

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

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Abstract

We provide a framework for analyzing buyer-supplier bargaining over the price of an imported good with two-sided market power and heterogeneity. Our main theoretical result is a price formula that tractably nests a wide range of configurations of market power and heterogeneity among importers and exporters in a unified way. We demonstrate that a shock to the exporter's costs can have a very different pass-through on import prices depending on the allocation of bargaining power and bilateral market shares. To estimate the model, we build a novel dataset merging transaction-level international trade data for the U.S. with balance sheet information on both the U.S. importers and foreign exporters. Our results shed light on two open questions on firms' participation in global value chains: the relationship between import and export concentration and markups; the role of firms in determining the tariff pass-through on import prices.

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1 Introduction

The recent surge in protectionist trade policies in advanced economies has spurred new interest in the tariff pass-through literature. Some recent studies have analyzed the effects of the 2018 U.S.-China trade war, finding evidence of an almost complete pass-through of U.S. import tariffs into import prices translating into substantial welfare losses (Fajgelbaum et al., 2020; Flaaen et al., 2020; Amiti et al., 2019, 2020; Cavallo et al., 2020). These findings are surprising for several reasons: For one thing, they challenge the conventional view of the terms-of-trade argument for non-zero tariffs (Bagwell and Staiger, 1999). More importantly, they are difficult to rationalize within workhorse price-setting models in the international literature, predicting an incomplete pass-through of cost shocks at most time horizons (Burstein and Gopinath, 2014). As the uncertainty surrounding trade remains high, understanding the micro-level determinants of import price responses to tariff shocks becomes a particularly high priority towards optimizing trade policies and trade agreements.

Import transactions typically occur within global value chains: networks of vertically-related firms exchanging goods or services. Recently, studies in the trade literature have stressed the value of conceptualizing such systems as a firm-level phenomenon to shed light on their consequences for the aggregate economy (Antràs, 2020). In particular, the relational nature of contracting and the lock-in effects associated with costly search may significantly impact the overall degree of market power of importing and exporting firms and the transmission of international shocks, such as tariffs, on import prices. We argue that two characteristics of firms in global value chains stand out as important for understanding international markups and prices: first, importers and exporters are granular.¹ Second, they exert some bargaining power over the terms of trade.

Despite its importance, we know little about granular firms' contribution to the observed import prices and pass-through elasticities thereof, as existing work mostly focuses on good-level or consumer-level data. In different contexts, several studies in the exchange-rate pass-through literature have shown that exporters' market power goes a long way to explain aggregate price and pass-through patterns (Berman et al., 2012; Amiti et al., 2014; Cook, 2014). Due to data limitations, this literature has mostly focused on one-sided heterogeneity, relying on theoretical frameworks in which exporters and importers transact through anonymous markets and market-clearing conditions determine prices. Similarly, theoretical frameworks of bargaining within vertically-related chains typically ignore the two-sided nature of market power and firm granularity.

This paper contributes to filling the existing theoretical and empirical gap by investigating the firm-level determinants of import prices and pass-through in firm-to-firm in-

¹Freund and Pierola (2015) finds that a single exporter may account for as much as 17% of total manufacturing exports using data on developing and middle-income countries. Using data on French manufacturing firms, Gaubert and Itskhoki (2020) finds that the largest firm accounts for 7% of total manufacturing exports, and 28% of the exports within a 4-digit industry.

ternational trade with two-sided market power and heterogeneity. To do so, we lay out a theoretical framework of price bargaining in two-sided markets, and we build a novel dataset merging international trade data with two-sided balance sheet information on both importers and exporters. We decompose and interpret comparative statics in this type of model, with a particular focus on the role of changes in buyers' and suppliers' concentration. We show that our model nests and provides richer price pass-through patterns than existing models, while consistent with the empirical findings (e.g., [Gopinath and Itskhoki, 2010](#)).

Our price bargaining framework is a partial equilibrium model of international trade where both exporters and importers have bargaining power over the price of an intermediate input. The negotiated price affects the importer's profits through total production costs; it affects the exporter's profits through total sales. We allow multiple sources of heterogeneity among buyers (importers) and suppliers (exporters), together with returns to scale in production. To tractably and feasibly analyze the division of surplus between buyers and suppliers, we leverage the Nash-in-Nash bargaining protocol ([Horn and Wolinsky, 1988](#)): the negotiated price is the Nash bargaining solution for that pair, given that all other pairs reach an agreement. Within each match, the two agents' outside options are assumed to be the profits when the match is terminated, conditional on the pre-existing network.

We theoretically characterize the effect of buyers' and suppliers' concentration on the negotiated price. Our main theoretical result is a price formula that tractably nests a wide range of configurations of market power and firm heterogeneity in a unified way. In particular, we show that when firms are granular and have market power over the terms of trade, the negotiated price can range from a monopoly markup over marginal cost down to a monopsony markdown below marginal cost. On the one hand, the markup increases with the supplier's share in the buyer's inputs, as in standard oligopolistic competition models. On the other hand, the buyer can extract a fraction of the supplier's rents through bargaining; the larger the buyer's share in the supplier's output, the lower the markup that the buyer succeeds in negotiating. Notably, the dispersion in bilateral markups and prices can be fully characterized given the match-level relative bargaining power of the importer and two bilateral market shares: the supplier's share in the buyer's input purchases and the buyer's share in the supplier's sales. While the relative bargaining power parameters are unobserved, the bilateral shares can be directly read off our two-sided trade dataset.

Our theoretical framework with two-sided market power has important implications for the transmission of shocks at the exporter level to import, and ultimately consumer prices. We explicitly characterize the determinants of pass-through elasticities of import prices. We show that we can reconcile a broad range of pass-through elasticities within our two-sided theoretical framework, unlike models with one-sided heterogeneity and market power. On the one hand, a tariff increases the importer's perceived cost of purchasing from a given supplier, who responds by lowering its markup, thus absorbing part of the overall tariff burden.

On the other hand, as the buyer’s demand falls following the tariff-induced price increase, its share on the supplier’s output (and its buyer power) also falls, leading the supplier to charge a relatively higher markup. While the supplier’s market power is a source of incomplete pass-through, the buyer’s market power leads to a more-than-complete pass-through. Moreover, when suppliers’ costs increase in total output, the pass-through elasticity also depends on a cost channel: the lower the input demand, the lower the production costs, leading to an incomplete pass-through of the tariff shock. The overall pass-through elasticity’s sign and magnitude depend on the allocation of market power and bilateral shares among importers and exporters and remain an empirical question.

We take this framework to the data using a newly-constructed dataset containing bilateral prices and buyers’ and suppliers’ characteristics. We merge transaction-level international trade data for the U.S. with balance-sheet information on both U.S. importers and foreign exporters. 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 the period 1992-2016. Balance-sheet information on U.S. importers is retrieved from the Longitudinal Business Database (LBD); information on foreign exporters come from the ORBIS database. We integrate the firm-level data with information on tariff changes at the country-product level over the same period. This novel dataset reports match-level information on the two critical bilateral shares and other covariates affecting the relative firms’ bargaining power.

With this dataset, we estimate the main parameters affecting bilateral markups and prices. In particular, we recover the bilateral bargaining terms for each buyer-supplier pair by allowing them to be a function of pair-level observables other than the bilateral shares. We posit that the firms’ relative bargaining ability is a non-parametric function of the relationship’s tenure, the firms’ age, and their number of employees. Our identifying assumption is that the supplier’s marginal cost of producing a good is country-specific but not buyer-specific. Leveraging our model’s structure, we can recover the relative bargaining terms by matching the observed price differences across buyers with the differences in markups implied by the model.

Related Literature Our paper belongs to the literature on buyer-supplier production networks studying input-output networks’ role in propagating and amplifying shocks (see [Bernard and Moxnes, 2018](#); [Carvalho and Tahbaz-Salehi, 2019](#) for surveys). In particular, we most closely relate to the growing branch of this literature, studying the role of firm-level interactions for shock transmission ([Taschereau-Dumouchel, 2018](#); [Tintelnot et al., 2019](#); [Kikkawa et al., 2019](#)). Our departure from competitive frameworks implies complex mechanisms of shock propagation via changes in firms’ surplus distribution. Our main contribution to this literature is to show that the two-sided market power and firm granularity interact in non-trivial ways in determining the intensive-margin pass-through elasticity of a

supplier's cost shock to the negotiated price.

A closely related paper is [Acemoglu and Tahbaz-Salehi \(2018\)](#), which develops a non-competitive model of supplier-customer relations to study the propagation effects of a firm's failure in the production network. Similarly, [Grossman and Helpman \(2020\)](#) develops a bargaining framework of firm-to-firm trade to study the impact of unanticipated tariffs on sourcing (extensive margin) and price (intensive margin) elasticities in global supply chains. These papers' primary focus is on the disruptive (extensive margin) effect of shocks on firm-to-firm linkages. We see their work as complementary to ours in this respect. While abstracting from the extensive margin channel, our model captures rich(er) pricing patterns by allowing for both two-sided market power and firm granularity. Our theoretical framework is useful to think about the intensive margin elasticities of prices in all those empirical contexts where the network can be "held fixed". Our pass-through application shows one such exercise.

Recent literature in international trade focuses on the role of two-sided firm heterogeneity for firm-level outcomes, such as the size distribution ([Bernard et al., 2018a, 2019](#)) and the intensive and extensive margin of trade ([Bernard et al., 2018b](#); [Carballo et al., 2018](#); [Monarch, 2014](#)). A smaller branch of this literature studies price setting in buyer-supplier relationships generating predictions on markup heterogeneity across or within relationships ([Cajal-Grossi et al., 2019](#); [Kikkawa et al., 2019](#); [Heise, 2019](#)). However, none of these papers investigates the joint role of two-sided market power and firm granularity.

The findings in this paper also contribute to the extensive literature studying the sources of pass-through heterogeneity across firms.² Several studies have investigated the implications of firm-to-firm international trade for the exchange-rate pass-through. In line with our theoretical results, [Neiman \(2010\)](#) shows that pass-through is higher in intra-firm relationships; [Heise \(2019\)](#) shows that pass-through rises as a relationship's length and intensity increase. These papers abstract from the bargaining underpinnings of pass-through elasticities. In this sense, we most closely relate to [Gopinath and Itskhoki \(2010\)](#) and [Goldberg and Tille \(2013\)](#), who discuss the pass-through implications of two-sided bargaining. We contribute to their work by theoretically characterizing the role of importers and exporters granularity for bilateral markups and pass-through elasticities. Our pricing framework nests a wide range of (static) price-setting models with market power and firm heterogeneity - from models with monopolistic suppliers and price-taking buyers to models with monopsonistic buyers with price-taking suppliers - within a unified framework. Thus, it can be used to understand and predict markups and pass-through elasticities in diverse settings.

