Multinational Production and Trade Policy*

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Abstract

Multinational enterprises (MNEs) dominate international trade, yet much of the literature on optimal trade policy has overlooked their significance. Using confidential Census data, we show that in response to the 2018–2019 U.S. import tariffs, MNEs reduced their import volumes from affected countries more sharply than other firms. Moreover, MNEs lowered their tariff-exclusive import prices by more than non-MNEs, suggesting transfer pricing. We develop a quantitative general equilibrium model with multinational production in which firms set transfer prices on intra-firm shipments, and derive sufficient-statistic formulas for optimal tariffs. We show that multinational production attenuates standard terms-of-trade effects through the endogenous relocation of production, generates profit-repatriation motives arising from foreign affiliate profits, breaks Lerner symmetry so that tariffs imperfectly substitute for missing export taxes, and weakens tariff compliance through transfer pricing. Optimal tariffs are 4.7%, far below the 20.5% implied by standard terms-of-trade motives alone.

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1 Introduction

Tariffs are levied on goods that cross borders. Standard optimal-tariff theory treats a country's trade response to tariffs as arising from substitution among producers in different countries, taking the price observed at customs as given. But a multinational facing a tariff can respond along margins that standard analysis ignores: shifting production to a foreign affiliate to serve the destination market without crossing the taxed border, or under-declaring the value of intra-firm shipments that do cross it. These are not marginal choices – multinational enterprises account for roughly a quarter of U.S. private-sector employment and 70 percent of aggregate exports and imports (Antràs et al., 2023). How does optimal trade policy change once firms can decide not just how much to trade, but whether to cross the border at all and what to declare when they do?

We start answering these questions using confidential transaction-level data on U.S. imports from the Longitudinal Firm Trade Transactions Database (LFTTD) of the U.S. Census Bureau, to study how changes in U.S. import tariffs in 2018-2019 affected MNEs' foreign sourcing. The key advantage of these data over aggregate trade statistics is twofold: first, each transaction is linked to an identifiable importer, exporter, 10-digit Harmonized System (HS10) product, and country of origin, which allows us to study how individual firms' trade relationships react to tariffs rather than how aggregate trade changes. Second, our analysis draws on an indicator in the LFTTD that distinguishes "related party" (RP) transactions, i.e., within multinationals, from transactions that occur at arm's length (AL). This allows us to compare the behavior of MNEs, which we define as firms that engage in RP transactions, and non-MNEs within the same product and country cell, and to compare the border prices of the same foreign exporter selling the same product simultaneously through related-party and arm's-length channels. Each of these comparisons would be invisible in country-product data, where firm identities and trade relationships are aggregated away.

Our first key empirical result is that MNE import quantities respond more strongly to tariff changes than those of non-MNEs. Comparing continuing importer-exporter relationships of MNEs with those of non-MNEs, a 10 percent increase in tariffs reduces imported quantities by 1.9 percent for non-MNEs compared with 6.0 percent for MNEs over 24 months. The differential survives controls for importer size, ruling out the possibility that it simply reflects the fact that MNEs tend to be larger firms. This finding is consistent with MNEs having a greater ability to reallocate sourcing across affiliates in response to tariffs.

Our second empirical result concerns the tariff base itself. Among foreign MNE exporters simultaneously making AL and RP sales of the same product to the United States, RP border prices from the same country decline more after tariffs rise. At the 24-month horizon, a 10 percent increase in tariffs is associated with a 3.8 percent greater border price decline for an MNE's RP relationships than for its AL relationships. This evidence is consistent with transfer pricing, since the exporter controls the related-party price and can set it to reduce the tariff burden on intra-firm shipments, but cannot do the same with arm's length prices. For multinationals, tariffs affect not only the quantity imported but also the price on which tariff revenue is collected.

These facts discipline a general equilibrium model of trade and multinational production. The framework features two types of firms: local firms that produce exclusively at their headquarter country, and MNE that can produce in multiple countries, facing bilateral frictions that reduce productivity at foreign affiliates. Households have a nested-CES preference structure, with separate elasticities governing substitution across varieties from different headquarter countries and substitution across production locations within a MNE; together, these determine how trade responds to tariff changes.[1] Firms charge markups over marginal cost, and because tariffs can induce production relocation, they also shift profits across borders — between home-owned affiliates abroad and foreign-owned affiliates at home Establishing foreign production requires paying a fixed cost, and therefore the decision to become a MNE is endogenous.

Multinational firms can also engage in transfer pricing, setting intra-firm border prices below arm's-length levels to reduce the tariff burden on intra-firm shipments. The extent of this undervaluation rises with the tariff rate and is limited by the penalty imposed by the government for departures from arm's-length pricing. Because transfer pricing lowers the customs value on which tariffs are collected, it reduces the effective protection a given statutory tariff provides.

We use this framework to study optimal tariffs in an open economy consisting of a small Home country and multiple large Foreign countries. To model the small open economy, we extend the methods developed by Caliendo and Feenstra (2024) and Demidova et al. (2024) to a setting with multinational production. In the special case of no selection into MNE status and no transfer pricing, the small-country assumption allows us to derive suficcient statistics formulas for optimal tariffs, which isolate the distinct roles of production relocation and profit ownership. We derive expressions both under perfect competition and under imperfect competition.

Our theoretical analysis delivers three main results. First, multinational production changes the elasticity that governs the conventional terms-of-trade motive for tariffs. Second, profits earned abroad by domestic MNEs create an additional motive for imposing tariffs. Third, profits earned at home by foreign MNEs create a countervailing force that lowers the optimal import tariff.

First, under perfect competition, the optimal tariff is uniform across countries and takes the familiar inverse-elasticity form, but the elasticity entering the formula is no longer a primitive parameter. Instead, it is a composite of two primitives, whose weights are equilibrium objects. Bilaterally, the trade elasticity between Home and a partner country is a weighted average of the elasticity of substitution across varieties and the elasticity of substitution across production locations within a MNE, where the weights on these two primitives are determined by how much of Home's sales to the partner flow through exports versus foreign affiliates. The optimal tariff is an export-share-weighted average of bilateral trade elasticities across all trading partners. If, as in our empirical estimates, substitution across production locations within MNEs is easier than substitution across varieties, a tariff-induced rise in the Home wage encourages Home MNEs to shift production to cheaper foreign affiliates more strongly than the elasticity of substitution across

[1] This specification is isomorphic to other theoretical formulations in which technological differences across countries are smaller within firms than across firms.

varieties alone would imply. Trade is then more elastic than a trade-only model would predict, lowering the optimal tariff relative to the conventional terms-of-trade benchmark. Multinational production thus endogenizes the sufficient statistic used by optimal-tariff theory.

Second, under imperfect competition, multinational profits become an additional channel through which tariffs affect Home welfare. A higher tariff induces multinationals to reallocate production toward their foreign affiliates. This relocation increases the profits earned abroad by domestic firms, which are repatriated to Home households, widening the trade deficit. By internalizing the resulting increase in import demand, the planner sets a higher tariff than the terms-of-trade motive alone would prescribe. This profit-repatriation motive is distinct from the profit-shifting mechanism emphasized by Brander and Spencer (1981), Bagwell and Staiger (2012), and Ossa (2012), in which tariffs affect profits only through changes in household income.

Third, when foreign firms also operate affiliates at Home, a countervailing force emerges. Lerner symmetry breaks down: import and export taxes are no longer equivalent instruments, and the import tariff takes on an additional role as a substitute for missing export taxes. Trade imbalances now reflect not only the repatriated profits of domestic MNES but also the profits earned by foreign affiliates operating at Home, which accrue to foreign households. The planner would ideally tax these profits through export taxes; in their absence, lowering the import tariff serves as a second-best substitute, since cheaper imports reduce the profitability of foreign operations at Home and partially offset the repatriation of those profits to foreign households. The optimal tariff is therefore lower than when only domestic firms operate as multinationals, though whether it lies above or below the no-MNE benchmark depends on which force dominates: the profit-repatriation motive or the missing-export-tax correction. Thus, what matters for policy is not only the size of a trade imbalance, but also whether it reflects profits earned abroad by domestic multinationals or profits earned at Home by foreign affiliates.

The analytical results do not allow for selection into MNE status and omit transfer pricing. To analyze optimal tariffs in the full environment, we calibrate the model using the simulated method of moments to match the U.S. economy, and compute optimal tariffs numerically. The empirical patterns documented above are informative of key parameters in the model: the differential quantity responses of MNEs and non-MNEs to tariffs discipline the elasticities of substitution across varieties and across affiliates within a multinational, while the differential price response of RP versus AL transactions within multinationals in the data discipline the model's transfer-pricing technology.

We compute optimal tariffs under four model variants that differ in whether firms select into multinational status and whether multinationals engage in strategic transfer pricing. When all trade is carried out by multinationals, the optimal tariff is 7.4 percent. We compare this with the sufficient-statistic formula derived under the small open economy assumption; the formula tracks the numerical optimum closely. Its decomposition, however, reveals that the terms-of-trade motive alone would call for a tariff of 20.5 percent, nearly three times the optimum. The profit-repatriation motive pushes tariffs higher still. The force that pulls the optimal tariff far below these benchmarks is the missing-export-tax correction: foreign affiliates earn substantial profits in the United States,

and the planner, lacking export taxes to recapture them, cannot raise the import tariff without also increasing the profits repatriated by those foreign affiliates. Allowing for selection into multinational status raises the optimal tariff to 12.1 percent, as local firms are less responsive to tariffs than global firms, lowering the aggregate trade elasticity. The gap between the formula and the numerical optimum widens, because the formula does not capture the contribution of local firms to aggregate trade flows.

Transfer pricing reduces optimal tariffs further. In the global-firms model, it lowers the optimal tariff from 7.4 to 4.7 percent; in the baseline with selection, from 12.1 to 10.9 percent. By eroding the tariff base, transfer pricing weakens both the terms-of-trade and the profit-repatriation motives. The effect is larger when all firms are multinationals, since every firm then has the ability to manipulate its border prices.

We use these results to evaluate the welfare consequences of the 2018–2019 U.S. tariffs and the gains from optimal policy. In the baseline model without transfer pricing, the 2018–2019 tariffs generate a small welfare loss of 0.02 percent, in contrast with the modest gains found in models without multinational production (see, for example, Antràs et al., 2024b). Optimal tariffs yield welfare gains equivalent to a 0.22 percent increase in consumption, compressed to 0.19 percent once transfer pricing is incorporated. A planner who ignores multinational production and sets the conventional inverse-elasticity tariff of roughly 15 percent achieves lower welfare than the MNE-aware optimum; in the global-firms model, this policy turns welfare gains into outright losses. Accounting for multinational production thus matters not only for the level and composition of optimal tariffs, but also for the welfare assessment of actual trade policy.

Our paper contributes to several strands of literature. First, we contribute to the literature on trade policy and multinational production. A long tradition studies how tariffs induce tariff-jumping FDI (Goldberg, 1995; Blonigen and Feenstra, 1996), and quantitative models of multinational production have shown that tariff changes generate third-country effects through the reallocation of production across affiliates (Ramondo and Rodríguez-Clare, 2013; Tintelnot, 2017; Flaaen and Pierce, 2019). We develop a tractable multi-country general equilibrium framework that nests both trade and multinational production, and incorporates strategic transfer pricing, building on models of intra-firm pricing under tax and tariff incentives (Bernard et al., 2006; Keuschnigg and Devereux, 2013; Egger and Seidel, 2013; Cristea and Nguyen, 2016).

Second, we contribute to the literature on optimal trade policy. The classical result that the optimal tariff equals the inverse export supply elasticity (Johnson, 1951; Gros, 1987) has been extended to environments with intermediate inputs, global value chains, and firm heterogeneity. (Costinot et al., 2015; Lashkaripour and Beshkar, 2020; Costinot et al., 2020; Caliendo and Parro, 2022; Lashkaripour and Lugovskyy, 2023), but the firms in these frameworks are always domestically owned. Antràs and Staiger (2012) show that offshoring introduces new externalities that traditional trade policy frameworks do not capture. We bring multinational production into the optimal tariff problem, derive sufficient-statistic formulas, and show that foreign ownership of domestic production

fundamentally alters the optimal tariff.[2]

The closest work to ours in studying optimal tariffs with cross-border ownership is Blanchard (2010) and Blanchard et al. (2025). They derive their results in specific-factors models where cross-border factor ownership generates trade imbalances through factor payments, and show that international ownership linkages are tariff-reducing, a finding we obtain as well. Our framework builds instead on new trade theory: firms are heterogeneous, selection into multinational production is endogenous, and trade imbalances arise from the reallocation of production across affiliates rather than from cross-border factor payments. This distinction matters because tariffs themselves alter the production decisions of multinationals, changing both the size and composition of the deficit. Pujolas and Rossbach (2024), Ignatenko et al. (2025), and Itskhoki and Mukhin (2025) show that trade deficits can enhance a country's ability to manipulate its terms of trade, implying higher optimal tariffs. Our analysis qualifies these findings: by endogenizing trade imbalances through multinational production decisions, we show that what matters is not only the size of the deficit but also whether it reflects profits earned abroad by domestic multinationals or profits earned at home by foreign affiliates.

