have been shown for firm-to-firm price information of French exports (Fontaine et al., 2020).

In order to understand the price dispersion across importers for a given exporter-HS10 product pair, Panel B reports how much of the dispersion in prices within an exporter-HS10-year is attributable to the importer fixed effects and the residual component.³¹ We find that importer fixed effects can only account for around 12% of the price dispersion within exporter-product-year triplets, and the rest of the variation remains specific to the importer-exporter relationship for a given product and year.

Table 6: Fixed-effect decomposition of price dispersion

	(1)	(2)
Panel A. Overall price dispersion		
Observable		-0.0006
HS10 x year FE	0.5190	0.5200
Exporter FE	0.3360	0.3360
Importer FE	0.0630	0.0628
Match residual	0.0818	0.0818
Panel B. Within exporter-product dispersion		
Observables		0.001
Importer FE	0.115	0.115
Match residual	0.885	0.884

Note: The table reports the results of estimating equation (28), over the period 2001-2016. We report in the two panels the results of the variance decomposition exercise of decomposing the observed price dispersion into different fixed effect components, in the entire sample and within exporter-HS10-year triplets. 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.

C.3 Pass-through regressions

In this section we empirically examine how the pass-through of cost shocks are influenced by different values of the two bilateral shares. We focus on the responses of import prices to the observed changes in import tariffs during the period of 2017-2018. Based on the analysis in Section 2.3, we regress the observed yearly changes in log prices—which is at the exporter i by importer j by HS10 product-level—on the changes in the tariff rates during the same period, $(1 + \tau_{it}^h)$, and their

³¹In Panel B the importer and match residual components are regressed on normalized log prices, where prices are normalized in the exporter-HS10-year dimension.

interaction with the importer’s (x_{ijt}^h) and the exporter’s share (s_{ijt}^h), respectively. Also consistent with the assumption made in Section 2.3 in which we assume that both the quantities that exporter i sells to other buyers ($-j$), $\Delta \ln q_{i(-j)t}^h$, and the prices that other suppliers ($-i$) charge to firm j , $\Delta \ln p_{(-i)jt}^h$, do not change, we construct these variables in our data and include them as controls in our regression. We run the following specification:

$$\begin{aligned} \Delta \ln p_{ijt}^h = & \alpha_0 + \alpha_1 \Delta \left(1 + \tau_{ct}^h \right) + \alpha_x \Delta \left(1 + \tau_{ct}^h \right) \times x_{ijt}^h + \alpha_s \Delta \left(1 + \tau_{ct}^h \right) \times s_{ijt}^h \\ & + \alpha_q \Delta \ln q_{i(-j)t}^h + \alpha_p \Delta \ln p_{(-i)jt}^h + \delta_j + \delta_s + \delta_c + \epsilon_{ijt}^h. \end{aligned}$$

The first three columns of Table 7 show results where we run pass-through regressions solely on the change in tariff—excluding the interaction terms—in the spirit of Fajgelbaum et al. (2020). Consistent with their findings, we find complete pass-through on average: We find coefficients close to zero when regressing prices before duties on the statutory tariff rates (Column (1)) or when regressing prices before duties on applied tariffs, instrumented by the statutory rates (Column (2)). At the same time, we find a coefficient close to one when regressing duty-inclusive price on applied tariffs with the same instruments (Column (3)). As in Fajgelbaum et al. (2020), we find a coefficient significantly lower than one when regressing duty-inclusive price on the statutory tariff rates (Column (4)).³² These similarities in the average pass-through results with those from Fajgelbaum et al. (2020) are remarkable despite the differences between the two settings. First, our datasets differ in their frequency: Fajgelbaum et al. (2020) use monthly data whereas we use annual changes. Second, we record the observed price changes within a given exporter-importer-product triplet, instead of at the country-product level, compelling us to use only exporter-importer pairs that trade the same HS10 product, more than once and consecutively, in the years 2017 and 2018.

In the last column of Table 7, we add terms that interact statutory tariff rates with the supplier and buyer shares. There we find the same pattern as what was found in Section 3.4: The magnitude of the pass-through diminishes as the pair has larger importer’s buyer share x_{ij} , and the coefficient on the exporter’s supplier share is positive but insignificant.

³²Notice that the coefficient in Column (4) is not one plus the coefficient in Column (1), because the duty inclusive unit value is constructed using actual duties collected by the U.S. customs data. As expected, the coefficient on duty-inclusive prices in Column (3) is one plus the coefficient in Column (2), since these are regressed on the applied tariffs.