Finally, our paper relates to burgeoning literature in industrial organization studying the relationship between market concentration and prices in bilateral bargaining settings ([Draganska et al., 2010](#); [Crawford and Yurukoglu, 2012](#); [Grennan, 2013](#); [Lee and Fong, 2013](#)).

²See, e.g. [Atkeson and Burstein \(2008\)](#); [Amiti et al. \(2014\)](#); [Berman et al. \(2012\)](#), for studies relating the incomplete pass-through of exchange rates to oligopolistic competition, imported inputs, and firm size, respectively.

In particular, we build on a recent set of papers using structural models with Nash-in-Nash bargaining protocols to estimate the impact of changes in market structure on negotiated prices (Gowrisankaran et al., 2015; Ho and Lee, 2017). We are among the first to apply similar techniques to the context of firm-to-firm international trade. To accommodate firm-level data, we rely on a structural framework and functional form assumptions both on the demand and supply sides while allowing for unobserved heterogeneity in estimation.

Structure of the Paper This paper is structured as follows. Section 2 sets up the model and characterize the properties of import prices. Section 3 analyzes the determinants of tariff pass-through elasticities. Section 4 introduces the data and the main covariates. Identification of the main model’s parameters and elasticities are discussed in Section 5. Section 6 quantifies our results and considers several counterfactual exercises. Section 7 concludes.

2 Theory

This section sets up a theoretical framework to analyze bilateral markups and prices in firm-to-firm international trade with two-sided market power and heterogeneity. The main model assumptions are motivated by the data used in estimation. The industry consists of multiple foreign exporters (indexed by i) and multiple U.S. importers (indexed by j) of intermediate inputs. A foreign exporter i may sell its differentiated product to multiple U.S. importers, who may buy from multiple foreign exporters. We let firms i and j interact within an arm’s-length relationship, where the terms of trade are determined by a Nash-in-Nash bargaining protocol. For easing exposition, we assume that each exporting firm sells a single differentiated product to all its buyers; i thus 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 take the network of supply chains as given. Since our focus is on the relationship between foreign exporter i and U.S. importer j , we make some simplifying assumptions on the other markets in which both firms operate, namely the downstream output market of firm j , the domestic input market(s) of firm j , and the upstream input market of firm i .

We assume that firm j faces an iso-elastic demand in its output market:

$$q_j = p_j^{-\nu} D_j. \tag{1}$$

The total downstream demand for firm j ’s output depends on the demand elasticity $\nu > 1$ and the demand shifter D_j , which the firm takes as exogenous. It also depends on the (unique) price p_j , determined in equilibrium as a constant markup over marginal cost.

We assume that firm j produces its output using a constant returns to scale production function with a nested structure. Firm j combines labor, l_j , domestic intermediates, q_j^d , and foreign intermediates, q_j^f , in a Cobb-Douglas manner:

$$q_j = \varphi_j (l_j)^{\alpha_j^l} (q_j^d)^{\alpha_j^d} (q_j^f)^{\alpha_j^f}, \quad (2)$$

where φ_j is firm-level TFP. The terms α_j^v , for $v = l, d, f$ with $\sum_v \alpha_j^v = 1 \forall j$, are the Cobb-Douglas elasticities of labor, domestic and foreign inputs, respectively, which we allow to vary by firm. Labor is supplied inelastically at the wage rate w , which domestic producers take as given. We assume that the domestic market for intermediates has a roundabout structure, whereby all U.S. firms buy each other's product and face the (common) price p^d , which they take as given. Finally, the foreign intermediate input q_j^f is a CES bundle of varieties that are imported from j 's set \mathcal{Z}_j of foreign exporters:

$$q_j^f = \left(\sum_{k \in \mathcal{Z}_j} \varsigma_{kj} (q_{kj})^{\frac{\rho-1}{\rho}} \right)^{\frac{\rho}{\rho-1}}, \quad (3)$$

where q_{kj} is the quantity of the foreign input sold from the foreign exporter k to firm j , and ς_{kj} is the input variety demand shifter. The term $\rho > 1$ denotes the elasticity of substitution between foreign varieties of the intermediate input.

Standard cost minimization yields the following unit cost function for firm j :

$$c_j = \varphi_j^{-1} \left(\frac{w}{\alpha_j^l} \right)^{\alpha_j^l} \left(\frac{p^d}{\alpha_j^d} \right)^{\alpha_j^d} \left(\frac{p_j^f}{\alpha_j^f} \right)^{\alpha_j^f}, \quad (4)$$

where the price index for the foreign intermediate input, p_j^f , is given by:

$$p_j^f = \left(\sum_{k \in \mathcal{Z}_j} \varsigma_{kj}^\rho p_{kj}^{1-\rho} \right)^{\frac{1}{1-\rho}}. \quad (5)$$

The term p_{kj} is the price that the foreign exporter k charges to firm j , which is the outcome of bilateral negotiations and the main focus of our analysis.

To allow for heterogeneity on the supply side of the relationship, we assume that exporter i produces the output q_i using a unique (composite) input I_i , according to:

$$q_i = \varphi_i I_i^\theta. \quad (6)$$

The parameter $\theta \in \mathbb{R}_+$ governs the returns to scale of production. When $0 < \theta < 1$, upstream production exhibits decreasing returns; there are increasing returns when $\theta > 1$,

while $\theta = 1$ implies constant returns to scale. We assume that each exporter i can buy input I_i at an exogenous unit price p_I . We define firm i 's average and marginal cost as $c_i \equiv \frac{p_I I_i}{q_i}$ and $\tilde{c}_i \equiv c_i/\theta$, respectively.

2.2 Price Bargaining

We assume that importers and exporters bargain over the price of the imported input.³ In each bargaining game, the outside options of firm i and firm j are assumed to be the profits when the $i - j$ link is terminated. Exporter i will experience fewer sales, and importer j will have higher costs (love-of-variety technology), which leads to fewer profits for both firms. Importantly, we take as fixed the firm-to-firm network, and the prices in other nodes. We thus posit that the bilateral price between i and j is the pairwise Nash bargaining solution taking all other bargaining outcomes as given (Horn and Wolinsky, 1988)⁴

The generalized Nash bargaining solution over the price p_{ij} between supplier i and buyer j is defined as the maximand of the so-called generalized Nash product

$$\max_{p_{ij}} \left(\pi_i(p_{ij}) - \tilde{\pi}_{i(-j)} \right)^{1-\phi_{ij}} \left(\pi_j(p_{ij}) - \tilde{\pi}_{j(-i)} \right)^{\phi_{ij}}, \quad (7)$$

where $\pi_i(p_{ij})$ and $\pi_j(p_{ij})$ are the profits to the supplier i and the buyer j if the negotiations succeed, and $\tilde{\pi}_{i(-j)}$ and $\tilde{\pi}_{j(-i)}$ are the so-called disagreement payoffs that are obtained by the parties if the negotiations fail. The disagreement profits are an important determinant of the parties' endogenous bargaining position. The higher the profits of a firm in case of a negotiation failure, the higher its bargaining power. The bargaining power parameter, $0 < \phi_{ij} < 1$, captures other determinants of the relative bargaining ability of firms 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).⁵ In our notation, a higher ϕ_{ij} denotes higher relative bargaining power of importer j .

2.3 Properties of Equilibrium Prices

We characterize the solution to (7) by considering special limit cases first. Throughout, we take the FOCs of (7), and rearrange terms to write the negotiation price p_{ij} as:

$$p_{ij} = \mu_{ij} \tilde{c}_i, \quad (8)$$

³In Appendix A.1, we consider the case of bargain over quantities. Both the theoretical discussion, and estimation strategy can be easily extended to this case.

⁴While abstracting from strategic interactions among nodes, the Nash-in-Nash bargaining protocol allows us to tractably and feasibly analyze the division of surplus between buyers and suppliers, which is the main focus of our analysis.

⁵In the empirical analysis, we will posit that we can capture these exogenous sources of the firms' relative bargaining position as a function of relationship tenure, firms' age, and firm size.

where $\tilde{c}_i \equiv c_i/\theta$ is firm i 's marginal cost, and μ_{ij} is the negotiated markup between importer j and exporter i .⁶ We let $s_{ij}^f = \zeta_{ij}^o (p_{ij}/p_j^f)^{1-\rho}$ denote the share of firm i 's sales over firm j 's total imports, which measures how important firm i is as a supplier to firm j . Similarly, we let $x_{ij} \equiv \frac{q_{ij}}{q_i}$ denote the share of units of good purchased by buyer j over the total units supplied by firm i . Lastly, we let $\tilde{\phi}_{ij} \equiv \frac{\phi_{ij}}{1-\phi_{ij}} \in \mathbb{R}_+$ denote the relative bargaining power of buyer j over the supplier i .

Special case: when $\tilde{\phi}_{ij} \rightarrow 0$. When the supplier has all the bargaining power ($\tilde{\phi}_{ij} \rightarrow 0$), the solution to (7) simplifies to the one in standard Nash-Bertrand models, as in [Kikkawa et al. \(2019\)](#). The markup in this case is given by:

$$\mu_{ij} |_{\tilde{\phi}_{ij} \rightarrow 0} = \frac{\varepsilon_{ij}}{\underbrace{\varepsilon_{ij} - 1}_{\equiv \mu_{ij}^{olig}}} \quad (9)$$

where the demand elasticity term ε_{ij} is defined as:

$$\varepsilon_{ij} = \rho (1 - s_{ij}^f) + \tilde{v}_j s_{ij}^f \quad (10)$$

$$\tilde{v}_j = (1 - \alpha_j^f) + \nu \alpha_j^f. \quad (11)$$

As expected, the demand elasticity ε_{ij} depends on the supplier's share s_{ij}^f . When the supplier's share is tiny ($s_{ij}^f \rightarrow 0$) the demand elasticity ε_{ij} collapses to ρ , the substitution elasticity across foreign varieties. As the supplier i obtains a non-negligible share in j 's foreign input expenditure, the elasticity ε_{ij} changes as it begins to capture the production elasticity to input variety i , which we denote by \tilde{v}_j . The latter is a weighted average of the substitution elasticity across productive inputs—equal to 1 due to the Cobb-Douglas assumption—and the demand elasticity ν . The relative weights are governed by α_j^f : the larger the share of foreign inputs in production, the more the elasticity \tilde{v}_j co-moves with the elasticity of downstream demand. Note that the bilateral markup μ_{ij} *increases* in the share s_{ij}^f insofar as $\rho > \tilde{v}_j$, namely, when the input demand elasticity increases in the “upstreamness” of the production stage.⁷

Special case: when $\tilde{\phi}_{ij} \rightarrow \infty$. Let us now assume that the buyer has full bargaining power ($\tilde{\phi}_{ij} \rightarrow \infty$). When production upstream is constant returns, namely when $\theta = 1$, the solution to (7) is a standard unitary markup:

$$\mu_{ij} |_{\tilde{\phi}_{ij} \rightarrow \infty, \theta=1} = 1, \quad (12)$$

⁶See Appendix A.2 for the detailed derivations of this expression.