Third, we contribute to the empirical literature on the effects of the 2018–2019 U.S. tariffs on trade and prices. Using product-country level data, Amiti et al. (2019) and Fajgelbaum et al. (2020) find that border prices remained nearly constant as imports declined, suggesting full pass-through of tariffs to importers. More recent work using firm-level data from the LFTTD shows that this aggregate pattern masks substantial heterogeneity: Alviarez et al. (2025) and He et al. (2026) demonstrate that tariff pass-through is incomplete within continuing buyer-supplier relationships. We push this disaggregation further along two dimensions. First, we show that MNE import quantities respond more strongly to tariffs than those of non-MNEs, consistent with multinationals' ability to reallocate sourcing across affiliates (see also Utar et al., 2025). Second, among foreign exporters simultaneously conducting related-party and arm's-length transactions, we show that related-party border prices fall more sharply after a tariff increase, consistent with multinationals manipulating the customs value of intra-firm shipments to reduce their tariff burden (Swenson, 2001; Clausing, 2003; Bernard et al., 2006; Cristea and Nguyen, 2016).

The rest of the paper is structured as follows. Section 2 documents the differential response of MNE and non-MNE imports to the 2018–2019 U.S. tariff changes and presents evidence that multinational firms use transfer pricing to reduce the customs value of intra-firm shipments. Section 3 presents the theoretical model, while Section 4 derives sufficient-statistic tariff formulas for a small open economy. Section 5 takes the model to the data and quantifies how multinational production and transfer pricing shape the optimal tariff. Section 6 concludes.

[2] In independent work, Dyrda et al. (2024) study optimal unilateral tariffs in a model with multinational firms.

2 Motivating Empirical Facts

In 2018–2019, the U.S. imposed tariffs on solar panels, washing machines, steel and aluminum products, and four waves of Section 301 tariffs on a wide variety of products from China. In this section, we present three empirical facts regarding related-party imports and tariffs during this episode to motivate the setup of our model. We first describe the data and then present the three empirical facts.

2.1 Data for Descriptive Analyses

We use two main datasets. First, we obtain confidential transaction-level U.S. import data from the Longitudinal Firm Trade Transactions Database (LFTTD) of the U.S. Census Bureau. These data capture the universe of U.S. import transactions in goods and contain, for each import transaction, an identifier for the U.S. importer, the 10-digit HS code traded, and the country of origin. The data also report an identifier for the foreign seller and an indicator of whether the transaction is between related parties.[3] We use the data for the period 2016–2021 and construct pre-tariff prices as the ratio of the value to the quantity shipped.

We perform several standard data cleaning steps. First, we drop import transactions not for consumption, i.e., warehouse entries. Second, we drop transactions that do not contain both an import value and a quantity. This step ensures that we compute prices (unit values) from a consistent set of observations for which both values and quantities are reported.[4] Third, we treat an importer-exporter pair as related in any year in which it reports at least one related-party transaction, for any product. Finally, as in Amiti et al. (2019), our regressions include only observations associated with price changes smaller than 3 log points in absolute value to eliminate outliers.

We merge the import transactions data with data on base tariff rates at the HS10–country level from the U.S. International Trade Commission, which capture MFN tariffs and any preferential trade agreements. We then add to these base rates the U.S. tariff changes during the recent period, collected from announcements in the Federal Register and from the United States Trade Representative (USTR).[5] We transform specific tariffs into ad valorem equivalents. Our final dataset contains an ad valorem tariff rate for each country-product-month triplet.

2.2 Two Empirical Facts on Related Party Trade and the 2018-19 Trade War

We now document two empirical facts on multinational trade and the tariffs in 2018–19.

[3] Based on Section 402(e) of the Tariff Act of 1930, related-party trade includes import transactions between parties with various types of relationships, including "any person directly or indirectly owning, controlling, or holding with power to vote, 5 percent or more of the outstanding voting stock or shares of any organization."

[4] In the publicly available data, this step is only possible at the product-country level, not at the level of individual transactions. Heise (2024) shows that about 17 percent of transactions do not report a quantity in 1992–2017, accounting for around 17 percent of imports.

[5] Our tariff data are an updated version of the tariff dataset used by Amiti et al. (2019).

Fact 1: Quantities Decline More Strongly in Continuing RP than in AL Relationships in Response to Tariffs

We first analyze how heterogeneity by related-party status influences the effect of tariffs on U.S. imports. We implement reduced-form regressions to estimate the effect of monthly tariff changes on import quantities and values, using specifications similar to those in Fajgelbaum et al. (2020). While these authors conduct their analysis using publicly available data aggregated at the country-product level, we estimate these regressions at the disaggregated importer-exporter–country-product-month level in the LFTTD, and use the resulting coefficients to discipline our model below.

Let f index an importer firm, x an exporter firm, i index a source country, g an HS10 product, and t a month between 2016:m1 and 2021:m12. We aggregate the raw transaction-level data to the $fxigt$ level and run specifications of the form

$$\Delta \ln y_{fxigt} = \eta_{fxig} + \eta_{gt} + \eta_{it} + \alpha \mathbb{I}_{fxt}(RP) + \beta \Delta \ln(1+\tau_{igt}) + \beta_{RP} \Delta \ln(1+\tau_{igt}) \mathbb{I}_{fxt}(RP) + \varepsilon_{fxigt}, \quad (1)$$

where y_{fxigt} is either the quantity or value imported by importer firm f from exporter firm x in country i of good g in month t, η_{fxig} is an importer firm by exporter firm by country by product fixed effect, η_{gt} and η_{it} are product-time and country-time fixed effects, respectively, and τ_{igt} is the statutory tariff rate for the product and country. The term $\mathbb{I}_{fxt}(RP)$ is a dummy that indicates whether the importer–exporter pair is related in month t.[6] The coefficient β_{RP} captures whether related party (RP) trade responds differently from arm's length (AL) trade to changes in tariffs. We run this regression for differences over horizons of length 1, 3, 12, and 24 months. Standard errors are clustered at the 8-digit HS code level.

The results in Table 1 indicate that—within importer-exporter relationships that continue trading the same product—RP trade is more responsive to tariff changes than AL trade. Over a one-month horizon, a 10% increase in tariffs reduces the quantity imported by 3.5% for AL trade but by 5.6% for RP trade. The response is slightly larger over a 24-month horizon, rising to 3.8% for arm's-length trade and 6.9% for related-party trade. The pattern is similar for the value imported, but the percentage decline in import value is larger than for quantity. Over a 24-month horizon, a 10% rise in tariffs lowers import value by 6.3% for arm's-length trade and by 8.3% for related-party trade. Overall, it appears that firms with related-party links find it easier to move production between different countries across a firm's affiliates than do firms with AL suppliers. This finding is consistent with Utar et al. (2025) , who show that MNEs relocated their supply chains from China to Mexico in response to the tariffs.

Our estimated elasticities are substantially smaller than those documented from country-product level regressions in the literature due to the different level of aggregation used in our regressions. In Appendix A.3, we aggregate the LFTTD data to the country-product level and conduct the standard reduced-form regression in Fajgelbaum et al. (2020) for the period 2016–2021. We obtain

[6] This property could be time-varying because some pairs may initially be at arm's length and then become related parties, or vice versa.

Table 1: Effect of Tariffs – AL vs RP

	1 mo	3 mo	12 mo	24 mo
Quantity				
$\Delta \ln(1+\tau_{igt})$	-0.349***	-0.252***	-0.388***	-0.382***
	(0.058)	(0.051)	(0.041)	(0.060)
$\Delta \ln(1+\tau_{igt})\mathbb{I}_{fxt}(RP)$	-0.215***	-0.167***	-0.188***	-0.312***
	(0.063)	(0.048)	(0.051)	(0.064)
Value				
$\Delta \ln(1+\tau_{igt})$	-0.440***	-0.393***	-0.611***	-0.631***
	(0.053)	(0.050)	(0.037)	(0.063)
$\Delta \ln(1+\tau_{igt})\mathbb{I}_{fxt}(RP)$	-0.161**	-0.138***	-0.113**	-0.194***
	(0.063)	(0.047)	(0.051)	(0.066)
Importer-Exporter-Country-HS10 FE	Y	Y	Y	Y
HS10-Time FE	Y	Y	Y	Y
Country-Time FE	Y	Y	Y	Y
R^2	0.094	0.122	0.199	0.297
Observations	31,170,000	26,480,000	15,970,000	8,831,000

Notes: Source: Census Bureau and authors' calculations. Table reports the results of regressing the change in the quantity or value (y_{igt}) on the change in the tariff (τ_{igt}). The regressions include importer firm-exporter firm-product-country, product-time, and country-time fixed effects. Standard errors, adjusted for clustering by HS8 product code, are reported below coefficient estimates. Coefficient on $\mathbb{I}_{fxt}(RP)$ is omitted for brevity. ***, **, and * represent statistical significance at the 1, 5, and 10 percent levels.

much larger elasticities from these regressions, of around -1.0 for quantity and -1.1 for import value over a one-month horizon, though these are still lower than the elasticities of around -1.5 for both in Fajgelbaum et al. (2020). Once we shorten our sample period to end in April 2019 as in their paper, we get nearly identical quantitative results.[7]

In our theory, we compare trade by MNEs and by non-MNEs. While MNEs predominantly engage in RP trade, in principle they can also trade with some partners at arm's-length. We next examine whether the response of MNE imports to tariff changes differs from that of non-MNEs. We define whether a firm is an MNE separately for each product, i.e., a firm could be an MNE for some of its inputs but not for others, to account for differences in import behavior across goods. Specifically, an importer-HS10 pair is defined to be an MNE if it engaged in at least one RP transaction in the pre-tariff period 2016-17 and another RP transaction in the period 2019-20. Thus, our analysis focuses on firms that continue to source goods via RP trade even after the tariffs have been imposed. We compare the import behavior of this group of firm-product pairs to those that are not MNEs. We define these as firm-products that do not import via RP at all but have at least one AL transaction in the period 2016-17 and no RP trade but at least one AL transaction in 2019-20. We drop the remaining firm-product pairs, i.e., those that we cannot clearly classify as one group or the other. These include, for example, cases where an importer used only arm's-length trade to source a product in 2016-17 but then also uses RP trade in 2019-20, or vice versa.

[7] As in their paper we do not find an effect of tariffs on foreign export prices.

Table 2: Effect of Tariffs – MNE vs Non-MNE

	1 mo	3 mo	12 mo	24 mo
Panel a: Combined regression				
Quantity				
$\Delta \ln(1+\tau_{igt})$	-0.243***	-0.171***	-0.210***	-0.189***
	(0.074)	(0.056)	(0.044)	(0.064)
$\Delta \ln(1+\tau_{igt})\mathbb{I}_{fg}(MNE)$	-0.247***	-0.244***	-0.323***	-0.414***
	(0.074)	(0.054)	(0.046)	(0.062)
Value				
$\Delta \ln(1+\tau_{igt})$	-0.379***	-0.385***	-0.532***	-0.524***
	(0.070)	(0.056)	(0.043)	(0.064)
$\Delta \ln(1+\tau_{igt})\mathbb{I}_{fg}(MNE)$	-0.160**	-0.115**	-0.151***	-0.233***
	(0.072)	(0.051)	(0.045)	(0.061)
Importer-Exporter-Country-HS10 FE	Y	Y	Y	Y
HS10-Time FE	Y	Y	Y	Y
Country-Time FE	Y	Y	Y	Y
R^2	0.093	0.117	0.181	0.285
Observations	19,150,000	16,740,000	11,320,000	7,028,000
Panel b: Separate regressions for MNE and Non-MNE				
Quantity: Non-MNE	-0.341***	-0.323***	-0.297***	-0.379***
Quantity: MNE	-0.434***	-0.357***	-0.494***	-0.581***

Notes: Source: Census Bureau and authors' calculations. Panel a reports the results of regressing the change in quantity or value (y_{igt}) on the change in the tariff (τ_{igt}) and its interaction with an indicator for multinational enterprises. Panel b reports coefficient estimates from separate quantity regressions run for MNE and Non-MNE firms. The regressions include importer firm-exporter firm-product-country, product-time, and country-time fixed effects. Standard errors, adjusted for clustering by HS8 product code, are reported below coefficient estimates in Panel a. ***, **, and * represent statistical significance at the 1, 5, and 10 percent levels.