Table 7: Pass-through and bilateral shares, x_{ij} and s_{ij}

	$\Delta \ln p_{ijt}^*$ (1)	$\Delta \ln p_{ijt}^*$ (IV) (2)	$\Delta \ln p_{ijt}$ (IV) (3)	$\Delta \ln p_{ijt}$ (4)	$\Delta \ln p_{ijt}$ (5)
$\Delta \ln(1 + \tau_{cht})$	0.00467 [0.0531]			0.153** [0.0659]	0.232** [0.0944]
$\Delta \ln(1 + \tau_{cht}^{app})$		0.0315 [0.357]	1.031*** [0.357]		
$\Delta \ln(1 + \tau_{cht}) \cdot x_{ijt}^h$					-0.187** [0.0950]
$\Delta \ln(1 + \tau_{cht}) \cdot s_{ijt}^h$					0.0946 [0.0982]
Country FE	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes
Importer FE	Yes	Yes	Yes	Yes	Yes
Observations	955,000	955,000	955,000	955,000	955,000
R-squared	0.086	-	-	0.087	0.087
First stage F stat		20.75	20.75		

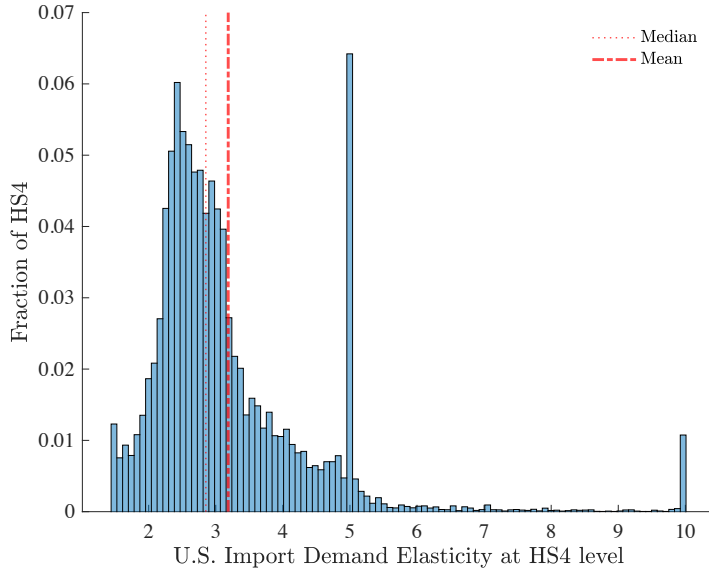
Notes: Table reports the response of prices to changes in import tariffs during the period 2017-2018. In columns (1) and (2) the dependent variable is the before duty unit values, and in columns (3)-(5) the dependent variable is the duty-inclusive unit values. Columns (1), (4) and (5) report before and after duty unit values regressed on the statutory tariff rate, $\Delta \ln(1 + \tau_{cht})$. Columns (2) and (3) report the second stage outcomes of before and after duty unit values regressed on the applied tariff, $\Delta \ln(1 + \tau_{cht}^{app})$, where $\Delta \ln(1 + \tau_{cht}^{app})$ is instrumented by the statutory tariff rate, $\Delta \ln(1 + \tau_{cht})$. The coefficient from a bivariate regression of applied tariff and statutory tariff is 0.148 and significant at 0.01 level. All regressions control for (a) the number of years the firm-pair relationship has last (age of the relationship); (b) the change in the quantities that exporter i sells to other importers but j , $\Delta \ln q_{i(-j)t}^h$; and (c) the weighted average of the change in prices of other exporters to firm j , $\Delta \ln p_{(-i)jt}^h = \sum_{k \neq i} s_{kj(t-1)}^h \Delta \ln p_{kjt}^h$, with weights given by the relative importance of other exporters ($-i$) in j 's imports of product h at the beginning of the period, $s_{kj(t-1)}^h$. All regressions include importer, industry and country fixed effects. Standard errors are clustered by country and industry. Significance: * 0.10, ** 0.05, and *** 0.01.

D Estimation Appendix

D.1 Downstream demand elasticity (ν)

Following Broda and Weinstein (2006), we assume that buyer j sells its output q_j to downstream customers in different countries. A representative consumer in each country maximizes her utility by choosing imports and domestic consumption. Following the standard in the literature, consumers aggregate over the composite 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^I , where I denotes the import market. Soderbery (2018) provides estimates of the elasticity σ_g^I , at the HS4 good g -importer country I level. The plot below shows the distribution of these elasticities when the exporter country I is the

Figure 5: Downstream demand elasticity



Notes: The figure displays the estimates of the import demand elasticity σ_g^I , where $I = USA$. These estimates are taken from Soderbery (2018). The mean and median value of σ_g^{US} is 3.2 and 2.85, respectively. Estimates are truncated above at 10.

U.S. We use these elasticities to calibrate a value of ν in our model. For our baseline estimation, we consider the median value of 2.85, which we see as a conservative choice.

D.2 Estimates of θ and ϕ_{ij} when not using instruments

In this section we repeat the GMM estimation of section 4.2 but this time under the assumption that the exporter’s marginal cost to produce a given HS10 product is the same across U.S. importers. Under this assumption there are no unobserved cost differences in equation (21) that we need to instrument for. We report in Table 8 the estimation results, corresponding to Panel B of Table 3. The signs and magnitudes of the estimates are largely unaffected by this alternative method of estimation.

Table 8: Estimated parameters (without instruments)

	Coef.	Std. Err.
κ		
Age of the relationship	-0.1505***	0.0153
Number of transactions	0.0846***	0.0048
Relative age	-0.1467***	0.0233
Relative network	-0.2058***	0.0099
Multiple HS10	0.1859***	0.0273
Constant	0.6831***	0.0534
θ	0.4069***	0.0083
Observations	1,376,000	

Notes: The table reports the results from the GMM regression that chose the vector κ and the return to scale upstream parameter θ . In the estimation we assume that the exporter's marginal cost to produce a given HS10 product is the same across U.S. importers, and do not make use of IVs. Standard errors are robust.