⁷This condition is standard in theoretical and empirical work. See, e.g., [Atkeson and Burstein \(2008\)](#).

which means that the bilateral price equals marginal (and average) costs, i.e., $p_{ij} = \tilde{c}_i = c_j$. Allowing for returns to scale in upstream production yields the following expression for the bilateral markup instead:

$$\mu_{ij} |_{\tilde{\phi}_{ij} \rightarrow \infty} = \underbrace{\theta \left(\frac{1 - (1 - x_{ij})^{\frac{1}{\theta}}}{x_{ij}} \right)}_{\equiv \mu_{ij}^{int}}. \quad (13)$$

We denote the right-hand side of equation (13) by μ_{ij}^{int} , as this markup term captures the interaction between j 's buyer share (x_{ij}) and the returns to scale upstream (θ).

When firm j is a fringe buyer to i ($x_{ij} \rightarrow 0$), then $\mu^{int} \rightarrow 1$ such that the supplier charges a price equal to the *marginal* cost, i.e., $p_{ij} = \tilde{c}_i$. Conversely, when firm j is the sole buyer to i ($x_{ij} \rightarrow 1$), then $\mu^{int} \rightarrow \theta$ such that the supplier charges a price equal to the *average* cost, i.e., $p_{ij} = c_i$. Since the buyer has all the bargaining power, the supplier never charges any markup over the cost to produce the *marginal* or the *average* unit of output purchased by the buyer, respectively. In other words, when $\tilde{\phi}_{ij} \rightarrow \infty$ the supplier cannot earn any rents besides technological ones.

A particularly important case worth mentioning in more detail is decreasing returns in upstream production ($\theta < 1$). Decreasing returns to scale imply that technological (Ricardian) rents exist in the market for good i . The discussion above indicates that only when the buyer is granular ($x_{ij} > 0$) can it extract parts of these rents through bargaining. When this happens, the markup μ_{ij} over marginal costs goes below unity.

General case: when $\tilde{\phi}_{ij} \in \mathbb{R}_+$. We can now discuss the general case where both the buyer and the supplier have some bargaining power ($\tilde{\phi}_{ij} \in \mathbb{R}_+$). It can be shown that the bilateral markup is a convex combination of the pure oligopoly markup $\frac{\varepsilon_{ij}}{\varepsilon_{ij}-1}$ and the term μ_{ij}^{int} :

$$\mu_{ij} = (1 - \omega_{ij}(\tilde{\phi}_{ij})) \cdot \mu_{ij}^{olig} + \omega_{ij}(\tilde{\phi}_{ij}) \cdot \mu_{ij}^{int}, \quad (14)$$

where the weighting factor, $\omega_{ij}(\tilde{\phi}_{ij}) \equiv \frac{\tilde{\phi}_{ij} \lambda_{ij}^{bgn}}{\tilde{\phi}_{ij} \lambda_{ij}^{bgn} + \varepsilon_{ij} - 1} \in (0, 1)$, is proportional to a term, $\tilde{\phi}_{ij} \lambda_{ij}^{bgn}$, capturing the *effective* buyer's relative bargaining position. It consists of the exogenous bargaining term ($\tilde{\phi}_{ij}$), and an endogenous bargaining term (λ_{ij}^{bgn}), indicating the strength of the buyer's outside option. The endogenous bargaining term is defined as:

$$\lambda_{ij}^{bgn} = \frac{s_{ij}^f (\tilde{v}_j - 1)}{1 + \hat{\tau}_j} \geq 0, \quad (15)$$

where $\hat{\pi}_j \equiv (\tilde{\pi}_{j(-i)} - \pi_j) = -\left(1 - s_{ij}^f\right)^{\frac{\bar{v}_j-1}{\rho-1}}$. Therefore, the more the buyer has to lose from an unsuccessful negotiation with firm i , the smaller the term λ_{ij}^{bgn} . Notice that $\frac{d\lambda_{ij}^{bgn}}{ds_{ij}^f} < 0$, showing that the larger the supplier, the lower the buyer's outside option, the lower the buyer's relative bargaining power.⁸

Our markup formula in (14) tractably nests all the different scenarios discussed thus far in an intuitive way. When production is constant returns, then $\mu_{ij}^{int} \rightarrow 1$ such that the negotiated markup swings between the oligopoly markup and the competitive level (i.e., $\mu_{ij} = 1$). Note that the size of the buyer has no bearing on the equilibrium markup and price when production is constant returns.

We consider a role for buyer power in equilibrium by introducing rents in upstream production.⁹ When $\theta < 1$, the markup swings between the oligopoly markup and the pure oligopsony markup, which decreases from 1 to θ as the buyer's share x_{ij} increases. The larger the *effective* buyer's relative bargaining position, $\tilde{\phi}_{ij}\lambda_{ij}^{bgn}$, the larger the weight $\omega_{ij}(\tilde{\phi}_{ij})$, and the closer is the bilateral markup μ_{ij} to the oligopsony markup. Thus, allowing for decreasing returns and granular buyers gives rise to the possibility that the price goes below competitive (i.e., marginal) levels.

2.4 Discussion

Before turning to the model's implications for pass-through elasticities, we discuss some of its assumptions and features. In particular, this section will touch on increasing returns to scale in the supplier's production, the role of the agents' outside options, and several model extensions.

Increasing Returns to Scale The discussion above has abstracted from the case $\theta > 1$, namely, increasing returns in upstream production. We did so purposefully, as this constitutes a corner case of our pricing framework. When the supplier's marginal costs decrease in total output, the marginal cost is below the average cost. The supplier must charge a positive markup for its marginal profits to be positive. Those equilibria where the bargaining weight tilts towards the buyer are thus incompatible with increasing returns to scale at the firm level. Whether or not an equilibrium with increasing returns to scale exists remains an empirical question, to which we will return below.

Outside Option Our theoretical framework imposes several assumptions on the agents' outside option. One is that, if negotiations between exporter i and importer j were to fail,

⁸The term $\frac{d\lambda_{ij}^{bgn}}{ds_{ij}^f}$ is negative whenever $\rho > \bar{v}_j$, which is the empirically relevant case as discussed above.

⁹Although estimates of returns to scale vary widely across industries, the average two-digit industry in the U.S. appears to produce with constant or decreasing returns (Basu and Fernald, 1997).

the effect on the buyer’s (supplier’s) profits is a function of the relative importance of the lost supplier (buyer) in the buyer’s (supplier’s) input purchases (sales) and parameters. This functional form restriction does not affect our estimates in a fundamental way. Equation (14) shows an isomorphism between the buyer’s (relative) outside option, which is captured by the term λ_{ij}^{bgn} , and the exogenous buyer’s relative bargaining power $\tilde{\phi}_{ij}$. Thus, we can avoid a model’s misspecification bias in estimation insofar as the estimates of $\tilde{\phi}_{ij}$ capture the unobserved differences in the agents’ outside options. We will return to this isomorphism below when discussing the measurement of $\tilde{\phi}_{ij}$.

A second critical assumption is that the supply-chain network is fixed, which means that we don’t allow for renegotiations. In concurrent work, [Grossman and Helpman \(2020\)](#) develop a firm-to-firm trade model similar to ours, focusing explicitly on renegotiation. We see their paper as complementary to ours in this respect. While abstracting from the extensive margin channel, our model captures rich(er) pricing patterns and is useful to think about the partial elasticities of prices in all those empirical contexts where the network can be “held fixed”, as shown in our pass-through application in the next section.

Model’s Extensions The model’s results do not depend on simplifying assumptions such as constant markups in the final good market, constant returns to scale of firm j ’s production function, and price-taking behavior of the upstream supplier in its input markets. In the Appendix, we discuss extensions of the baseline model where we relax each of these assumptions, one at a time.

We first consider a model with variable markups in the final good’s markets of firm j in Appendix A.3. All the results still hold in this more general model; the main difference is the appearance of an extra term (Γ_j) affecting the equilibrium price, which captures the elasticity of downstream markups to changes in j ’s marginal costs. Despite the tractability of the more general model, we abstract from this dimension of heterogeneity in our baseline estimation because our data only allow identifying an aggregate measure of the demand elasticity parameter ν .

We then extend the model to allow for returns to scale in production of firm j in Appendix A.4. We show that our results do not critically depend on the assumption of constant returns in firm j ’s production. In particular, we show that the effect of returns to scale in the final good’s production is isomorphic to the effect of elasticity of downstream demand, and is fully captured by the elasticity ν in equation (1).

Finally, in Appendix A.5, we consider an extension of the model where we endogenize firm i ’s unit cost c_i by allowing the firm to have input market power over its upstream suppliers, as in [Morlacco \(2019\)](#). As with the case of variable markups, we show that the main model’s intuitions are maintained in this more general model, with the difference that firm i ’s marginal cost c_i now depends on firm i ’s share as a buyer in its input markets. Because we are not able to measure this share in the data, we abstract from this dimension

of heterogeneity in the baseline model. We return to all these extensions along with their implications below when we discuss our estimation strategy.