We then run a regression on the subsample of importers classified as MNEs or non-MNEs that is similar to specification (1), but includes a dummy for whether the importer-product pair is an MNE:

$$\Delta \ln y_{fxigt} = \eta_{fxig} + \eta_{gt} + \eta_{it} + \beta \Delta \ln(1+\tau_{igt}) + \beta_{MNE} \Delta \ln(1+\tau_{igt})\mathbb{I}_{fg}(MNE) + \varepsilon_{fxigt}, \quad (2)$$

where $\mathbb{I}_{fg}(MNE)$ is an indicator equal to one if the importer-product pair is classified as an MNE.

Panel a of Table 2 shows that MNEs respond more strongly to tariff changes than non-MNEs at all horizons. Over a one-month horizon, a 10% increase in tariffs reduces the quantity imported by non-MNEs by 2.4%, while MNEs lower their imports by 4.9%. Over 24 months, the reduction is 1.9% for non-MNEs and 6.0% for MNEs. As in the comparison of arm's-length and related-party trade, the pattern is similar for the value imported, but the elasticities are larger. We note that the number of observations is significantly smaller in Table 2 than in Table 1 because importer–product pairs that do not have continuous MNE or non-MNE status are dropped. However, we still capture nearly all of the import value in Table 1. At the one-month horizon, the specification focusing only

on continuing MNEs and non-MNEs captures about 75% of the import value included in regression (1), and about 90% over 24 months.

We next run the regression (2) for the change in quantity separately for Non-MNEs and for MNEs, omitting the interaction between the tariff change and MNE status, and report the coefficients on the term $\Delta \ln(1 + \tau_{igt})$ in Panel b of Table 2. These results will be used for the calibration of our model below. In this specification, Non-MNEs and MNEs are allowed to have different values of the fixed effects, which aligns with our model. We find larger elasticities for Non-MNEs with this specification than with the combined regression in Panel a, and a smaller gap between MNEs and Non-MNEs. However, qualitatively the results are similar, with MNEs responding more strongly to tariff changes than Non-MNEs.

We explore whether MNEs respond differently to tariffs for transactions that are RP versus those that are AL. Across all products, the average MNE in our data sources 77% of its imports via related-party trade, with the remainder via arm's-length trade. We therefore re-run regression (2) with an additional interaction between the tariff change, the MNE status dummy, and a dummy for whether the MNE is trading with a related party. Results in Appendix A.4 show that MNEs reduce their imported quantities more strongly in response to tariffs than Non-MNEs even for AL trade across all horizons except at the one-month interval. They reduce their RP trade slightly more. Overall, these findings show that MNE status itself is important for understanding importers' adjustment to tariffs.

One possibility is that the stronger response to tariffs that we attribute to MNEs is driven by firm size, as MNEs tend to be larger on average than Non-MNEs. We test this possibility by including in regression (2) an interaction between the tariff change and firm size as a control. We measure size in two ways: first, using a dummy that is equal to one if firm f's imports of product g were above the 90th percentile of imports for that good in 2016–17; and second, using a dummy that is equal to one if f imports g from more than one country in that time period. Results in Appendix A.5 still show a significantly stronger quantity response to tariffs for MNEs than for Non-MNEs even with this additional control, but larger firms also tend to have a greater elasticity of imports.

As a robustness check, in Appendix A.7, we run regressions using publicly available data in which we interact the tariff change with an industry's share of RP trade as the right-hand side variable, and show that industries with more RP trade display stronger responsiveness of imports to tariffs, consistent with our findings.

Fact 2: Evidence of Transfer Pricing

We next examine how import prices (exclusive of tariffs) respond to a change in tariffs. Standard trade theory suggests that, if supply curves are not perfectly elastic, import prices should fall in response to higher tariffs as foreign exporters absorb some of the tariff effect. Earlier work has shown that import prices basically did not decline in response to the tariffs in 2018-19, for example Amiti et al. (2019) and Fajgelbaum et al. (2020). However, these papers used data aggregated to the country-product level. In our regressions at the importer-exporter-product level, we find evidence

that foreign exporters lowered their prices in response to the tariffs. Comparing the coefficients for the change in import value and import quantity in Table 1 and Table 2, we find that both MNEs and Non-MNEs saw lower tariff-exclusive import prices, as import values fall by more than quantities. Focusing on Table 2, over a 24-month horizon, an increase in tariffs of 10% is associated with a decline in the tariff-exclusive import price of 3.4% for Non-MNEs (as quantities fall by 1.9% and import values fall by 5.2%). For MNEs, a 10% increase in tariffs is associated with a decline in prices of 1.5%. This finding is consistent with Alviarez et al. (2025). These authors also find that import prices in the U.S.-China trade war fell within continuing relationships in response to tariffs. Recent work by He et al. (2026) argues that incomplete pass-through within relationships and complete pass-through at the aggregate level reflect a compositional shift of imports towards higher-priced relationships, which offsets the import price decline within relationships. These papers do not separately analyze AL and RP trade.

Our finding that import prices for MNEs fell *less* than those of Non-MNEs suggests that MNEs did not reduce their within-firm import prices to lower their tariff burden. However, MNEs and Non-MNEs face different supply curves. To investigate this possibility, we next examine price setting *within* MNEs by comparing the prices of an MNE's AL transactions to the prices of the same MNE's RP transactions. Since prices should be set by the exporter, any differential price change of the exporter for its within-firm (RP) transactions and its transactions with AL buyers could be attributed to transfer pricing.

To explore the possibility that MNE exporters set different prices for AL and RP buyers, we define exporter-product pairs that are MNEs in a similar way to importers as those that engage in at least one RP transaction in 2016-17 and another RP transaction in the period 2019-20. For these MNEs, we aggregate the data to the exporter-country-HS10 product-related party status-month level. We then run:

$$\Delta \ln p_{xigrt} = \eta_{xig} + \eta_{gt} + \eta_{it} + \beta \Delta \ln(1 + \tau_{igt}) + \beta_{RP} \Delta \ln(1 + \tau_{igt}) \mathbb{I}_{xigr}(RP) + \varepsilon_{xigrt}, \tag{3}$$

where the left-hand side denotes the change in the tariff-exclusive price (unit value), and on the right-hand side $\mathbb{I}_{xigr}(RP)$ is equal to one if the transaction of exporter x from country i for product g and related party status r is RP. We restrict our sample to only exporter-country-product-month observations where we can compute a price change for both AL trade and RP trade. Thus, by construction, our sample includes for every exporter and month both an AL and an RP transaction of the same product. Across all horizons, this sample includes about 10% of the imports by value included in the regression with all MNEs in Table 2.

Results in Table 3 indicate that, over the 12- and 24-month horizons, MNE exporters lower their price by significantly more than Non-MNEs. At the 12-month horizon, a 10% increase in tariffs is associated with a fall in the RP price that is 2% greater than the decline in the AL price. This difference grows to 3.8% over 24 months. We do not find a significant decline in the AL price of MNEs.

Cristea and Nguyen (2016) argue that it is easier for firms to engage in transfer pricing for

Table 3: Effect of Tariffs on Prices

	1 mo	3 mo	12 mo	24 mo
Price				
$\Delta \ln(1+\tau_{igt})$	-0.209	-0.122	-0.172	0.037
	(0.163)	(0.105)	(0.110)	(0.190)
$\Delta \ln(1+\tau_{igt}) \cdot \mathbb{I}_{xigr}(RP)$	0.002	-0.038	-0.202**	-0.375***
	(0.109)	(0.066)	(0.099)	(0.116)
Exporter-Country-HS10 FE	Y	Y	Y	Y
HS10-Time FE	Y	Y	Y	Y
Country-Time FE	Y	Y	Y	Y
R^2	0.171	0.201	0.320	0.426
Observations	1,301,000	1,090,000	542,000	302,000

Notes: Source: Census Bureau and authors' calculations. Table reports the results of regressing the change in the tariff-exclusive unit value (y_{igt}) on the change in the tariff (τ_{igt}). The regressions include exporter firm-product-country, product-time, and country-time fixed effects. Standard errors, adjusted for clustering by HS8 product code are reported below coefficient estimates. ***, **, and * represent statistical significance at the 1, 5 and 10 percent levels.

differentiated products. For these types of products, firms can more easily attribute deviations from arm's-length pricing to differences in product quality or complexity than for commodities, which are traded on organized exchanges. To examine this inution, we restrict our sample to "differentiated" products according to Rauch (1999), and re-run regression (3). Results, in Appendix A.6, indicate a stronger average price response: at the 12-month horizon, the average tariff-exclusive price for AL transactions falls by 2.4% instead of an (insignificant) 1.7% for a 10% tariff increase. The difference between AL and RP transactions is broadly stable: while the gap increases at the 12-month horizon, indicating that a 10% increase in tariffs is associated with a 2.9% greater fall in RP prices than AL prices for differentiated products, the gap at the 24-month horizon is slightly smaller.

We also consider a more stringent version of regression (3) where instead of exporter firm-country-HS10 product, product-time and country-time fixed effects we include exporter-product-time fixed effects. These fixed effects more stringently control for the supply curve facing a given exporter, and absorb the baseline tariff response β. Thus, in this specification, only β_{RP}, the difference between AL and RP pricing, is identified. Results, in Appendix A.6, are similar to before and show that the differential price response of an exporter MNE for AL versus RP relationships also hold with this specification.

Overall, our results suggest that MNEs engage in transfer pricing: they tend to reduce their prices more in related party transactions, possibly to reduce their tariff burden and to shift profits from the foreign affiliate to the U.S. This finding is consistent with several papers that have found evidence for transfer pricing by MNEs (e.g., Bernard et al., 2006), for example in response to differences in taxes (Clausing, 2003).

Additional Results

In Appendix A.1, we show that related-party importers and exporters tend to be larger than their arm's-length counterparts. The average RP importer accounts for 11.5% of imports within an HS10–country cell in 2017, compared with 7.7% for the average AL importer. Similarly, the average RP exporter accounts for 8.0% of U.S. imports within HS10–country compared to 6.0% for AL exporters. This result will support a model with selection into multinational firms versus local or independent firms below.

3 Theoretical Framework

The model features N countries and a single sector. In each country, there are two types of firms, which we refer to as *local* and *global*. Local firms produce only domestically and serve foreign markets through exports. Global firms operate production facilities both at home and abroad, using all production locations to serve destination markets. The total measure of firms of a given origin is exogenous; however, the decision to become a global firm is endogenous.

We adopt the following indexing conventions. Letters i, l, and m denote countries. Goods are identified by their variety $\omega \in \Omega_i$, the country of origin $i \in \mathcal{N}$, and the location of production $l \in \mathcal{N}$.[8]

3.1 Households

In each country, a representative household supplies labor inelastically and consumes goods produced by both local and global firms from all countries. The representative household in country m has preferences given by

$$U_m = \left[\sum_{i=1}^{N} \int_{\omega \in \Omega_i} Q_{i,m}(\omega)^{\frac{\sigma-1}{\sigma}} \, d\omega\right]^{\frac{\sigma}{\sigma-1}}, \tag{4}$$

where $Q_{i,m}(\omega)$ denotes country m's consumption of variety ω originating in country i, itself a CES bundle over final goods produced by firms across different production sites

$$Q_{i,m}(\omega) = \left[\sum_{l=1}^{N} q_{i,lm}^{d}(\omega)^{\frac{\varepsilon-1}{\varepsilon}}\right]^{\frac{\varepsilon}{\varepsilon-1}}. \tag{5}$$

The (exogenous) set of varieties originating in country i is denoted by Ω_i, and $\sigma > 1$ and $\varepsilon > 1$ are the elasticities of substitution across distinct varieties and across production locations within a given variety, respectively.[9]

[8] Throughout the paper, the terms *headquarters*, *origin country*, and *origin of ideas* are used interchangeably.

[9] Whereas ε here is a preference parameter, it could equally reflect substitutability in the production technology of a multinational firm. As discussed in Antràs et al. (2024a), this specification is isomorphic to the one used in Tintelnot (2017), in which each firm has a continuum of products that can be produced in various locations, with productivities drawn from a Fréchet distribution. The parameter σ also governs substitution across varieties within an origin country; this dimension plays a limited role in the analysis.

This preference structure implies the following demand system for each variety:

$$p_{i,lm}^{d}(\omega)\, q_{i,lm}^{d}(\omega) = \left(\frac{p_{i,lm}^{d}(\omega)}{P_{i,m}(\omega)}\right)^{1-\varepsilon} \left(\frac{P_{i,m}(\omega)}{P_m}\right)^{1-\sigma} E_m, \tag{6}$$

where E_m denotes household income, and P_m and $P_{i,m}(\omega)$ are country m's dual price indexes to equations (4) and (5).

3.2 Global and Local Firms

We consider two types of firms, *local* and *multinational*. For simplicity, we assume that multinational firms operate globally; hence, we refer to them as *global firms*. This abstracts from heterogeneity in plant location decisions across multinational enterprises (e.g., Tintelnot, 2017), which is not the focus of our study. This modeling choice provides a parsimonious way to capture the increasing role of global firms in international trade and the growing importance of intra-firm trade. It is motivated by tractability and by evidence from many countries that a small number of *superstar* firms account for most aggregate trade (Bernard et al., 2018). Given their scale, these firms are likely well approximated as global firms.

Local firms are headquartered in country i and operate a single production location, namely their headquarters. They therefore serve destination market m only through exports from i. Global firms are also headquartered in country i, but they can organize production across multiple locations and use this network to serve destination markets worldwide. In that sense, multinational production expands the set of locations from which a firm can reach a market, while the headquarters remains the origin of the variety and of the firm's productivity.

Local Firms. A local firm produces a unique variety ω in the same country in which it is headquartered and serves all destination markets through exports. Output shipped to destination market m increases linearly with labor input:

$$q_{i,im}^{d}(\omega) = \frac{A_{i,i} z(\omega)}{\tau_{im}}\, \ell_{i,im}(\omega), \tag{7}$$

where $\tau_{im} \geq 1$ denotes the iceberg trade cost for shipping goods from country i to country m, and $A_{i,i}z(\omega)$ is firm-level productivity, given by the product of a country–specific and a firm–specific component.[10] Local firms have a single location of production; therefore, $q_{i,im}^{d}(\omega) = Q_{i,m}(\omega)$.

We do not impose a specific market structure for local firms. Instead, we assume that firms charge prices equal to a constant markup μ over marginal cost. Accordingly, the producer price charged by a local firm is

$$p_{i,im}(\omega) = \mu \frac{\tau_{im}}{A_{i,i} z(\omega)}\, w_i, \tag{8}$$

[10] We normalize $\tau_{ii} = 1$.

where w_i denotes the wage in country i. This formulation nests both monopolistic and perfect competition as special cases without requiring changes to the preference structure.

Let t_{im} denote the (one plus) tariff rate on goods imported by country m from country i. The consumer price paid when importing from a local firm is then $P_{i,m}(\omega) = p^d_{i,im}(\omega) = t_{im}p_{i,im}(\omega)$, since local firms produce exclusively in their headquarters location.

The profits for a local firm are proportional to its sales, and given the demand in equation (6), these are given by:

$$\pi_{i,im}(\omega) = \left(1 - \frac{1}{\mu}\right) \frac{1}{t_{im}} P_{i,m}(\omega) Q_{i,m}(\omega). \tag{9}$$

Global Firms. Global firms differ from local firms along two dimensions: their ability to produce in multiple locations and serve foreign markets from those sites, and their ability to conduct intrafirm trade from the production site to the destination market before the good is distributed to final consumers.

Production for a global firm involves two stages before reaching consumers. Production begins at an upstream *production-subsidiary* (u) in location l, where the firm produces a location-specific variety ω, which is shipped to country m. In m, the good is handled at no cost by a *distribution-subsidiary* (d) owned by the firm who then sells directly to the consumer.

The production technology for the subsidiary is similar to that of a *local* firm. Output destined for the distribution unit in market m, produced at location l, is proportional to labor input, with the production function given by:

$$q^u_{i,lm}(\omega) = \frac{A_{i,l} z(\omega)}{\tau_{lm}\gamma_{i,l}} \ell_{i,lm}(\omega). \tag{10}$$

Relative to equation (7), the technology for *global* firms includes the parameters $A_{i,l}$ and $\gamma_{i,l} \geq 1$, both of which capture the efficiency loss from producing outside the firm's headquarters.[11]

The distributor imports the location-specific variety from the production-subsidiary paying the corresponding import tariff before re-selling the good to the consumer. Since the distributor handles the good at no cost, the good offered to the consumer satisfies $q^d_{i,lm}(\omega) = q^u_{i,lm}(\omega)$. The assumption of a distributor in each destination market implies that global firms serve all markets from all production locations.

The multinational enterprise (MNE) adopts the following pricing rule. We assume that total firm-level markups for MNEs are identical to those of non-MNE firms. However, MNEs can choose how to allocate profits from a sales transaction between the location of the production-subsidiary and the destination market where the distribution-subsidiary operates. Let $\mu^u_{i,lm}(\omega)$ denote the markup applied in the production-subsidiary and $\mu^d_{i,lm}(\omega)$ the markup applied by the distribution-subsidiary in the destination market. The price that the distributor charges in the destination market, $p^d_{i,lm}(\omega)$, equals:

$$p^d_{i,lm}(\omega) = \mu^d_{i,lm}(\omega) t_{lm} p^u_{i,lm}(\omega), \tag{11}$$

[11] We impose the normalization $\gamma_{i,i} = 1$.

with $p^u_{i,lm}(\omega)$ the price set by the production-subsidiary:

$$p^u_{i,lm}(\omega) = \mu^u_{i,lm}(\omega)\frac{\tau_{lm}\gamma_{i,l}w_l}{A_{i,l}z(\omega)}. \tag{12}$$

We impose the constraint $\mu^u_{i,lm}(\omega)\mu^d_{i,lm}(\omega) = \mu$, where μ is the overall firm-level markup. To rule out loss-making transactions at any stage, we assume that markups are weakly greater than one. Accordingly, the production subsidiary sets a markup $1 \leq \mu^u_{i,lm}(\omega) \leq \mu$, while the affiliated distributor in the destination market sets a markup $1 \leq \mu^d_{i,lm}(\omega) \leq \mu$.

Note that global firms can reduce the tariffs collected by customs, and therefore its tariff burden without affecting the price charged to consumers. To see this, consider two firms with the same marginal cost, one being *local* and the other *global*, exporting to the same destination. The local firm charges its full markup at the border, so the tariff is levied on a high price. By contrast, the global firm can shift markups across stages: it may set a low transfer price for the intra-firm transaction at the border and apply a higher markup in the destination market. Given that the combined markup for the global firm is constrained to be the same as that of the local firm, both organizational forms charge the same final retail price but the global firm reduces its tariff base by shifting markups to the distributor stage.

Total MNE profits from sales to market m equal the sum of the distributors' profits in that market and the profits of all production subsidiaries:

$$\Pi_{i,m}(\omega) = \sum_{l=1}^{N}\left[\left(1-\frac{1}{\mu^d_{i,lm}(\omega)}\right)+\frac{1}{\mu^d_{i,lm}(\omega)}\left(1-\frac{1}{\mu^u_{i,lm}(\omega)}\right)\frac{1}{t_{lm}}\right]p^d_{i,lm}(\omega)\,q^d_{i,lm}(\omega) \tag{13}$$

The term $p^d_{i,lm}(\omega)q^d_{i,lm}(\omega)$ represents household expenditure on the location-l component of variety ω produced in country l. Of this, a share $\left(1-\frac{1}{\mu^d_{i,lm}(\omega)}\right)$ accrues as profits to the distributor in the destination market. The remaining share $\frac{1}{\mu^d_{i,lm}(\omega)}$ is remitted to the production subsidiary: of these payments, a fraction $\left(1-\frac{1}{\mu^u_{i,lm}(\omega)}\right)$ becomes subsidiary profits, while the rest covers production costs. Because subsidiaries receive payments net of import tariffs, each subsidiary's contribution is weighted by $\frac{1}{t_{lm}}$.

Two features of the MNE's profit expression are worth noting. First, since the final consumer price depends only on the product $\mu^u_{i,lm}(\omega)\mu^d_{i,lm}(\omega) = \mu$ and not on the individual markups, total household expenditure $p^d_{i,lm}(\omega)q^d_{i,lm}(\omega)$ is invariant to the choice of $(\mu^u_{i,lm}(\omega), \mu^d_{i,lm}(\omega))$. Second, because household expenditure for a given production location l is invariant to the choice $(\mu^u_{i,lm}(\omega), \mu^d_{i,lm}(\omega))$, the optimal markup split for each location l is independent of the splits chosen at all other production locations. As a result, since subsidiary revenues are discounted by tariffs relative to distributor revenues, in the absence of penalties for such manipulation of the the markup split, it would set $\mu^u_{i,lm}(\omega) = 1$ and $\mu^d_{i,lm}(\omega) = \mu$ whenever cross-border transactions are subject to an import tariff, booking all profits at the distributor stage and lowering its tariff burden on intra-firm transactions.[12]

[12]Import subsidies would flip the result: the firm would want to set a higher markup at the production stage

Engaging in transfer pricing, however, is costly for the firm. Whenever the price reported to customs authorities deviates too far from the customs authority's expectation the firm pays a penalty. Following Egger and Seidel (2013), we assume that the penalty depends on the misreported price according to the *Arm's length principle*.[13] Global firms should set internal prices as if they were arm's-length transactions, implying that they charge the full markup, μ, at the border.

The customs authority in country m penalizes deviations between the reported transfer price and the arm's length price, with the magnitude of the penalty increasing in the size of the transaction. The total penalty paid by the MNE when selling to country m from a production location in country l is[14]

$$T_{i,lm}(\omega) = \delta \frac{\kappa}{\alpha} \left((\mu - \mu^u_{i,lm}(\omega)) c_{i,lm}(\omega) \right)^{\alpha} q^d_{i,lm}(\omega), \tag{14}$$

with $c_{i,lm}(\omega) = \tau_{lm}\gamma_{i,l}w_l/A_i z(\omega)$ the production-subsidiary unit cost. In equation (14), the parameter $\alpha > 1$ governs the convexity of the penalty on the misreported price, and the parameter $\kappa > 0$ governs its scale. The parameter $\delta \in (0,1)$ indicates that the firm does not expect to repay the entire difference in the revenue streams, and can be thought of as the probability of being caught.[15] The MNE chooses the two markups, $\mu^u_{i,lm}(\omega)$ and $\mu^d_{i,lm}(\omega)$, for each location of production l and destination market m to maximize profits, balancing tariff savings against expected penalties[16]

$$\begin{aligned} \max_{\{\mu^u_{i,lm}(\omega)\geq 1, \mu^d_{i,lm}(\omega)\geq 1\}} \quad & \sum_{m=1}^{N} \Pi_{i,m}(\omega) - \sum_{m=1}^{N}\sum_{l=1}^{N} T_{i,lm}(\omega) \\ \text{s.t.} \quad & \mu^u_{i,lm}(\omega)\mu^d_{i,lm}(\omega) = \mu \quad \forall l, m. \end{aligned} \tag{15}$$

It follows from our previous discussion that if $\kappa \to 0$, lowering the tariff burden by shifting profits to the distributor carries no penalty and therefore the MNE sets $\mu^u_{i,lm}(\omega) = 1$ and $\mu^d_{i,lm}(\omega) = \mu$. If $\kappa \to \infty$ instead, any deviation from the arm's length principle generates infinite penalties and

relative to the distributor. In the main text, we discuss the solution for import tariffs only.

[13]The arm's length principle is the international standard endorsed by OECD countries for determining the pricing of transactions between associated enterprises across borders. It is primarily used for tax purposes to ensure that multinational enterprises (MNEs) set prices for intra-group transactions as if they were conducted between independent parties under comparable conditions. This principle is articulated in Article 9 of the 2010 OECD Model Tax Convention on Income and on Capital.

[14]There are different ways in which the literature has specified the penalty function. For example, in Bernard et al. (2006) and Cristea and Nguyen (2016) the penalty is a convex function of the misreported income. In Swenson (2001) instead the penalty is based on proportional deviation in prices. Finally, in Davies et al. (2018) the penalty only depends on price deviation and a fixed payment. Our choice of penalty function is guided by tractability.

[15]To close the model we assume that this penalty is collected by the tax authority in country m and rebated lump-sum to the household. Later on we assume that profits of global firms go back to their headquarters country. Hence, the penalty is a transfer from the headquarters country to the country imposing the import tariff.