3 Pass-Through

We now investigate the role of two-sided market power in determining the import price response (pass-through elasticity) of aggregate cost shocks. We consider a generic shock at the producer level, which we denote as ϑ_i . We let this shock act as a cost shifter; it can be interpreted as either a import tariff or an exchange-rate shock. The price equation in (8) (in log terms) can be written as:

$$\ln p_{ij} = \ln \mu_{ij} + \ln c_i - \ln \theta + \ln \vartheta_i, \quad (16)$$

where $\ln \mu_{ij} = \ln \mu \left(s_{ij}^f, x_{ij}; \tilde{\phi}_{ij}, \alpha_j^f, \boldsymbol{\beta} \right)$, with the function $\mu(\cdot)$ defined in (14) and $\boldsymbol{\beta}$ representing primitive parameters $\boldsymbol{\beta} = \{\rho, \nu, \theta\}$. Log-differentiating (16), we have that the log change in price, $d \ln p_{ij}$, can be approximated as:

$$d \ln p_{ij} = \Gamma_{ij}^s d \ln s_{ij}^f - \Gamma_{ij}^x d \ln x_{ij} + d \ln c_i + d \ln \vartheta_i \quad (17)$$

where we have defined $\Gamma_{ij}^s \equiv \frac{\partial \ln \mu_{ij}}{\partial \ln s_{ij}^f} > 0$ as the partial elasticity of bilateral markups with respect to the supplier share s_{ij}^f , and $\Gamma_{ij}^x \equiv -\frac{\partial \ln \mu_{ij}}{\partial \ln x_{ij}} > 0$ as the partial elasticity of bilateral markups with respect to the buyer share x_{ij} . Recall that the supplier's and buyer's shares are defined as $s_{ij}^f = \zeta_{ij}^\rho \left(p_{ij} / p_j^f \right)^{1-\rho}$ and $x_{ij} = q_{ij} / q_j$, respectively. Log-differentiating, we get:

$$d \ln s_{ij}^f = -(\rho - 1)(1 - s_{ij}^f) d \ln p_{ij} \quad (18)$$

$$d \ln x_{ij} = -\varepsilon_{ij}(1 - x_{ij}) d \ln p_{ij}, \quad (19)$$

where $\varepsilon_{ij} \equiv -\frac{d \ln q_{ij}}{d \ln p_{ij}}$ is the price elasticity of the input variety demand, defined by equation (10). The previous expressions are derived under the assumption that we can take as given the prices in other nodes of the network, namely, that $d \ln p_{kj} = 0, \forall k \neq i$ and $d \ln q_{iz} = 0 \forall z \neq j$. The average cost c_i can be written as $c_i = \frac{p_i}{\varphi_i^{\frac{1}{\theta}}} q_i^{\frac{1}{\theta}-1}$, so that, under the same assumptions,

$$d \ln c_i = -\frac{1 - \theta}{\theta} x_{ij} \varepsilon_{ij} d \ln p_{ij}. \quad (20)$$

Combining equations (17)-(20), and collecting terms:

$$d \ln p_{ij} = \frac{1}{1 + \Gamma_{ij}^s(\rho - 1)(1 - s_{ij}^f) - \Gamma_{ij}^x \varepsilon_{ij}(1 - x_{ij}) + \frac{1-\theta}{\theta} x_{ij} \varepsilon_{ij}} d \ln \vartheta_i. \quad (21)$$

Consider a change in the producer level cost shifter ϑ_i , which we interpret as import tariff. We obtain the following result.

Proposition 1 : *The pass-through of a shock to the supplier's cost on the bilateral price when $d \ln p_{kj} = 0, \forall k \neq i$ and $d \ln q_{iz} = 0 \forall z \neq j$ is given by:*

$$\Phi_{ij} \equiv \frac{d \ln p_{ij}}{d \ln \vartheta_i} = \frac{1}{1 + \Gamma_{ij}^s(\rho - 1)(1 - s_{ij}^f) - \Gamma_{ij}^x \varepsilon_{ij}(1 - x_{ij}) + \frac{1-\theta}{\theta} x_{ij} \varepsilon_{ij}}. \quad (22)$$

Equation (22) provides a useful way of summarizing the response of border prices to cost-push shocks, assuming that changes in prices in other network nodes, namely, $d \ln p_{kj} \forall k \neq i$ and $d \ln q_{iz} \forall z \neq j$, can be controlled for in pass-through regressions. This type of exercise is feasible in our case due to the availability of data on bilateral transactions and two-sided heterogeneity.¹⁰ We refer to Appendix A.6 to discuss a more general pass-through equation that considers the "indirect" (general equilibrium) effects.

Equation (22) indicates that the pass-through elasticity to a cost shock in a bargaining model with two-sided heterogeneity can be written as a function of the two observed bilateral shares, s_{ij}^f and x_{ij} , given the share of foreign inputs in production (α_j^f) and the parameter vector (β). Next, we illustrate the individual channels through which the bilateral shares affect pass-through, starting from special limit cases. Throughout, we will assume decreasing returns to scale in i 's production function, $\theta < 1$.

Special case: when $\tilde{\varphi}_{ij} \rightarrow 0$ Let us first assume that the supplier has all the bargaining power. The price pass-through in equation (22) simplifies to:

$$\Phi_{ij} |_{\tilde{\varphi}_{ij} \rightarrow 0} = \frac{1}{\underbrace{1 + \Gamma_{ij}^s(\rho - 1)(1 - s_{ij}^f)}_{\text{markup channel}(+) } + \underbrace{\frac{1 - \theta}{\theta} x_{ij} \varepsilon_{ij}}_{\text{cost channel}(+) }}, \quad (23)$$

where $\Gamma_{ij}^s = \frac{\varepsilon_{ij} - \rho}{\varepsilon_{ij}(\varepsilon_{ij} - 1)} > 0$. As highlighted in equation (23), the pass-through elasticity will depend on the two shares through a *markup* channel, and a *cost* channel. The latter is positive whenever $\theta < 1$. The top three panels of Figure 1 plot the contours of the pass-through Φ_{ij} for different values of s_{ij}^f and x_{ij} . Panel 1a focuses on the markup channel; it is obtained by setting the cost channel equal to zero. Panel 1b isolates the cost channel and is constructed by fixing the markup channel equal to zero. Panel 1c presents the overall pass-through elasticity when both channels are considered. Panel 1a shows that the pass-through elasticity is always below one through the markup channel, which means that the exporter's behavior always leads to an incomplete pass-through: following a positive cost shock, the supplier

¹⁰Concretely, our dataset reports information on the quantity sold by a given exporter i to all its U.S. buyers, which makes it possible to control for $d \ln q_{iz} \forall z \neq j$. Similarly, we observe the import price at the firm-variety level, which allows to control for $d \ln p_{kj} \forall k \neq i$.

will reduce the markup to prevent the buyer from substituting away from its variety. Note that the response of import prices to cost shocks is U-shaped in the supplier's market share, a well-known result in the exchange-rate pass-through literature (Auer and Schoenle, 2016; Goldberg and Tille, 2013). When the supplier share is either tiny ($s_{ij}^f \rightarrow 0$) or very large ($s_{ij}^f \rightarrow 1$), the shock's effect on the supplier's share in the buyer's input purchases is small, leading to a lesser impact on the negotiated markup. Finally, notice the buyer share plays no role for the markup channel of the pass-through elasticity when the bargaining power is concentrated on the supplier side.

The cost channel in Panel 1b captures the price response due to changes in the supplier's average cost. This effect is positive and increases in the buyer's share: the larger the buyer, the lower the pass-through of a cost shock to the bilateral price. The intuition is as follows. When the bilateral price increases due to the shock's direct effect, a standard demand effect leads the buyer to demand less of supplier i 's variety. As the input demand weakens, the average production cost decreases, and so does the price. The larger the buyer, the more substantial the cost (and price) reduction. Therefore, the cost channel intensifies the degree of pass-through incompleteness implied by the markup channel in isolation. This can be observed in Panel 1c.

Special case: when $\tilde{\phi}_{ij} \rightarrow \infty$ When the buyer has all the bargaining power, the pass-through in equation (22) becomes:

$$\Phi_{ij} |_{\tilde{\phi}_{ij} \rightarrow \infty} = \frac{1}{\underbrace{1 - \Gamma_{ij}^x \varepsilon_{ij} (1 - x_{ij})}_{\text{markup channel}(-)} + \underbrace{\frac{1 - \theta}{\theta} x_{ij} \varepsilon_{ij}}_{\text{cost channel}(+)}} \quad (24)$$

where the elasticity $\Gamma_{ij}^x = 1 - \frac{(1 - x_{ij})^{\frac{1 - \theta}{\theta}}}{\mu_{ij}^{int}} \geq 0$ is strictly positive as long as production is decreasing returns. As in the previous case, we can decompose the overall pass-through effect into a markup and a cost channel. The latter acts exactly as in the previous case. The markup channel is instead different, as it now originates from the change in the buyer share. We plot the markup, cost, and combined pass-through effects in the center row of Figure 1.

When we only consider the markup channel, the pass-through elasticity is always above one and is hump-shaped in the buyer's output share x_{ij} (Panel 1d). The source of the more-than-complete pass-through is an endogenous response of the buyer's market power to the shock. The shock's direct effect is to reduce the buyer's demand and its buyer's share thereof; as the buyer's market power decreases with the buyer's share, the negotiated markup increases.¹¹ The intuition behind the hump shape is similar to the one above: When

¹¹As explained earlier, here we consider the "direct" pass-through in which we take as fixed the supplier's sales quantities to other buyers.

the buyer's share is either tiny ($x_{ij} \rightarrow 0$) or very large ($x_{ij} \rightarrow 1$), the shock's impact on the buyer's share is small, leading to a lesser impact on the negotiated markup. Notably, the hump shape flattens out as the supplier share s_{ij}^f becomes larger. A larger s_{ij}^f means lower demand elasticity ε_{ij} (equation (10)), leading to a smaller response of the buyer share x_{ij} to the cost increase of the supplier.

Combining the markup with the cost channel leads to Panel 1f. The pass-through now is monotonically decreasing in the buyer share, due to the effect of x_{ij} on both markups and costs; it is close to one in a large portion of the bilateral shares space, especially in the region where the buyer's share is small.

General case In the general case in which both the buyer and the supplier have bargaining power, the pass-through elasticity reads:

$$\Phi_{ij} = \frac{1}{\underbrace{1 + \Gamma_{ij}^s(\rho - 1)(1 - s_{ij}^f) - \Gamma_{ij}^x \varepsilon_{ij}(1 - x_{ij})}_{\text{markup channel}(+/-)} + \underbrace{\frac{1 - \theta}{\theta} x_{ij} \varepsilon_{ij}}_{\text{cost channel}(+)}}. \quad (25)$$

The sign of the markup channel is, in principle, ambiguous due to the contrasting role of the buyer's and supplier's market power. The bottom three panels of Figure 1 display the pass-through's contour plot in this general case, assigning an equal bargaining power to the two agents ($\tilde{\phi}_{ij} = 1$). Panel 1g shows the markup channel. Endogenous changes in markups lead to a more-than-complete pass-through when the supplier share is low, especially when the buyer's share is in the intermediate range. Conversely, when the supplier's share is large, the markup channel leads to an incomplete pass-through. Note that Panel 1g is not a simple addition of Panel 1a and 1d, because the values of Γ_{ij}^s and Γ_{ij}^x depend on the value of $\tilde{\phi}_{ij}$. Combining the markup with the cost channel leads to Panel 1i.