[16]Alternatively, one could set up the problem as one where global firms choose prices for internal transactions and consumer prices given household demand and the constraint that prices cannot be set below unit costs. In Appendix B.3, we show that absent transfer pricing penalties the solution to this problem coincides with ours when $\mu = \sigma/(\sigma-1)$. We do not adopt this approach for two reasons. First, we want to keep the problem of global firms consistent with that of local firms. Second, when transfer pricing penalties are positive there is double marginalization. The firm's partial adherence to the arm's length principle causes both internal prices and consumer prices to be set as markups over marginal cost, with a combined markup that is larger than $\mu = \sigma/(\sigma-1)$.

the MNE sets $\mu^u_{i,lm}(\omega) = \mu$ and $\mu^d_{i,lm}(\omega) = 1$. In general, the first-order condition for problem (15) with respect to $\mu^u_{i,lm}(\omega)$ (after substituting $\mu^d_{i,lm}(\omega) = \mu/\mu^u_{i,lm}(\omega)$) implies a markup for the production-subsidiary that is non-increasing in productivity and given by

$$\mu^u_{i,lm}(\omega) = \max\left\{\mu - \frac{A_{i,l}z(\omega)}{\tau_{lm}\gamma_{i,l}w_l}\left(\frac{t_{lm}-1}{\delta\kappa}\right)^{\frac{1}{\alpha-1}}, 1\right\}. \tag{16}$$

Setting a lower markup for the production-subsidiary reduces the MNE's tariff burden, but it increases the expected penalty. The optimal markup in equation (16) balances these two opposing forces. When import tariffs are low, the benefits of setting a low markup for the production-subsidiary are small relative to the expected penalty, and the multinational chooses $\mu^u_{i,lm}(\omega)$ so that its price is closer to the arm's length principle. In the limit, when there are no import tariffs ($t_{lm} = 1$), there are no tariff savings and the firm sets $\mu^d_{i,lm}(\omega) = 1$ and $\mu^u_{i,lm}(\omega) = \mu$. Conversely, when import tariffs are high, it becomes more attractive for the MNE to economize on tariff payments, despite the associated penalties, and this incentive is higher for more productive MNEs.[17] Taking the maximum on the right-hand side reflects the fact that the firm might otherwise choose a markup for the production-subsidiary below one, which is not allowed.

This adjustment in $\mu^u_{i,lm}(\omega)$ has direct implications for tariff pass-through. Since a higher tariff lowers $\mu^u_{i,lm}(\omega)$ and therefore the subsidiary price at the border, the model predicts incomplete pass-through at the border — a prediction consistent with Empirical Fact 3 in Section 2, where we document that related-party prices at the border decline in response to tariff increases. For the price that the consumer pays in the destination market, however, pass-through is complete since the consumer price, given by equations (11) and (12), depends on the product $\mu^u_{i,lm}(\omega)\mu^d_{i,lm}(\omega) = \mu$ rather than on the individual markups, so transfer pricing does not affect consumer price pass-through.

Finally, becoming a global firm with this structure of production and pricing to market is an endogenous choice. Global production requires a fixed cost of f_i units of labor in the headquarters country. This cost reflects the overhead required to coordinate operations across borders, and in our model it governs firms' selection into local or multinational status.

3.3 Equilibrium

We close this section with a description of the model's equilibrium. An equilibrium, given import tariffs, consists of an allocation, prices, measures of *global* firms, and productivity thresholds that satisfy the following conditions: (i) households maximize utility subject to their budget constraint, i.e., equation (6) holds; (ii) *local* firms set prices according to equation (8), while *global* firms set prices according to equation (11), (12), and (16); (iii) firms select into global and local firms; (iv) the government collects tariff revenue and transfer-pricing penalties and rebates them lump-sum to the household; and (v) markets clear. We provide a full definition of the equilibrium in Appendix B.1.

We assume that profits are redistributed to the household in the country where the firm is

[17] The parameter α mediates the responsiveness of export prices to changes in import tariff relative to the arm's length benchmark. In Section 5 we use our empirical results to calibrate this parameter.

headquartered, which implies that trade flows need not be balanced. The balance of payments identity states that the current account equals the sum of net exports and net income from abroad. The net foreign income reflects differences between profits generated by domestic firms located abroad and profits generated by foreign firms located in the domestic economy.

4 Optimal Unilateral Import Tariffs

A central contribution of this paper is to characterize optimal import tariffs in an environment with multinational enterprises (MNEs), and to understand how the presence of multinationals modifies standard optimal tariff results derived in models with exporting firms only.

We study a domestic planner that unilaterally chooses trade policy to maximize domestic welfare. Solving this problem in the full environment described in Section 3 is analytically challenging. To build intuition and isolate the primitive economic forces shaping optimal tariffs, we begin by characterizing the optimal tariff under three simplifying assumptions.

4.1 Three Simplifying Assumptions

Assumption 1 (A Small Open Economy). We consider an economy in which country m, a small open economy, chooses its trade policy unilaterally. In standard trade models with only exporting, a country can be small in two senses. It may have a small population and therefore produce little relative to the rest of the world. It may also be effectively remote — if export costs are sufficiently high, its goods represent a negligible share of foreign absorption even if the country is not small in population terms. Building on Alvarez and Lucas Jr (2007), Demidova and Rodríguez-Clare (2013), Caliendo and Feenstra (2024), and Demidova et al. (2024), we construct the small open economy as the limit of a sequence of economies indexed by n, scaling population, export costs, and multinational production frictions for country m as

$$\begin{aligned} L_m &= n^{\frac{1-\sigma}{1-\varepsilon}} \bar{L}_m, \\ \tau_{mj} &= n^{1/(1-\varepsilon)} \bar{\tau}_{mj} \qquad \forall j \neq m, \\ \gamma_{m,j} &= n^{1/(1-\varepsilon)} \bar{\gamma}_{m,j} \qquad \forall j \neq m, \end{aligned} \tag{17}$$

and analyzing the limit as $n \to 0$.

Earlier work in this literature relied on scaling population alone (Alvarez and Lucas Jr, 2007; Demidova and Rodríguez-Clare, 2013). Caliendo and Feenstra (2024) and Demidova et al. (2024) showed that this generates undesirable properties and that jointly scaling population and export costs resolves them, delivering a well-behaved limit with finite wages in which foreign prices are independent of country m's policies, and import shares are strictly between zero and one, consistent with observed expenditure patterns in the data.

With multinational production, however, these two channels are not sufficient. As export costs rise without bound, country m's firms would optimally substitute away from exporting and serve

foreign markets exclusively through affiliate production, bypassing trade frictions entirely. A country could therefore be entirely remote in terms of trade yet still influence foreign prices through the activity of its foreign subsidiaries. To rule this out, we also scale multinational production frictions as in the third line of equation (17). As $n \to 0$, it becomes increasingly costly for firms headquartered in m to serve foreign markets through either exports or affiliate production, ensuring country m's influence on foreign markets vanishes in the limit.

Under this parameterization, there exists a well-defined limit equilibrium in which the vector of foreign wages is independent of country m's fundamentals — including its import tariffs — while the domestic wage w_m remains finite and import and multinational production shares remain strictly positive.[18] In this limit, country m cannot influence foreign relative prices through its trade policy and is therefore a small open economy. However, the domestic relative wage w_m remains endogenous and responds to country m's trade policy.

Assumption 2 (**No Selection into Global Firms).** Second, we abstract from selection into multinational status by setting the fixed cost of becoming a MNE, f_i, equal to zero in all countries. In equilibrium, all firms are global and operate production facilities in every location, serving foreign markets through both exporting and multinational production. As a result, in each headquarters country there is a representative multinational firm. This assumption provides a polar benchmark in which all firms engage in multinational production, in contrast to standard optimal tariff analyses where trade is conducted exclusively by local exporting firms.

Assumption 3 (**Infinite Transfer Pricing Penalties).** Finally, we restrict pricing behavior by setting the penalty on transfer pricing, $\kappa \to \infty$. This assumption allows us to abstract from strategic transfer pricing considerations and focus on how multinational production decisions affect optimal trade policy. Under this restriction, the representative multinational sets markups for internal transactions to $\mu^u_{i,lm} = \mu$, and therefore, $\mu^d_{i,lm} = 1$. As a result, the representative multinational prices at the border at a markup μ over marginal cost, the same rule that governs prices for local exporting firms.

4.2 The Domestic Planner's Problem

In this section we solve for the optimal unilateral trade policy of country m (the Home country) under Assumptions 1-3. Under these assumptions, the equilibrium can be summarized by a vector of wages $\{w_i\}$ and income levels $\{Y_i\}$.[19] Importantly, the wages and income levels of all foreign countries $i \neq m$ are independent of Home's fundamentals, including its trade policy. Home's equilibrium wage w_m and income level Y_m, however, depend on foreign wages and foreign income levels.

[18] See Appendix B.2 for details. This limit requires $\varepsilon > \sigma$, a condition we maintain throughout Section 4 and that is consistent with our estimates in Section 2.

[19] Formally, Y_m represents country m's income excluding tariff revenues, i.e., payments to labor and aggregate profits $Y_m = w_m L_m + \Pi_m$. See Appendix B.2 for details.

Home's domestic planner chooses import tariffs $\{t_{jm}\}_{\forall j \neq m}$ unilaterally, taking the trade policies of all other countries as given, to maximize domestic welfare U_m subject to the two equilibrium conditions Home's labor market clearing condition (LMC), and Home's balance-of-payment identity (BoP) which describe how Home's wage w_m and income level Y_m respond to changes in trade policy:

$$\max_{\{t_{jm}>0\}_{j\neq m}} \quad U_m, \quad \text{s.t.} \quad m\text{'s LMC in (19) and BoP in (21)} \tag{18}$$

The labor market clearing condition in country m can be written as

$$w_m L_m = \sum_j \frac{1}{\mu} \Lambda_{m,mj} Y_j + \sum_{i \neq m} \frac{1}{\mu} \Lambda_{i,mm} Y_m \tag{19}$$

where the left-hand side represents the value of Home's labor endowment at wage w_m, while the right-hand side represents the labor demand from all production units operating in country m. Because firms sell at a constant markup μ, a share $1/\mu$ of their revenues is paid to labor. The revenue of a firm headquartered in i, producing in m, and selling to j is given by $\Lambda_{i,mj} Y_j$, where $\Lambda_{i,mj}$ is defined as

$$\Lambda_{i,mj} = \frac{\lambda_{i,mj} \lambda_{i,j} / t_{mj}}{\sum_o \sum_l \lambda_{o,lj} \lambda_{o,j} / t_{lj}}. \tag{20}$$

Here $\lambda_{i,j}$ and $\lambda_{i,mj}$ are CES expenditure shares defined by our preference structure in equations (4) and (5), respectively.[20]

The balance-of-payments identity for country m can be written as

$$Y_m - \sum_i \Lambda_{i,mm} Y_m - \sum_{j \neq m} \Lambda_{m,mj} Y_j = \sum_{j \neq m} \sum_{i \neq m} \left(1 - \frac{1}{\mu}\right) \Lambda_{m,ij} Y_j - \sum_{i \neq m} \left(1 - \frac{1}{\mu}\right) \Lambda_{i,mm} Y_m, \tag{21}$$

where the left-hand side represents the net imports of country m — here, $\sum_i \Lambda_{i,mm} Y_m$ is Home's domestic sales and $\sum_{j \neq m} \Lambda_{m,mj} Y_j$ is Home's exports, so their difference from income yields net imports — while the right-hand side corresponds to Home's net foreign income: the difference between the profits of domestic subsidiaries producing abroad and the profits of foreign subsidiaries producing domestically.[21]

Two properties of problem (18) are worth noting. First, although Home is small in the sense that it cannot affect the prices charged by foreign firms, it nevertheless can improve Home's terms of trade through the effect of import tariffs on Home's relative wage.

Second, multinationals profits imply that trade does not have to be balanced. Because multinational profits depend on where production takes place, the planner can also influence the distribution

[20] Note that the demand for Home's labor does not include the sales of foreign subsidiaries located in Home that export to foreign countries. In the small open economy limit, trade frictions for exporting from country m become arbitrarily large. As a result, foreign subsidiaries prefer to serve foreign destinations either from their headquarters location or from other foreign countries acting as export platforms. In other words, in the small open economy limit foreign firms produce in country m only to serve consumers in that country.

[21] Note that the profits of domestic subsidiaries do not include exports from those subsidiaries to Home. In the small open economy limit, Home's multinational production frictions become arbitrarily large. As a result, domestic subsidiaries located abroad never use those production locations to serve the Home market.

of profits across countries — and thereby the size of Home's trade imbalance — by using import tariffs to affect multinationals' production decisions.[22]

To separate the role of these two forces, we compute optimal import tariffs under nested specifications of our model. We start with an environment in which global firms are perfectly competitive, and therefore trade is balanced. We then introduce imperfect competition, but restrict foreign firms' ability to produce outside their headquarters country, before finally presenting optimal tariffs when both domestic and foreign firms can produce abroad.