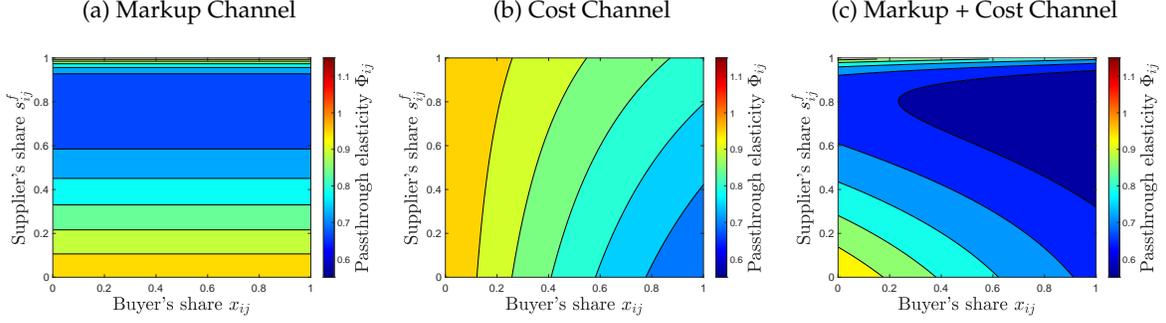
In this section, we highlighted the role of bargaining power, supplier's and buyer's shares in determining the pass-through of cost shock to import prices. Figure 1 provides a visual representation of the considerable heterogeneity in pass-through that can arise in contexts where firms are granular and enjoy market power, like that of global value chains. Notably, this analysis has revealed that when the market power of both sellers and buyer is considered, the evidence of a high pass-through into import prices appears less puzzling than initially thought. In the following sections, we bring this model to the data to empirically test its ability to rationalize import prices' behavior.

4 Data and Stylized Facts

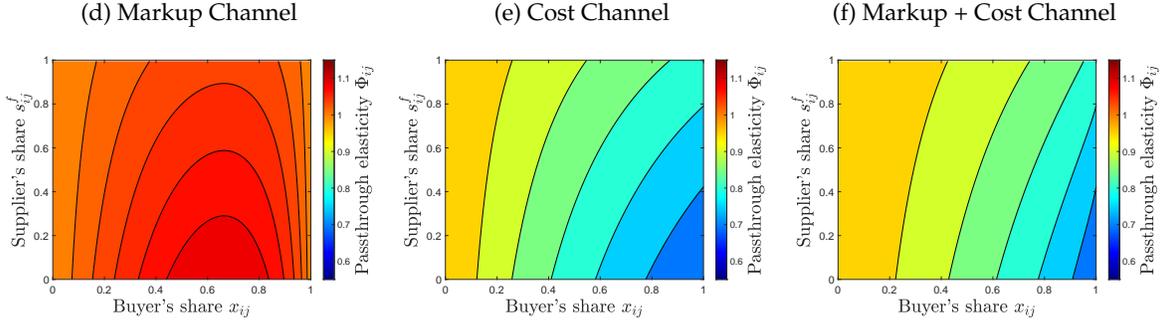
One of the challenges of studying two-sided market power is that detailed information on outcomes of bilateral transactions between importers and exporters (e.g., prices and quan-

Figure 1: pass-through on bilateral shares

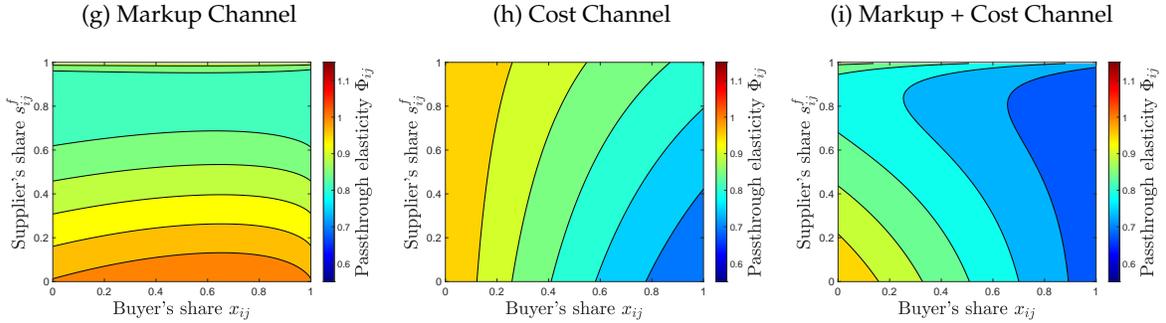
PRICE-TAKING BUYERS ($\tilde{\phi}_{ij} \rightarrow 0$)



PRICE-TAKING SELLERS ($\tilde{\phi}_{ij} \rightarrow \infty$)



SYMMETRIC BARGAINING POWER ($\tilde{\phi}_{ij} = 1$)



Notes: The figure displays the degree of price pass-through, Φ_{ij} , with respect to the two bilateral shares, s_{ij}^f and x_{ij} . The top three panels impose price-taking behavior on the buyer's side, such that $\tilde{\phi}_{ij} \rightarrow 0$. The middle three panels show the case when the buyer has full bargaining power ($\tilde{\phi}_{ij} \rightarrow \infty$). The bottom three panels display the intermediate case, where agents' bargaining power is symmetric ($\tilde{\phi}_{ij} = 1$). In all rows, the left panel plots Φ_{ij} when we set the cost channel equal to zero; in the middle panel we set the markup channel equal to zero, while the right panel restores both channels. Note that the 'cost channel' graph is identical in all three rows as it does not depend on the value of $\tilde{\phi}_{ij}$. For other parameters, we use $\alpha_j^f = 0.18$, $\rho = 2.5$, $\nu = 1.98$, and $\theta = 0.85$.

tities) 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 of Manufacturers (CM), and the ORBIS dataset. This matched dataset allows us to identify firms' characteristics on both sides of the cross-border trade transaction (Alviarez et al., 2019).

The LFTTD dataset contains information on the universe of transactions between U.S. importers and foreign exporters during 1992-2016. This dataset is constructed from customs 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 supplier 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 bill, 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.¹²

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 describe how we use these datasets to measure the critical variables implied from the model in Section 4.3.

4.1 Selection

We use the following criteria to construct our estimation sample. To ensure that the selection of foreign suppliers 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 those transactions 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 a business relationship does not exist between the exporter and importer. To do so, we leverage the

¹²See Appendix B.1 for more details on the construction of the MID variable.

information on ownership relationships from both the LFTTD and ORBIS.¹³ Also, we select only those exporters that sell a given product to two or more U.S. (arm’s-length) 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.

4.2 Stylized facts

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4.3 Measuring key variables of the model

With the merged dataset, it is possible to measure almost all the shares that the model indicates relevant for markups and pass-through elasticities. Hereafter, we restore multiple products and countries and discuss how we construct the key variables from our dataset. We define products at the HS 10-digit level, the most detailed level of aggregation available, and denote them by h . We estimate the model within a product category; consequently, all parameters will be evaluated at the product-level.

Share of firm i ’s sales over j ’s total imports ($s_{ij}^{f,h}$) We assume that when a firm imports multiple products, it combines the different products in a Cobb-Douglas fashion. The production function in (2) thus becomes:

$$q_j = \varphi_j l_j^{\alpha_j^l} (q_j^d)^{\alpha_j^d} \left(\prod_{h \in \mathcal{H}_j} (q_j^{f,h})^{\alpha_j^{f,h}} \right). \quad (26)$$

To construct the numerator of the supplier’s share $s_{ij}^{f,h}$, we consider all imports of firm j from firm i (a MID in our dataset) within product category h during the year; the denominator adds product-specific imports across all j ’s trading partners in all countries.

Share of firm j ’s purchases over i ’s total output (x_{ij}^h) Unlike $s_{ij}^{f,h}$ the buyer’s 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 exhibits returns to scale at the product-destination level, and define the denominator q_i^h as exporter i ’s total quantity of product h sold to the United States, namely, $q_i^h = \sum_{j \in US} q_{ij}^h$.

Share of foreign imports of product h in the total cost of firm j ($\alpha_j^{f,h}$) This corresponds to the Cobb-Douglas share of foreign product h in firm j production function. We construct the total cost of the firm by adding the firm’s wage bill, wl_j , the total domestic materials consumed, $p_d q_{dj}$, and total imports, $p_{fj} q_{fj} = \sum_h p_{fj}^h q_{fj}^h$. The wage bill is available from the LBD, while we recover expenditures on domestic materials from the I-O tables, using the

¹³See Appendix B.2 for details.

ratio of domestic materials consumed over the labor costs.¹⁴ In our baseline analysis, we construct the numerator, $p_{fj}^h q_{fj}^h$, by summing firm j 's total imports of product h across all origin countries. Since not all firms' imports are necessarily used as intermediate inputs in the production process, we perform a robustness check by classifying trade transactions by its intended use following [Boehm et al. \(2016\)](#).¹⁵

4.4 Descriptive statistics

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5 Estimation

In this section, we discuss the estimation of the primitive parameters, $\beta = \{\rho, \nu, \theta\}$, together with the bilateral bargaining terms, ϕ_{ijt} , by leveraging the model's price and markup equations. With the knowledge that we estimate these parameters at the product level, we hereafter drop the product h superscript to ease notation.

5.1 Import elasticity of substitution ρ

We start by estimating ρ , which represents the elasticity of substitution across foreign varieties. The model implies leverage the following relationship between bilateral trade flows (r_{ijt}) and prices:

$$r_{ijt} = \varsigma_{ijt}^\rho p_{ijt}^{1-\rho} \left(p_{jt}^f\right)^{\rho-1} \alpha_{jt}^f c_{jt} q_{jt}. \quad (27)$$

By taking logs and collecting terms, we can write equation (27) as:

$$\Delta \ln r_{ijt} = (1 - \rho) \Delta \ln p_{ijt} + \gamma_{jt} + \varepsilon_{ijt}, \quad (28)$$

where $\gamma_{jt} \equiv \ln \left(\left(p_{jt}^f\right)^{\rho-1} \alpha_{jt}^f c_{jt} q_{jt} \right)$ and $\varepsilon_{ijt} = \rho \Delta \ln \varsigma_{ijt} + e_{ijt}$, e_{ijt} indicates a zero-mean i.i.d. idiosyncratic shocks or measurement error, and where we defined the Δ operator on any given variable x as: $\Delta \ln x_{ijt} \equiv \ln x_{ijt} - \ln x_{it-1}$. Equation (28) relates bilateral trade flows to bilateral prices, and buyer-time fixed effects. We consider an IV-OLS regressions on (28), where we instrument prices with bilateral trade shifters, such as tariffs or exchange-rate

¹⁴For manufacturing importers, we observe material inputs from the CM. The correlations between our baseline α_{jt}^{fh} and the α_{jt}^{fh} utilizing the materials from CM are high.

¹⁵[Boehm et al. \(2016\)](#) classify firm-level imports as intermediates only if the firm does not export that product to North America (i.e. Canada and Mexico). An alternative to this method is to define as final goods those products produced by U.S. establishments in a given industry, assuming that the remaining products are to be used by establishments in that industry either as intermediate inputs or as capital investment. An advantage of using the export data to North America is that Census data on detailed production and domestic material usage is only available for a subset of manufacturing firms.

shocks. Our identifying assumptions simply requires that bilateral trade shifters are exogenous to the preference shocks ζ_{ijt} .

5.2 Price Elasticity of (Final) Demand ν

We take the following approach to estimate ν . The price of j 's output can be written as $p_{jt} = \mu_{jt}c_{jt}$, where μ_{jt} is the markup charged by firm j . Under the assumption of CES demand in the final good market, and leveraging equations (1) and (4), one can express firm j 's change in log revenue as:

$$d \ln r_{jt} = (1 - \nu)\alpha_{jt-1}^l d \ln w_t + (1 - \nu)\alpha_{jt-1}^d d \ln p_{jt}^d + (1 - \nu)\alpha_{jt-1}^f d \ln p_{jt}^f + u_{jt},$$

where $u_{jt} \equiv (1 - \nu)(-d \ln \varphi_{jt} + d \ln \Omega_{jt}) + d \ln D_{jt} + v_{jt}$. The term v_{jt} is a zero-mean i.i.d. measurement error and Ω_{jt} is a function of the cost shares of inputs for firm j . We can operationalize the above equation with the following regression specification:

$$\Delta \ln r_{jt} = \delta + (1 - \nu)(1 - \rho)^{-1} \alpha_{jt-1}^f \underbrace{\sum_{k \in \mathcal{Z}_j} s_{kjt-1}^f \Delta \ln p_{kjt}}_{(1-\rho)\Delta \ln p_{jt}^f} + \gamma_{st} + u_{jt} \quad (29)$$

The term γ_{st} is the sector-time fixed effect that captures common input prices across firms, which include wages and production price deflators, namely the price index of domestic intermediates. Note that using log changes (rather than levels) allows one to measure $\Delta \ln p_{jt}^f$ from the data. Following equation (5), we can construct the term $\Delta \ln p_{jt}^f$ as a weighted average of changes in bilateral import prices given our estimate of ρ and data on α_{jt}^f .¹⁶

A potential concern about OLS regressions is that the bargained import prices are endogenous to both unobserved demand shocks D_{jt} , and markups μ_{jt} . These unobserved variables will affect both the outside option and the relative bargaining position of the buyer j , and the import prices thereof. To make progress, we consider instruments for $\Delta \ln p_{jt}^f$ based on sales-shares-weighted averages exchange rates or tariffs across sourcing countries.¹⁷

¹⁶In particular, from equation we can write:

$$(1 - \rho)d \ln p_j^f = \sum_{k \in \mathcal{Z}_j} \frac{\zeta_{kj}^\rho p_{kj}^{1-\rho}}{\sum_{k \in \mathcal{Z}_j} \zeta_{kj}^\rho p_{kj}^{1-\rho}} d \ln p_{kj} = \sum_{k \in \mathcal{Z}_j} s_{kj}^f d \ln p_{kj}.$$

Therefore, the observed sellers' shares subsume the effect of the unobserved preference shocks, allowing us to write $d \ln p_j^f$ in terms of observable variables.

¹⁷In particular, we can construct instruments for $\Delta \ln p_{jt}^f$ as:

$$IV(1) : \Delta e_{jt} = \sum_{k \in \mathcal{Z}_j} s_{ijt-1}^f \Delta \ln e_{it} \quad (30)$$

$$IV(2) : \Delta \tau_{jt} = \sum_{k \in \mathcal{Z}_j} s_{ijt-1}^f \Delta \ln \tau_{it}, \quad (31)$$

5.3 Estimation of parameters θ and ϕ_{ij}

In order to estimate the remaining parameters, θ and ϕ_{ij} , we first assume the following functional form expression for the bilateral bargaining terms:

$$\tilde{\phi}_{ijt} = e^{\kappa_0 + \kappa' \mathbf{X}_{ijt}}, \quad (32)$$

where \mathbf{X}_{ijt} is a vector of covariates determining the relative bargaining position of importers and exporters. This vector includes the age of the $i - j$ relationship, relative age of firm i over the age of firm j , and relative number of employees of firm i over that of firm j . We impose the following estimating assumption:

Assumption 5.1 : *For a given supplier i , the marginal cost of producing a given good h does not vary across buyers located in a given country. In other words, for all buyers j located in the same country:*

$$c_{ijt}^h = c_{it}^h. \quad (33)$$

Given this assumption, it is possible to obtain moment conditions that can identify the parameter vector $(\theta, \bar{\kappa})$: For each $i - j - j'$ triplet where the foreign exporter i sells to both j and j' , the difference in prices equal the difference in markups:

$$\ln p_{ijt} - \ln p_{ij't} = \ln \mu \left(e^{\kappa_0 + \kappa' \mathbf{X}_{ijt}}, \theta \right) - \ln \mu \left(e^{\kappa_0 + \kappa' \mathbf{X}_{ij't}}, \theta \right). \quad (34)$$

Importantly, it can be shown that according to the definition of equation (13) for any given μ_{ij}^{int} , there exists a unique θ , proving that θ is identified from variation across the shares x_{ij} and $x_{ij'}$. We operationalize this by minimizing the stacked differences across all triplets between the model's predicted log differences in prices across buyers and the price differences observed in the data.

6 Results

TBA

7 Conclusions

TBA

where e_{it} is the bilateral exchange rate between USD and the currency of the foreign exporter, and τ_{it} is the import tariff imposed by the U.S. on the product of focus imported by country of exporter i .

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A Derivations and additional theoretical results

A.1 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 (7), we now have the following Nash bargaining problem

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

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

$$p_{ij} = \left[(1 - \bar{\omega}_{ij}(\tilde{\phi}_{ij})) \frac{\bar{\varepsilon}_{ij}}{\bar{\varepsilon}_{ij} - 1} + \bar{\omega}_{ij}(\tilde{\phi}_{ij}) \mu_{ij}^{int} \right] \frac{c_i}{\theta},$$

where $\bar{\varepsilon}_{ij}^{-1} = \frac{1}{\rho} \left(1 - s_{ij}^f \right) + \left(1 - \alpha_j^f + \frac{1}{\nu} \alpha_j^f \right) s_{ij}^f$ and $\bar{\omega}_{ij}(\tilde{\phi}_{ij}) \equiv \frac{\varepsilon_{ij} \tilde{\phi}_{ij} \lambda_{ij}^{bgn} / \nu}{\varepsilon_{ij} (1 + \tilde{\phi}_{ij} \lambda_{ij}^{bgn} / \nu) - 1} \in (0, 1)$ is the effective buyer's relative bargaining power in this model. The price above has a similar structure as in equation (14). It is a weighted average between a standard oligopoly (Cournot) markup, $\frac{\bar{\varepsilon}_{ij}}{\bar{\varepsilon}_{ij} - 1}$, and the markup term μ_{ij}^{int} . The oligopoly markup depends in this case on the elasticity $\bar{\varepsilon}_{ij}$, which is a harmonic weighted average of elasticities ν and ρ as in [Atkeson and Burstein \(2008\)](#).

A.2 Derivation of equation (8)

Here we outline the derivation of equation (8). We solve for the FOCs of (7) by first listing each of its four elements $\left\{ \pi_i, \pi_j, \tilde{\pi}_{i(-j)}, \tilde{\pi}_{j(-i)} \right\}$, and then taking derivatives with respect to p_{ij} .

Profit of firm i , π_i Firm i 's profit can be expressed as

$$\pi_i = p_{ij} q_{ij} + \sum_{k \neq j} p_{ik} q_{ik} - p_I I_i.$$

Recall that $I_i = \varphi_i^{-\frac{1}{\theta}} q_i^{\frac{1}{\theta}}$. Using the derivatives of $\frac{dq_{ij}}{dp_{ij}} \frac{p_{ij}}{q_{ij}} = -\varepsilon_{ij}$ and

$$\begin{aligned} \frac{dI_i}{dp_{ij}} \frac{p_{ij}}{I_i} &= \frac{dI_i}{dq_i} \frac{q_i}{I_i} \frac{dq_i}{dq_{ij}} \frac{q_{ij}}{q_i} \frac{dq_{ij}}{dp_{ij}} \frac{p_{ij}}{q_{ij}} \\ &= -\varepsilon_{ij} \frac{1}{\theta} \frac{q_{ij}}{q_i}, \end{aligned}$$

we can express the derivative of π_i as

$$\begin{aligned}\frac{d\pi_i}{dp_{ij}} &= q_{ij} + p_{ij} \frac{dq_{ij}}{dp_{ij}} - p_I \frac{dI_i}{dp_{ij}} \\ &= \frac{q_{ij}}{p_{ij}} \left(p_{ij} (1 - \varepsilon_{ij}) + c_i \varepsilon_{ij} \frac{1}{\theta} \right).\end{aligned}$$

Profit of firm j , π_j Firm j 's profit can be expressed as

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

Using the derivatives of $\frac{dc_j}{dp_{ij}} \frac{p_{ij}}{c_j} = \alpha_{fj} s_{ij}^f$, we can express the derivative of π_j as

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

Outside profits, $\tilde{\pi}_{i(-j)}$ and $\tilde{\pi}_{j(-i)}$ The outside profit of firm i , $\tilde{\pi}_{i(-j)}$, is

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

where

$$\tilde{I}_i = \varphi_i^{-\frac{1}{\theta}} \left(\sum_{k \neq j} q_{ik} \right)^{\frac{1}{\theta}}.$$

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

$$\begin{aligned}\pi_i - \tilde{\pi}_{i(-j)} &= p_{ij} q_{ij} - p_I I_i + p_I \tilde{I}_i \\ &= q_{ij} \left[p_{ij} - \frac{c_i}{\theta} \mu_{ij}^{int} \right],\end{aligned}$$