4.2.1 Trade Policy with Multinational Production under Perfect Competition

We begin by imposing that firms set prices equal to marginal cost ($\mu = 1$). Since trade is balanced, the domestic planner maximizes domestic welfare U_m subject to a single constraint: the balanced-trade condition. With zero firm profits, import tariffs serve a single purpose: improving Home's terms of trade. The following proposition characterizes the optimal tariff.

Proposition 1. *Under Assumptions 1-3 with perfectly competitive markets ($\mu = 1$), country m's optimal import tariffs are uniform across trading partners and equal to*

$$t_{jm} = 1 + \frac{1}{\bar{\theta}_m} \qquad \forall\, j \neq m, \tag{22}$$

where $\bar{\theta}_m$ is the export-share-weighted average trade elasticity, defined below in equation (23).

Proof. See page 19 of Appendix B.2.5. □

This result is closely related to a large body of work on optimal tariffs in models where trade occurs exclusively through exporting (see, for example, Gros, 1987; Costinot et al., 2020; Lashkaripour and Lugovskyy, 2023; Caliendo and Feenstra, 2024; Demidova et al., 2024). In those models, optimal import tariffs are related to the inverse of the trade elasticity, which is a constant governed by a single structural parameter: the elasticity of substitution across varieties, $\sigma - 1$. With multinational production, by contrast, the trade elasticity θ_{mi} is endogenous and given by[23]

$$\theta_{mi} \equiv -\frac{\partial \log(\lambda_{mi}/\lambda_{ii})}{\partial \log w_m} = (\sigma - 1)\lambda_{m,mi} + (\varepsilon - 1)\left(1 - \lambda_{m,mi}\right) \qquad \forall\, i \neq m. \tag{23}$$

The relevant object for the optimal tariff is $\bar{\theta}_m \equiv \sum_{i \neq m} \frac{Ex_{mi}}{Ex_m} \theta_{mi}$, the export-share-weighted average of θ_{mi} across destinations.

Two structural parameters, σ and ε, and the endogenous production share $\lambda_{m,mi}$ jointly determine θ_{mi}. When multinational production is absent, firms in country m can only reach country i through exports ($\lambda_{m,mi} = 1$), and $\theta_{mi} = \sigma - 1$, the standard Armington elasticity. When firms in country m

[22] When multinational production frictions are infinite, trade is balanced and country m's balance of payment identity, equation (21), is equivalent to country m's labor market clearing condition, equation (19).

[23] Here λ_{lm} measures the share of expenditure in market m on goods produced in country l. This shares satisfy $\lambda_{mi} = \sum_{i=1}^{N} \lambda_{i,lm}\lambda_{i,m}$.

serve country i exclusively through foreign subsidiaries ($\lambda_{m,mi} = 0$), the trade elasticity equals $\varepsilon - 1$, governed entirely by the ease of substitution across production locations within the multinational firm. More generally, the trade elasticity is a weighted average of these two extremes.

Notably, when $\varepsilon > \sigma$, multinationals can substitute across production locations more easily than households can substitute across varieties, making trade more elastic, consistent with our Fact 2 in Section 2. This cuts into Home's ability to manipulate the terms of trade in its favor, reducing the optimal tariff relative to a model without multinational production.

Another feature of Proposition 1 is that the optimal tariff is uniform across trading partners. Since Home is a small open economy, the terms of trade depend only on the domestic wage w_m. Differentiating tariffs across trade partners therefore yields no additional terms-of-trade benefit while introducing distortions in relative import prices.[24]

4.2.2 Trade Policy with No Foreign MP under Imperfect Competition

For the following results we allow firms to set prices above marginal cost ($\mu > 1$). As a result, multinational firms earn profits from their international operations and trade need not be balanced. To develop intuition for how multinational profits affect optimal tariffs, we impose here the following assumption.

Assumption 4. MP frictions for foreign firms headquartered in $i \neq m$ when producing in country m are prohibitive: $\gamma_{i,m} \to \infty$.

As highlighted by Blanchard (2009), and more recently by Costinot and Werning (2019), with multinational production and trade imbalances Lerner symmetry does not generally hold; Assumption 4 is a knife-edge where it is restored. When foreign firms cannot produce in country m, trade imbalances arise solely from the repatriated profits of domestic multinationals, eliminating the asymmetry between import and export taxes.

In this context, the domestic planner chooses its trade policy to manipulate the terms of trade, but now also takes into account how import tariffs relocate profits for the domestic multinationals across foreign countries, thereby affecting Home's net imports. The following proposition characterizes the optimal import tariff.

Proposition 2. *Under Assumptions 1–4 with imperfectly competitive markets ($\mu > 1$), country m's optimal import tariffs are uniform across trading partners and equal to*

$$t_{jm} = \left(1 + \frac{1}{\bar{\theta}_m}\right) \frac{\bar{\theta}_m E x_m}{\bar{\theta}_m E x_m - \bar{\vartheta}_m \Pi_m^{mne}} \qquad \forall j \neq m, \tag{24}$$

where $\bar{\theta}_m$ is the export-share-weighted average trade elasticity, defined in equation (23), $\bar{\vartheta}_m$ is the export-share-weighted average elasticity for exports of m's affiliate, defined in equation (25), and

[24] With multiple countries, import tariffs are a second-best instrument. We show in Appendix B.2.3 that if available, the domestic planner would prefer country-specific export taxes. The optimal export tax to country i is $x_{mi} = 1 + 1/\theta_{mi}$. The optimal tariff in Proposition 1 instead targets the average response across destinations. With two countries, import tariffs are perfect substitutes for the missing export taxes as a consequence of Lerner symmetry.

Ex_m and Π_m^{mne} are Home's aggregate exports and aggregate profits earned by its foreign affiliates, respectively.

Proof. See page 21 of Appendix B.2.5. □

With country m's multinationals earning profits abroad, the trade elasticity is no longer a sufficient statistic for optimal import tariffs. The first term in parentheses in equation (24) is the inverse elasticity formula from the previous section, which as before captures Home's optimal manipulation of the terms of trade in its favor by reducing its imports from foreign countries. The second term is specific to our model, greater than one, and entirely attributable to Home's multinational firms earning profits outside of their headquarters country.

A higher import tariff induces domestic multinationals to reallocate production abroad, making trade more elastic as in equation (23). Under perfect competition this is the only margin that matters, and it limits Home's ability to manipulate the terms of trade in its favor. Under imperfect competition, however, this relocation also shifts profits: when domestic multinationals earn profits abroad, relocating production to foreign affiliates increases the profits repatriated to Home households, widening Home's trade deficit. Because the planner internalizes this additional demand for imports, it finds it optimal to impose a higher tariff than the terms-of-trade motive alone would prescribe. This *profit-repatriation* motive for trade policy is distinct from the *profit-shifting* mechanism emphasized in Brander and Spencer (1981), Bagwell and Staiger (2012), and Ossa (2012, 2014), where the effect of tariffs on profits materializes through changes in household income levels.

The elasticity $\vartheta_{m,lj}$ captures the rate at which production is reallocated toward Home's foreign affiliates as Home's relative wage w_m rises:

$$\vartheta_{m,lj} \equiv \frac{\partial \log \left(\Lambda_{m,lj}/\Lambda_{j,jj}\right)}{\partial \log w_m} = (\varepsilon - \sigma)\, \lambda_{m,mj}, \qquad l, j \neq m. \tag{25}$$

When $\varepsilon > \sigma$, consistent with our Fact 2 in Section 2, $\vartheta_{m,lj} > 0$: a higher domestic wage w_m makes production at headquarters relatively more expensive, inducing global firms to substitute production toward their foreign affiliates. Because production reallocation happens uniformly across country m's affiliates, the relevant object for the optimal tariff is $\bar{\vartheta}_m$, the export-share-weighted average of $\vartheta_{m,lj}$ across production locations and destination markets.[25] Therefore, optimal import tariffs remain uniform across country m's trading partners.[26]

[25] Specifically, $\bar{\vartheta}_m = \sum_{j\neq m}\sum_{l\neq m} \frac{Ex_{m,lj}}{\sum_{j\neq m}\sum_{l\neq m} Ex_{m,lj}}\, \vartheta_{m,lj}$.

[26] With multiple countries, import tariffs are a second-best instrument. We show in Appendix B.2.3 that if available, the domestic planner would prefer country-specific export taxes. The optimal export tax to country i follows a similar formula to that in equation (24). However, export taxes are country-specific and depend on bilateral elasticities, rather than the country-level averages. With two countries, import tariffs are perfect substitutes for the missing export taxes, a consequence of Lerner symmetry.

4.2.3 Trade Policy with Multinational Production under Imperfect Competition

We now dispense with Assumption 4 and allow foreign firms to engage in multinational production in country m. In this environment Lerner symmetry no longer holds: trade imbalances now reflect not only the repatriated profits of domestic multinationals, but also the profits earned by foreign affiliates operating in Home. As a result, import and export taxes are no longer equivalent instruments, and tariffs take on an additional role as a substitute for missing export taxes.

In this environment, the optimal import tariff is also no longer uniform across trading partners: because the profits earned by foreign affiliates depend on their country of origin, the planner would like to differentiate tariffs bilaterally. Endowing the planner with a full set of country-specific import and export instruments, however, leads to an extreme outcome: the planner sets arbitrarily high country-specific export taxes coupled with a full import subsidy.[27]

To abstract from this extreme outcome and maintain comparability with the preceding subsections, we restrict the planner to a uniform import tariff.[28] The following proposition characterizes its optimal value.

Proposition 3. *Under Assumptions 1–3 with imperfectly competitive markets ($\mu > 1$), country m's optimal uniform import tariffs are equal to*

$$t_m = \left(1 + \frac{1}{\bar{\theta}_m}\right) \frac{\bar{\theta}_m Ex_m}{\bar{\theta}_m Ex_m - \bar{\vartheta}_m \Pi_m^{mne}} \Upsilon_m, \tag{26}$$

where $\bar{\theta}_m$ is the export-share-weighted average trade elasticity, defined in equation (23), $\bar{\vartheta}_m$ is the export-share-weighted average elasticity for m's foreign-affiliate sales, defined in equation (25), and Ex_m and Π_m^{mne} are Home's aggregate exports and aggregate profits earned by its foreign affiliates, respectively. The residual term (i.e., missing-export-tax correction) satisfies $\Upsilon_m \leq 1$, with equality whenever the profits of foreign affiliates operating in Home are zero.

Proof. See page 23 of Appendix B.2.5. □

With both domestic and foreign multinational firms earning profits outside their headquarters countries, the trade elasticity is again not a sufficient statistic for optimal trade policy. The formula in equation (26) contains the same two terms as Proposition 2: the inverse-elasticity formula capturing the terms-of-trade motive, and the profit-repatriation correction that amplifies the tariff

[27] Export taxes allow the planner to extract the profits of foreign affiliates operating in Home, generating a transfer from foreign countries to Home. The import subsidy then ensures the optimal degree of terms-of-trade manipulation. This result resonates with Itskhoki and Mukhin (2025), who derive a similar outcome in an environment where trade imbalances affect welfare only through valuation effects on prices. In our framework, both the nominal and real value of trade imbalances are endogenous and affected by policy through multinational relocation decisions, yet this additional margin is not sufficient to rule out unbounded optimal taxes. We show in Appendix B.2.3 that once the size of subsidies is constrained, the optimal policy features finite export taxes and import tariffs that reach this bound. Li et al. (2025) study the joint optimization of import tariffs, export taxes, and multinational production policies as an alternative way to recover finite trade instruments.

[28] While this rules out bilateral differentiation, it provides a natural benchmark for evaluating how multinational production modifies trade policy prescriptions derived in environments where international trade occurs only through exporting, where optimal tariffs are homogeneous.

when domestic multinationals earn profits abroad. The new element is $\Upsilon_m \leq 1$, which scales the optimal tariff down whenever foreign affiliates earn profits in Home.

The correction Υ_m reflects the role of import tariffs as an imperfect substitute for missing export taxes. When foreign affiliates operate in Home, the domestic planner would ideally tax the profits they repatriate using export instruments (Blanchard, 2009, 2010). In the absence of such instruments, lowering the import tariff serves as a second-best alternative: cheaper imports reduce the profitability of foreign operations in Home, partially offsetting the transfer of resources to foreign countries.

This result is qualitatively consistent with Blanchard (2010) and Blanchard et al. (2025), who show that international ownership linkages are tariff-reducing. Pujolas and Rossbach (2024), Ignatenko et al. (2025), and Itskhoki and Mukhin (2025) show that trade deficits can enhance a country's ability to manipulate its terms of trade, implying higher optimal tariffs as in Proposition 2. Proposition 3 qualifies this: by endogenizing trade imbalances through multinational production decisions, the source of the deficit matters. When imbalances are driven by foreign affiliates earning profits in Home, the missing-export-tax correction $\Upsilon_m \leq 1$ can offset the terms-of-trade force.

Whether the optimal tariff is larger or smaller than in models that abstract from multinationals altogether remains an empirical question. The profit-repatriation motive pushes toward a higher tariff, while the missing-export-tax correction embodied in Υ_m pushes in the opposite direction. In Section 5 we calibrate the model to assess the quantitative relevance of these mechanisms alongside the additional forces we have abstracted from throughout Section 4: large-open-economy effects, selection into multinational status, and strategic transfer pricing.

5 Quantitative Optimal Tariffs

In this section, we take the model of Section 3 to data, calibrating the multi-country framework to aggregate trade, output, and multinational production data, and using the empirical estimates from Section 2 to discipline the key elasticities. The main message from our small-open-economy analysis—that accounting for multinational production matters for optimal trade policy—carries over to the large open economy.

5.1 Data and Parameters

Data. We group countries into seven regions, plus the United States, and focus on the manufacturing sector.[29] We calibrate our model parameters to match data for 2016.

We use several data sources. Bilateral trade shares, measuring the share of expenditure in market m on goods produced in country l, are constructed from the OECD Inter-Country Input-Output Tables (2023 release). We use the same data to construct total expenditure levels for each country, normalizing the expenditure in the US to one. Bilateral output shares, measuring the fraction of

[29]The seven regions are Canada, Mexico, China, Europe, South America, Asia excluding China, and the rest of the world.

output in country l that is produced by firms headquartered in country i, are constructed from the OECD AMNE Analytical Database (2024 release). We use the same data to construct the share of a country's exports accounted for by domestic and foreign MNEs. We use World Bank Enterprise Survey to construct the shares of global firms operating in each country. For tariffs, we use Teti (2024) for non-U.S. trading partners and U.S. InternationalbTrade Commission data for the United States, aggregated using import-volume weights. Finally, following Caselli (2004) and Waugh (2010), we construct countries' labor endowment as $L_i = K_i^{0.3}(h_i N_i)^{0.7}$, where K_i is the PPP-adjusted capital stock, h_i is human capital per worker, and N_i is employment in country i. All variables come from Penn World Table 10.01. We normalize US labor endowment to one. Appendix C.1 describes the construction of these moments and reports summary statistics by country group.

Elasticities of Substitution. Absent transfer pricing, a multi-sector extension to our model implies restricted gravity equations relating US imports of sector k varieties ω from continuing local (L) and global (G) firms producing in country l to import tariff changes:

$$\Delta \log X_{l,lt}^{k,L}(\omega) = -\sigma \Delta \log t_{lt}^{k} + \xi_{lt}^{L} + \xi_{t}^{k,L} + u_{lt}^{k,L}(\omega) \tag{27}$$

$$\Delta \log X_{i,lt}^{k,G}(\omega) = -\varepsilon \, \Delta \log t_{lt}^{k} + \xi_{lt}^{G} + \xi_{t}^{k,G} + \xi_{it}^{k,G} + u_{lt}^{k,G}(\omega) \tag{28}$$

where ξ_{lt}^{L} and ξ_{lt}^{G} are country-time fixed effects controlling for changes in wages in the production location, $\xi_{t}^{k,L}$ and $\xi_{t}^{k,G}$ are sector-time fixed effects controlling for changes in the price index and aggregate expenditure in the US, and $\xi_{it}^{k,G}$ is a headquarter-sector-time fixed effect. The error term reflects idiosyncratic productivity shocks which are assumed to be uncorrelated with tariff changes. The coefficient on the tariff change for local firms corresponds to σ, while the coefficient for global firms corresponds to ε. The derivations are in Appendix C.2.

Panel B of Table 2 reports estimates from equation (2), run separately for continuing non-MNE and MNE relationships, whose model counterparts are equations (27) and (28). The empirical specification departs from these model equations in two ways. First, in equation (2) we add a relationship fixed effect η_{fxlg} to control for differential trends across exporter-importer-product relationships. Second, in equation (2) we omit the headquarter-sector-time fixed effect $\xi_{it}^{k,G}$ from the MNE regression, since headquarter origins are not directly observed. Simulations suggest that omitting this fixed effect does not prevent recovery of ε (see Appendix C.2).

The elasticity estimates from Section 2 capture short-run responses. Since our model captures variation across long-run equilibria, we scale the 24-month elasticities from Panel B of Table 2 using the scaling factor of fourteen estimated in Anderson and Yotov (2025), yielding $\varepsilon = 7.96$ and $\sigma = 5.19$. These values are consistent with an average long-run demand elasticity within the range of the estimates provided by the literature. We also consider robustness using the more conservative scaling factor of seven, also estimated in Anderson and Yotov (2025), implying values of $\varepsilon = 4.07$ and $\sigma = 2.65$. We prefer the higher elasticities in the baseline because they are associated with more plausible magnitudes of trade and MP frictions (see Appendix D).

Markups and Transfer-pricing Parameters. We set the markup of local and global firms to $\mu = 1.35$, based on the markup for the median US establishment from Antràs et al. (2017). Our choice exceeds the CES benchmark evaluated at our estimate of $\sigma = 5.19$, which implies a markup of 1.24, and delivers higher aggregate trade imbalances and more scope for transfer pricing.

The transfer pricing penalty involves three parameters: the probability of being caught δ, the scale of the penalty κ, and the curvature of the penalty function α. The first two parameters cannot be separately identified, we set $\delta \times \kappa = 0.279$ based on Swenson (2001). We calibrate α as part of our estimation procedure described below. We include in our set of moments the 24-month differential price response between related-party and arm's-length transactions, equal to -0.152, reported in Table 3. The model's counterpart is computed using the differential price response between the internal price set by a global firm when selling to country m, $p^u_{i,lm}(\omega) = \mu^u_{i,lm}(\omega)c_{i,lm}(\omega)$, and the price that global firm would charge if it adheres to the arm's length principle $\mu c_{i,lm}(\omega)$. The constructed moment aggregates these heterogeneous price responses across all global firms exporting to $m =$ US. Derivations are left in Appendix C.3. In our baseline model with both local and global firms, the calibrated curvature parameter equals $\alpha = 1.496$.

Productivity, Trade Costs, MP Frictions, Mass of firms, and Fixed Costs. We assume that firm-level productivity $z(\omega)$ is drawn from a Pareto distribution with scale parameter normalized to one and a shape parameter of ς. The Pareto distribution implies in our model that the firm size distribution also follows a Pareto distribution, but with shape parameter $\varsigma/(\sigma - 1)$. Empirical studies using U.S. firm-level data have typically estimated this ratio to be close to one consistent with Zipf's law for firm size (see, for example, Axtell, 2001; Bernard et al., 2003; Eaton et al., 2011; di Giovanni and Levchenko, 2012). We use our estimate of $\sigma = 5.19$ and recover $\varsigma = 1.29 \times (\sigma - 1)$ using the estimates in Bernard et al. (2003).

We follow Ramondo and Rodríguez-Clare (2013) and parameterize trade costs and MP frictions as a function of distance, common language, and contiguity:

$$\tau_{il} = 1 + (\beta^\tau_0 + \beta^\tau_{\text{dist}}\, \text{dist}_{il}) \times (\beta^\tau_{\text{bord}})^{\text{bord}_{il}} \times \left(\beta^\tau_{\text{lang}}\right)^{\text{lang}_{il}}, \tag{29}$$

$$\gamma_{i,l} = 1 + (\beta^\gamma_0 + \beta^\gamma_{\text{dist}}\, \text{dist}_{il}) \times (\beta^\gamma_{\text{bord}})^{\text{bord}_{il}} \times \left(\beta^\gamma_{\text{lang}}\right)^{\text{lang}_{il}}, \tag{30}$$

where dist_{il}, lang_{il}, bord_{il} are import-weighted averages of the corresponding CEPII variables. We then jointly calibrate the parameters in equations (29) and (30), the country-specific productivity parameters, which we restrict to be the product of an origin and a location component, and the fixed costs to become a global firm, by matching model-implied moments to their empirical counterparts. We target the following moments: i) the bilateral trade shares; ii) the bilateral output shares; iii) the expenditure level in each country relative to the US; and iv) the share of firms in each country that are global.[30] The set of moments also includes the 24-month differential price response estimated in

[30] For trade and bilateral output shares, we only include off-diagonal elements, as in Ramondo and Rodríguez-Clare (2013).

Table 4: Calibrated Parameters and Models' Fit

	Without strategic transfer pricing		With strategic transfer pricing	
	Global Firms	Local & Global Firms	Global Firms	Local & Global Firms
Panel A: Estimated parameters				
Transfer pricing				
Curvature parameter α			1.789	1.496
Scale parameter $\delta \times \kappa$			0.279	0.279
Trade costs, eq. (29)				
Constant	0.887	0.971	0.876	0.971
Distance	0.028	0.023	0.026	0.022
Common border	0.664	0.632	0.671	0.632
Common language	0.962	0.993	0.966	0.992
Average τ	2.097	2.134	2.072	2.130
MP frictions, eq. (30)				
Constant	0.819	0.346	0.822	0.346
Distance	0.088	0.044	0.089	0.044
Common border	0.623	0.697	0.617	0.696
Common language	0.834	0.449	0.836	0.444
Average γ	2.518	1.655	2.526	1.654
Panel B: Goodness of fit and RMSE				
Targeted moments				
Bilateral trade shares	0.0131	0.0125	0.0133	0.0126
Bilateral output shares	0.0202	0.0201	0.0202	0.0201
Inward foreign-owned firm share	0.8416	0.0270	0.8416	0.0270
Expenditure relative to US	0.0019	0.0025	0.0022	0.0025
Differential price response	0.3750	0.3750	0.0001	0.0000
Untargeted moments				
MNE domestic output share	0.6295	0.2076	0.6295	0.2088
MNE export share	0.3796	0.5009	0.3796	0.5067

Notes: The four columns correspond to four model variants: whether strategic transfer pricing is allowed or shut down, and whether the firm population includes only global firms (*Global Firms*) or both local and global firms (*Local & Global Firms*). Panel A reports the parameters estimated. Trade costs and MP frictions follow the functional forms in equations (29) and (30). The curvature parameter α governs the transfer pricing technology and is not estimated in the first two columns. Panel B reports the root mean squared error (RMSE) between model-generated and data moments.

Fact 3, used to calibrate the transfer pricing penalty parameters. We set the mass of firms equal each country's population size, given that we estimate country-specific productivity parameters.

Model Calibrated Parameters and Fit. We calibrate four different versions of our model: with and without selection into MNE status, and with and without strategic transfer pricing. For each model variant we re-calibrate the model to match the same data moments. Table 4 reports the fit for each calibrated model along with key recovered parameters.

Panel A of Table 4 reports the estimated trade and MP friction parameters, which are broadly consistent with the literature. Across all calibrations, distance raises both types of costs: a 10 percent increase in distance between a country pair raises trade costs by about 1 percent and MP costs by

about 2 percent. A common border lowers trade costs by about 20 percent, but reduces MP costs only by 12 percent. Conversely, a common language lowers MP costs by about 22 percent while leaving trade costs virtually unchanged. Allowing for local firms substantially reduces the estimated MP frictions: the average γ falls from about 2.5 in the Global Firms calibration to about 1.7 in the Local & Global calibration, while average trade costs remain nearly unchanged across variants.

Panel B shows that all four model variants fit the targeted moments closely. In the Local & Global calibrations, the RMSEs across targeted moments are at most 2.7 percentage points. The Global Firms calibrations fit trade and output shares equally well, although they cannot reproduce the observed share of global firms since all firms are global by construction. Panel B also reports the fit for two untargeted moments: the shares of domestic output and exports accounted for by domestic and foreign MNEs. By construction, the Global Firms calibration assigns a value of one to both of these shares, generating large RMSEs for these moments in columns 1 and 3. Allowing for selection into MNE status substantially improves the fit of these untargeted moments. Additional results on the model's fit, together with the full list of estimated parameters, are provided in Appendix D.