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

The outside profit of firm j , $\tilde{\pi}_{j(-i)}$, is

$$\tilde{\pi}_{j(-i)} = \mu_j^{1-\nu} \tilde{c}_j^{1-\nu} D_j - w_H \tilde{I}_j - \sum_{k \in Z_j, k \neq i} p_{kj} \tilde{q}_{kj} - p_d \tilde{d}_j,$$

where

$$\begin{aligned}\tilde{q}_j &= \tilde{c}_j^{-\nu} D_j \\ \tilde{c}_j &= \varphi_j^{-1} \Omega_j \omega_{HPd}^{\alpha_j^l \alpha_j^d} \tilde{p}_{fj}^{\alpha_j^f} \\ \tilde{p}_{fj} &= \left(\sum_{k \in Z_j, k \neq i} \omega_{kj}^{\rho} p_{kj}^{1-\rho} \right)^{\frac{1}{1-\rho}}.\end{aligned}$$

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

$$\pi_j - \tilde{\pi}_{j(-i)} = (\mu_j - 1) c_j q_j (1 - A_{ij}),$$

where

$$A_{ij} = \left(1 - s_{ij}^f \right)^{\frac{1-\nu}{1-\rho} \alpha_j^f}.$$

First order conditions With the ingredients derived above, we now solve for the FOC,

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

Rearranging the above yields

$$p_{ij} = \mu_{ij} \frac{c_i}{\theta},$$

where

$$\mu_{ij} = (1 - \omega_{ij}(\tilde{\phi}_{ij})) \cdot \frac{\varepsilon_{ij}}{\varepsilon_{ij} - 1} + \omega_{ij}(\tilde{\phi}_{ij}) \cdot \mu_{ij}^{int}, \quad (35)$$

where $\omega_{ij}(\tilde{\phi}_{ij}) \equiv \frac{\tilde{\phi}_{ij} \lambda_{ij}^{bgn}}{\tilde{\phi}_{ij} \lambda_{ij}^{bgn} + \varepsilon_{ij} - 1} \in (0, 1)$.

A.3 Accounting for firm j 's competition in its output market

The model presented in Section 2 assumed that firms take as given the markup firm j charges on its output, when firms i and j bargain over price p_{ij} . Here we explore the implication of this assumption, by considering a more general setup in which firms take into account the response of j 's markup.

We let the demand elasticity vary at the firm-level, $\nu_j \equiv \frac{d \ln q_j}{d \ln p_j}$. We also denote the elasticity of markup μ_j with respect to marginal cost c_j by $\Gamma_j^\mu \equiv -\frac{d \ln \mu_j}{d \ln c_j}$. Taking into account this

markup elasticity, firms solve for (7). The resulting price p_{ij} is summarized as follows:

$$p_{ij} = \left[\left(1 - \omega_{ij}^{VM}(\tilde{\phi}_{ij}) \right) \cdot \frac{\varepsilon_{ij}^{VM}}{\varepsilon_{ij}^{VM} - 1} + \omega_{ij}^{VM}(\tilde{\phi}_{ij}) \cdot \mu_{ij}^{int} \right] \frac{c_i}{\theta},$$

where instead of the term ε_{ij} in equation (14), we have

$$\varepsilon_{ij}^{VM} = \rho \left(1 - s_{ij}^f \right) + s_{ij}^f \left[\left(1 - \alpha_j^f \right) + \alpha_j^f v_j \left(1 - \Gamma_j^\mu \right) \right],$$

and instead of $\omega_{ij}(\tilde{\phi}_{ij})$ we have $\omega_{ij}^{VM}(\tilde{\phi}_{ij}) \equiv \frac{\tilde{\phi}_{ij} \lambda_{ij}^{bgn,VM}}{\tilde{\phi}_{ij} \lambda_{ij}^{bgn,VM} + \varepsilon_{ij} - 1}$, with:

$$\lambda_{ij}^{bgn,VM} = \frac{(v_j - 1) \alpha_j^f s_{ij}^f}{1 - A_{ij}^{VM}}$$

$$A_{ij}^{VM} = \left(\left(\left(1 - s_{ij}^f \right)^{-\Gamma_j^\mu \frac{\alpha_j^f}{1-\rho}} - 1 \right) v_j + 1 \right) \left(1 - s_{ij}^f \right)^{\frac{\alpha_j^f}{1-\rho}} \left(1 - (1 - \Gamma_j^\mu) v_j \right).$$

Notice that if we assume that when the buyer firms charge constant markups on their output, $\Gamma_j^\mu = 0$, then the terms ε_{ij}^{VM} and $\lambda_{ij}^{bgn,VM}$ collapse back to ε_{ij} and λ_{ij}^{bgn} , giving the price equation that is identical to equation (14).

We also characterize the implication of variable markups downstream on the estimation of ν . Using the demand structure and the markup elasticity Γ_j^μ , we obtain the following relationships:

$$\begin{aligned} d \ln p_{jt} &= \left(1 - \Gamma_j^\mu \right) d \ln c_{jt} \\ d \ln q_{jt} &= -v_j \left(1 - \Gamma_j^\mu \right) d \ln c_{jt} \\ d \ln r_{jt} &= (1 - v_j) \left(1 - \Gamma_j^\mu \right) d \ln c_{jt}. \end{aligned}$$

Therefore, when one runs the regression equation (29), the estimated coefficient would not recover $1 - \nu$ but instead the average value of $(1 - v_j) \left(1 - \Gamma_j^\mu \right)$ across firms.

A.4 Returns to scale of firm j

In Section 2 we considered firm j having Cobb Douglas production function with constant returns to scale, facing demand elasticity of ν . Here we show that this setup is isomorphic to a more general setup. In particular, we consider firm j having Cobb Douglas production function with returns to scale parameter θ_j :

$$q_j = \varphi_j l_j^{\alpha_j^l \theta_j} q_{dj}^{\alpha_j^d \theta_j} q_{fj}^{\alpha_j^f \theta_j}.$$

To avoid confusion, we now denote the returns to scale parameter for firm i by θ_i . We also denote the demand that firm j faces by

$$q_j = p_j^{-\bar{\nu}} D_j.$$

Under this setup, the two firms solve the Nash bargaining problem (7). Solving for the FOCs, we obtain the optimal bilateral price p_{ij}^{RTS} :

$$p_{ij}^{RTS} = \left[\left(1 - \omega_{ij}^{RTS}(\tilde{\phi}_{ij}) \right) \cdot \frac{\varepsilon_{ij}^{RTS}}{\varepsilon_{ij}^{RTS} - 1} + \omega_{ij}^{RTS}(\tilde{\phi}_{ij}) \cdot \mu_{ij}^{int} \right] \frac{c_i}{\theta}, \quad (36)$$

where $\omega_{ij}^{RTS}(\tilde{\phi}_{ij}) \equiv \frac{\tilde{\phi}_{ij} \lambda_{ij}^{bgn,RTS}}{\tilde{\phi}_{ij} \lambda_{ij}^{bgn,RTS} + \varepsilon_{ij} - 1}$ and:

$$\varepsilon_{ij}^{RTS} = \rho \left(1 - s_{ij}^f \right) + \left(1 + \left(\frac{\bar{\nu}}{\theta_j + \bar{\nu} (1 - \theta_j)} - 1 \right) \alpha_j^f \right) s_{ij}^f$$

$$\lambda_{ij}^{bgn,RTS} = \frac{\left(\frac{\bar{\nu}}{\theta_j + \bar{\nu} (1 - \theta_j)} - 1 \right) \alpha_j^f s_{ij}^f}{1 - \left(1 - s_{ij}^f \right) \frac{\frac{\bar{\nu}}{\theta_j + \bar{\nu} (1 - \theta_j)} - 1}{\rho - 1} \alpha_j^f}. \quad (37)$$

Comparing equations (36) and (37) with equations (8), (10), (11), and (15), one can see that the two sets of equations have identical structures. The term $\bar{\nu} \frac{1}{\theta_j + \bar{\nu} (1 - \theta_j)}$ in the model with returns to scale for firm j is replaced by ν when one assumes constant returns to scale for firm j . This result shows that the term ν in Section 2 captures not only the demand elasticity that U.S. importers face, but also the degree of returns to scale of their production functions.

A.5 Input market power of firm i

In Section 2 we endogenize firm i 's cost c_i by allowing the firm to have returns to scale technology. In this section we consider an alternative way to endogenize c_i , by allowing firm i to have input market power. We assume that firm i faces an upward sloping supply curve in the market of its own inputs I_i , as in [Morlacco \(2019\)](#). In so doing, we allow firm i to have buyer power over its suppliers. The unit price of the input is given by p_I , determined by the following (inverse) supply function

$$p_I = \delta Q_I^\alpha,$$

with supply elasticity $\kappa > 0$, and where Q_I denotes aggregate demand of input I , i.e. $Q_I = I_i + Q_{-i}$. The term Q_{-i} denotes the demand of inputs by other foreign exporters. Firm i will exercise buyer power whenever $q_i/Q_I > 0$, namely, whenever it is large enough to be able to affect aggregate demand.

Firm i minimizes cost, $p_I I_i$, by choosing I_i , taking as given other exporter firms' input choices Q_{-i} . This yields the firm i 's "effective" unit cost of output, or marginal expenditure, as

$$c_i = \underbrace{\varphi_i^{-1} p_I}_{\tilde{c}_i} \left(1 + \kappa \frac{I_i}{Q_I} \right). \quad (38)$$

Equation (38) summarizes the effect of firm i 's buyer power on its marginal cost of production. While the unit price of input I is p_I , such that producing the marginal unit of output would only cost $\tilde{c}_i = \varphi_i^{-1} p_I$ to the firm, the effective cost of the marginal unit to the firm is higher, as the firm takes into account the effect of the extra unit on all the infra-marginal units. This extra cost is summarized by the term $1 + \kappa \frac{I_i}{Q_I}$, which effectively summarizes the buyer power of firm i .

Firm i and firm j engage in price bargaining as in Section 2, but now the two firms take into account that firm i 's "effective" unit cost c_i is affected by the choice of p_{ij} . The price p_{ij} will affect the sales of the firm, q_i , which in turn affects the input quantity demanded, I_i , which then affects c_i through equation (38). Taking the new set of FOCs, we now obtain the following price equation:

$$p_{ij} = \frac{\varepsilon_{ij}}{\varepsilon_{ij} + \tilde{\phi}_{ij} \lambda_{ij}^{bgn} - 1} \left(1 + \kappa \frac{I_i}{Q_I} \right) \tilde{c}_i + \frac{\tilde{\phi}_{ij} \lambda_{ij}^{bgn} \mu_{ij}^{input}}{\varepsilon_{ij} + \tilde{\phi}_{ij} \lambda_{ij}^{bgn} - 1} \tilde{c}_i, \quad (39)$$

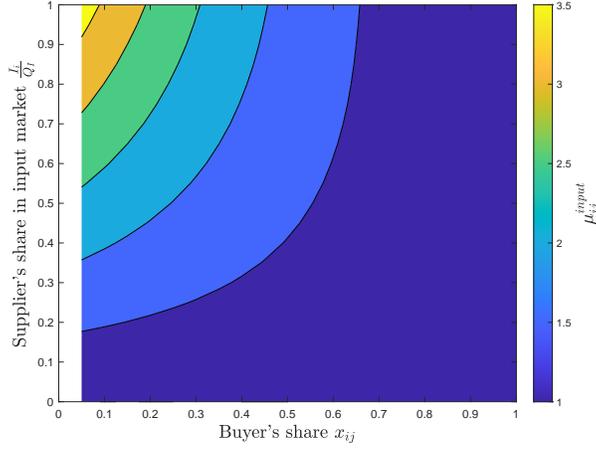
where

$$\mu_{ij}^{input} = \frac{1}{x_{ij}} \left(1 - \left(1 - \frac{I_i}{Q_I} x_{ij} \right)^\kappa (1 - x_{ij}) \right). \quad (40)$$

The input market power of supplier i has two effects on the equilibrium prices: First, it changes the marginal cost due to the effect of i 's input demand on input prices p_I ; Second, the bilateral markup also changes through the interaction with the bargaining term λ_{ij}^{bgn} . The term μ_{ij}^{input} captures the interplay between firm i 's oligopsony power and bargaining between i and j . The larger share firm i has in its input market, i.e. as $\frac{I_i}{Q_I} \rightarrow 1$, the larger the markup firm i can charge on its goods sold to j , ceteris paribus. Through the bargaining between i and j , this effect diminishes as the buyer share x_{ij} increases.

The term μ_{ij}^{input} hits the lower bound of 1 when either $x_{ij} \rightarrow 1$, $\kappa \rightarrow 0$, or $\frac{I_i}{Q_I} \rightarrow 0$. In the limit case when buyer j accounts for all of firm i 's output, i.e. when $x_{ij} \rightarrow 1$, all the rent generated by the input market power of i is taken by the buyer j through bargaining. When

Figure 2: Input market power and buyer share



Notes: The figure displays the contour of the term μ_{ij}^{input} defined in equation (40), with respect to the buyer share x_{ij} and firm i 's market share in its input market, $\frac{I_i}{Q_L}$. We use $\kappa = 3$ for the computation.

either $\kappa \rightarrow 0$ or $\frac{I_i}{Q_L} \rightarrow 0$, the supplier i behaves as a price taker in the upstream input market. Figure 2 draws the markup contour plot for all the possible combinations of buyer share x_{ij} and supplier's share in input market I_i/Q_L . Note that for high enough values of x_{ij} and low enough values of I_i/Q_L , the input market power of firm i has no bearing on the bilateral markup.

A.6 Pass-Through - Derivations and General Results

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

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

The elasticity of the supplier share s_{ij}^f , $\frac{d \ln s_{ij}^f}{d \ln \vartheta_i}$, can be derived as

$$\frac{d \ln s_{ij}^f}{d \ln \vartheta_i} = (1 - \rho) \left(1 - s_{ij}^f \right) \frac{d \ln p_{ij}}{d \ln \vartheta_i}.$$

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

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

where we denote the demand elasticity that firm i faces by other firms by $\varepsilon_i \equiv -\frac{d \ln q_i}{d \ln \vartheta_i}$, with $q_i \equiv q_i - q_{ij}$.

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

$$\Gamma_{ij}^s \equiv \frac{\partial \ln \mu_{ij}}{\partial \ln \varepsilon_{ij}} \frac{\partial \ln \varepsilon_{ij}}{\partial \ln s_{ij}^f} + \frac{\partial \ln \mu_{ij}}{\partial \ln \lambda_{ij}^{bgn}} \frac{\partial \ln \lambda_{ij}^{bgn}}{\partial \ln s_{ij}^f},$$

where

$$\begin{aligned} \frac{\partial \ln \mu_{ij}}{\partial \ln \varepsilon_{ij}} &= \frac{\varepsilon_{ij}}{\varepsilon_{ij} + \tilde{\phi}_{ij} \lambda_{ij}^{bgn} \mu_{ij}^{int}} - \frac{\varepsilon_{ij}}{\varepsilon_{ij} + \tilde{\phi}_{ij} \lambda_{ij}^{bgn} - 1} \\ \frac{\partial \ln \varepsilon_{ij}}{\partial \ln s_{ij}^f} &= \frac{\varepsilon_{ij} - \rho}{\varepsilon_{ij}} \\ \frac{\partial \ln \mu_{ij}}{\partial \ln \lambda_{ij}^{bgn}} &= \frac{\tilde{\phi}_{ij} \lambda_{ij}^{bgn} \mu_{ij}^{int}}{\varepsilon_{ij} + \tilde{\phi}_{ij} \lambda_{ij}^{bgn} \mu_{ij}^{int}} - \frac{\tilde{\phi}_{ij} \lambda_{ij}^{bgn}}{\varepsilon_{ij} + \tilde{\phi}_{ij} \lambda_{ij}^{bgn} - 1} \\ \frac{\partial \ln \lambda_{ij}^{bgn}}{\partial \ln s_{ij}^f} &= 1 - \frac{1}{\rho - 1} \left(1 - s_{ij}^f\right)^{\frac{\tilde{\nu}_j}{\rho-1} - 1} \lambda_{ij}^{bgn}. \end{aligned}$$

The term $\Gamma_{ij}^x = -\frac{d \ln \mu_{ij}}{d \ln x_{ij}}$, is computed as

$$\Gamma_{ij}^x = -\frac{\partial \ln \mu_{ij}}{\partial \ln \mu_{ij}^{int}} \frac{\partial \ln \mu_{ij}^{int}}{\partial \ln x_{ij}},$$

where

$$\begin{aligned} \frac{\partial \ln \mu_{ij}}{\partial \ln \mu_{ij}^{int}} &= \frac{\tilde{\phi}_{ij} \lambda_{ij}^{bgn} \mu_{ij}^{int}}{\varepsilon_{ij} + \tilde{\phi}_{ij} \lambda_{ij}^{bgn} \mu_{ij}^{int}} \\ \frac{\partial \ln \mu_{ij}^{int}}{\partial \ln x_{ij}} &= \frac{(1 - x_{ij})^{\frac{1-\theta}{\theta}}}{\mu_{ij}^{int}} - 1. \end{aligned}$$

Putting all together, one can obtain the pass-through equation of

$$\Phi_{ij} = \frac{-\Gamma_{ij}^x (1 - x_{ij}) \varepsilon_i - \frac{1-\theta}{\theta} (1 - x_{ij}) \varepsilon_i + 1}{1 + \Gamma_{ij}^s (\rho - 1) \left(1 - s_{ij}^f\right) - \Gamma_{ij}^x (1 - x_{ij}) \varepsilon_{ij} + \frac{1-\theta}{\theta} x_{ij} \varepsilon_{ij}}.$$

The pass-through equation above captures two sets of forces that affect the bilateral price. The first set of forces is the one operating through the changes in the two bilateral shares. A cost increase of the supplier reduces the supplier share s_{ij}^f as the buyer substitutes away from the supplier's good, inducing the supplier to reduce its markup (the term $\Gamma_{ij}^s (\rho - 1) (1 - s_{ij}^f)$). The same shock would also change the buyer share x_{ij} , depending on the relative demand elasticities the supplier faces from its buyer and from its other buyers

(the terms $\Gamma_{ij}^x (1 - x_{ij}) \epsilon_i$ and $\Gamma_{ij}^x (1 - x_{ij}) \epsilon_{ij}$). For example, if the buyer has more elastic demand ($\epsilon_{ij} > \epsilon_i$), then the buyer share x_{ij} will decrease. Under decreasing returns to scale technology the markup would increase, hence increasing the price pass-through.

The second set of forces are the ones operating through the change in scale of the supplier. A positive cost shock on the supplier reduces its scale, and if the production technology exhibits decreasing returns it would decrease its cost, dampening the magnitude of the price pass-through. The reduction in scale can come through the reduction of sales to the buyer (the term $\frac{1-\theta}{\theta} x_{ij} \epsilon_{ij}$) or through the reduction of sales to other buyers (the term $\frac{1-\theta}{\theta} (1 - x_{ij}) \epsilon_i$).

To be consistent with the empirical exercise we primarily consider the “direct” pass-through (Burstein and Gopinath, 2015) where we assume $\Delta p_{ik} = \Delta q_{kj} = 0$. In this case we can turn off the effects that operate through changes in other buyers’ demand and through changes in overall scale, leading to the following pass-through equation:

$$\Phi_{ij} = \frac{1}{1 + \Gamma_{ij}^s (\rho - 1) \left(1 - s_{ij}^f\right) - \Gamma_{ij}^x (1 - x_{ij}) \epsilon_{ij} + \frac{1-\theta}{\theta} x_{ij} \epsilon_{ij}}.$$

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 manufacturing ID 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.¹⁸

¹⁸Other general rules also apply. For example, english words such as “a”, “an”, “and”, “the” and also hyphens should be ignored from the company’s name. Common prefixes such as “OOO”, “OAO”, “ISC”, or “ZAO” in Russia, or “PT” in Indonesia, should be 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 should be ignored.

The matching is conducted as follows. First, we match the name part of the manufacturer's ID in LFTTD with the name part in ORBIS. Second, we construct a location matching score for the manufacturer's ID 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 manufacturer's ID 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.

The LFTTD MID variable has recently been used in academic research papers to identify buyer-supplier relationships (see [Eaton et al., 2012](#); [Kamal and Sundaram, 2012](#); [Kamal and Krizan, 2013](#); [Monarch, 2014](#); [Kamal and Monarch, 2018](#)). 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. This 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.¹⁹ Since we know the NAICS code of the firms in ORBIS, we have excluded retailers and wholesalers from the matched Census-ORBIS dataset.

B.2 Related party trade measured by ORBIS

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

¹⁹The law requires the importer to declare the MID of the manufacturer exporter, not the intermediary, but complacency of this rule is hardly enforceable.

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 which may generate false-positives as multinationals identifier since the ownership threshold for related-party trade is 6% or higher for imports, well below majority ownership or even levels that would confer sufficient control rights.