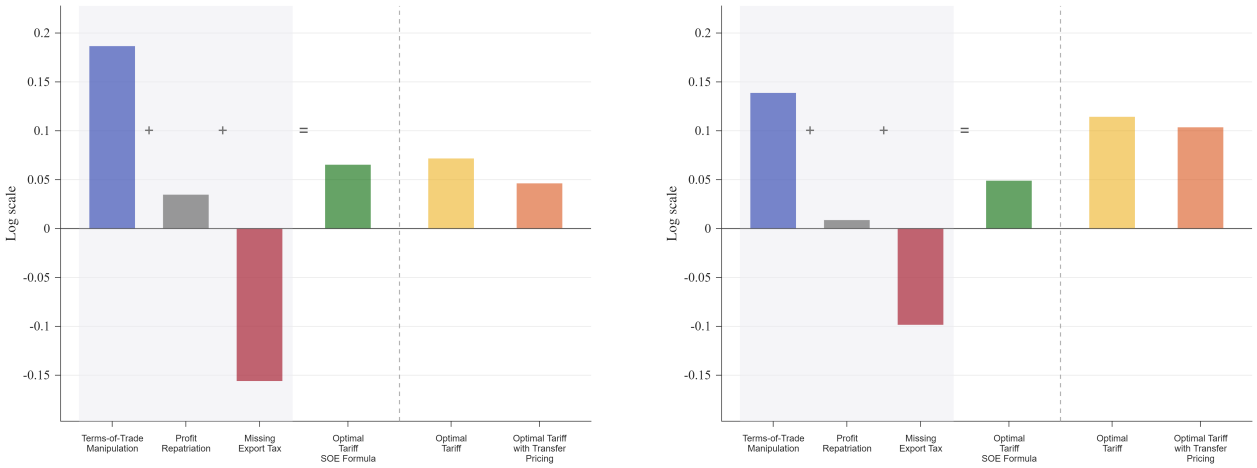
5.2 Quantitative Optimal Tariffs

Equipped with our calibrated models, we compute (unilaterally) optimal import tariffs for the United States and contrast them with the theoretical formula derived under the small open economy assumption. We restrict the planner to uniform tariff across all trading partners, consistent with our analysis in Section 4.

We start with the optimal tariff in the models without strategic transfer pricing, displayed in Figure 1 in log-scale. In the model with only global firms (left-panel), the numerically computed optimal tariff is 7.4% (in yellow, $\exp(0.072) - 1$). We compare it with the sufficient-statistic formula of Proposition 3, evaluated at the calibrated equilibrium. This mirrors how the formula would likely be applied in practice: we use the equilibrium values under current tariffs as inputs, rather than those consistent with the optimal tariff. Despite using the values from the initial equilibrium, the sufficient-statistic formula closely tracks the numerical optimum, suggesting that the small open economy approximation remains reasonable when most trade is conducted by multinational firms.

Figure 1 also decomposes the sufficient-statistic formula into its components: the terms-of-trade motive, the profit-repatriation motive, and the missing-export-tax correction. Since the figure is in log scale, the first three columns add up to the fourth column (in green). The decomposition reveals that the terms-of-trade component alone would yield an optimal tariff of 20.5%, comparable to estimates in the literature that rely solely on the trade elasticity. This estimate is, however, nearly three times as large as the optimal tariff itself. The profit-repatriation motive calls for an even higher tariff beyond the terms-of-trade component. By contrast, the missing-export-tax correction is large and negative: the profits earned by foreign affiliates operating in the United States substantially limit the government's ability to use import tariffs. Raising tariffs benefits those foreign-owned producers, and the planner cannot recover those gains through export taxes.

Figure 1: Optimal Tariffs: Formula Decomposition and Comparison with Numerical Optimum



(a) Model with only Global Firms **(b)** Model with Local and Global Firms

Notes: The left panel corresponds to the model with only global firms; the right panel to the model with selection into multinational status. Each panel decomposes the log of the sufficient-statistic formula from Proposition 3 into its three components. The first column plots $\log\left(1+\frac{1}{\bar{\theta}_m}\right)$, capturing the terms-of-trade motive. The second column plots $\log\left(\frac{\bar{\theta}_m Ex_m}{\bar{\theta}_m Ex_m - \bar{\vartheta}_m \Pi_m^{mne}}\right)$, capturing the profit-repatriation motive. The third column plots $\log \Upsilon_m$, the downward correction reflecting the absence of export taxes. The green column is the sum of the three components; the yellow column is the log of the numerically computed optimal tariff; and the red column is the log of the numerically computed optimal tariff in the model with strategic transfer pricing.

We next allow for selection into multinational status (right panel). The numerical optimal tariff rises from 7.4% to 12.1%, and the gap between the formula and the optimum widens to around 7 percentage points. Our estimates in Section 2 imply that local firms are less responsive to tariffs than global firms. Consistent with Fact 2, as the share of exports accounted for by local firms rises, the aggregate trade elasticity falls, raising the optimal tariff. The sufficient-statistic formula partially captures this effect: the terms-of-trade motive is smaller in the right panel, reflecting the lower aggregate elasticity. However, the formula still understates the optimum because it evaluates the elasticity using only global firms' trade shares. Furthermore, with fewer global firms, the base of foreign affiliate profits subject to repatriation is smaller, reducing the profit-repatriation motive in the right panel. The missing-export-tax correction is also smaller in absolute value, as fewer foreign affiliates operate in the home market. On net, the numerical optimum rises because the lower elasticity dominates the weaker MNE-specific forces.

We now turn to the role of strategic transfer pricing. Under our calibration, allowing for strategic transfer pricing reduces the optimal tariff from 7.4% to 4.7% in the global-firms model and from 12.1% to 10.9% in the baseline. Transfer pricing lowers the optimal tariff through two channels. First, it weakens the production-relocation channel that underpins both the terms-of-trade and the profit-repatriation motives. Second, it induces foreign firms to shift more profits to Home, which intensifies the incomplete-instruments problem and pushes for even lower tariffs. This second effect is partially offset by transfer-pricing penalties, which limit the extent to which foreign multinationals

can repatriate profits to their headquarters country. The overall reduction in the optimal tariff is larger in the global-firms model, where all firms engage in transfer pricing, than in the baseline, where local firms are unaffected by this channel and pay tariffs on the full arm's-length price.

5.3 Welfare Analysis of Optimal Tariffs and the 2018-19 US Tariffs

We now evaluate the welfare consequences of the 2018-19 US tariffs and the gains from implementing the optimal policy. Table 5 reports welfare effects across the different model variants considered in Section 5.2. We express welfare changes in consumption-equivalent terms.

The welfare assessment of the 2018-19 US tariffs implies small but negative welfare effects. The tariffs imposed by the US range from 0.02 percent (Canada) to 17.9 percent (China), and average 5.73 percent when weighted using 2016 import values. This tariff represents a 3.91 percentage point increase on average relative to its 2016 values. In our baseline calibration (without transfer pricing), the import tariff imposed by the United States is equivalent to a reduction in consumption of 0.0158%. Since MNEs account for the majority of trade, our model with only global firms delivers a qualitatively similar result, with a larger welfare loss of 0.0543%.

In the *Local & Global Firms* model, implementing the optimal tariff of 12.1% is equivalent to a 0.2181% increase in consumption. To illustrate the cost of ignoring MNEs when setting policy, we impose the No-MNE optimal tariff—the inverse of the trade elasticity, approximately 14.88%—in our baseline model. Despite being higher than our model's optimal tariff of 12.1%, this policy yields welfare gains of only 0.2073%, below the 0.2181% the baseline model predicts, as multinational relocation partially offsets the intended terms-of-trade gains. In the global-firms model, the cost of ignoring MNEs is far starker: the No-MNE formula yields a welfare loss of 0.1841%, turning what would be a 0.0949% gain under the optimal tariff into an outright loss.

Transfer pricing introduces an additional dimension to these welfare comparisons. For optimal tariffs, it compresses the achievable welfare gains: from 0.2181% to 0.1941% in the baseline and from 0.0949% to 0.0516% in the global-firms model. It also amplifies the welfare losses from the 2018-19 tariffs, which worsen from -0.0158% to -0.0222% in the baseline and from -0.0543% to -0.1042% in the global-firms model. Transfer pricing erodes the tariff base, reducing both the revenue collected and the terms-of-trade gains from any given tariff level. At the optimum, the planner adjusts the tariff downward to partially compensate; for the fixed 2018-19 tariffs, no such adjustment is possible, and the erosion translates directly into larger welfare losses.

6 Conclusions

Multinational enterprises account for the bulk of U.S. international trade, yet nearly all quantitative frameworks for optimal trade policy treat trade as occurring exclusively through exporting. This paper shows that the omission matters: once multinational production is accounted for, the optimal tariff is substantially different from standard prescriptions, the welfare gains from trade policy are considerably more modest, and the channels through which tariffs affect welfare are fundamentally

Table 5: Welfare Effects of Tariffs Across Model Variants

	Without strategic transfer pricing			With strategic transfer pricing		
	Optimal	No-MNE Formula	2018–19 US	Optimal	No-MNE Formula	2018–19 US
Global Firms	0.0949	-0.1841	-0.0543	0.0516	-0.4783	-0.1042
Local & Global Firms	0.2181	0.2073	-0.0158	0.1941	0.1719	-0.0222

Notes: The table reports welfare gains in consumption-equivalent terms. *Optimal* corresponds to the model-specific optimal uniform import tariff. *No-MNE Formula* imposes the export-share-weighted average trade elasticity prescribed by models of only exporting, evaluated in each MNE model variant. *2018–19 US* reproduces the magnitude of the actual US tariffs implemented in 2018–19. *Global Firms* is the model with no selection into multinational status. *Local & Global Firms* features local and global firms with endogenous selection into multinational status.

altered.

Using transaction-level data from the 2018–2019 U.S.–China trade war, we document two features of MNE behavior that are central to these conclusions. Related-party trade is substantially more responsive to tariffs than arm's-length trade, and MNEs reduce imports more strongly than non-MNEs, reflecting their ability to reallocate production across affiliates. In addition, MNE exporters lower within-firm prices more than their arm's-length prices in response to the same tariff change, consistent with strategic transfer pricing. Together, these facts imply that the trade elasticity relevant for optimal policy is shaped by the extent of multinational activity, and that the tariff base itself erodes when MNEs are present.

Our analytical results identify three channels through which multinational production alters the standard terms-of-trade logic for trade policy. First, because production is more easily relocated across affiliates than goods can be substituted across origins, multinational activity makes aggregate exports more elastic, attenuating the terms-of-trade motive for tariffs. Second, tariffs raise domestic wages, which induces domestically owned MNEs to shift production abroad and repatriate profits widening the country's trade deficit; this additional demand for imports allows the planner to impose tariffs above the inverse-elasticity benchmark. Third, when foreign multinationals earn profits domestically, Lerner symmetry fails, and import tariffs serve imperfectly as a substitute for missing export taxes, pushing optimal tariffs downward. Quantitatively, the last force dominates: the terms-of-trade component alone calls for a 20% tariff, but the missing-export-tax correction pulls the net optimal tariff down to 7–12% depending on whether selection into MNE status is accounted for, and further to 5–11% once transfer pricing is incorporated.

The welfare gains from trade policy are substantially smaller than those implied by standard trade-only models. Our analysis of the 2018–19 U.S. tariffs yields small welfare losses of around 0.02% in our baseline, whereas a model without MNEs would predict modest gains. Abstracting from multinational production therefore leads to misleading conclusions about both the effectiveness of actual trade policy and the potential gains from optimal tariffs.

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Multinational Production and Trade Policy

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Online Appendix (Not for Publication)

A Additional Empirical Results

A.1 Related-Party Transactions are Larger than Arm's-Length Transactions

We show that related-party (RP) import relationships tend to be larger than arm's-length (AL) relationships. For each HS10–country cell in 2017, we compute each importer's quantity imported under AL and RP (if there are non-zero imports) as a share of total quantity imported in that cell. We then compute the distribution of these shares across the economy, separately for AL and RP imports. This exercise shows how large individual firm's AL and RP imports are relative to total imports within narrowly defined product–source country cells.

The first two rows of Table A.1 report the distribution of importer shares from the LFTTD, as well as their mean and standard deviation. The average RP importer accounts for 11.5% of imports within an HS10–country cell, compared with 7.7% for the average AL importer. The right tail has substantially larger shares for RP imports: at the 95th percentile, an RP importer accounts for 99% of imports in an HS10–country cell, compared with 70% for an AL importer.

The bottom two rows of Table A.1 repeat this exercise from the perspective of the foreign exporter. We now compute the share of each exporter under each related party status in total U.S. imports by HS10 code–country in 2017, and then compute the distribution of these shares in the economy. The results are broadly similar to the import-side. The mean (95th percentile) of market shares for RP exporters is 8.0% (70.8%), compared to 6.0% (46.6%) for AL exporters. Overall, these results will support a model with selection into multinational versus local or independent firms.

Table A.1: Distribution of Importer and Exporter Shares across HS10–Country Cells

	P5	P25	P50	P75	P95	Mean	SD
Importer shares							
AL	0.000	0.000	0.001	0.015	0.702	0.077	0.221
RP	0.000	0.000	0.002	0.036	0.990	0.115	0.269
Exporter shares							
AL	0.000	0.000	0.001	0.008	0.466	0.060	0.195
RP	0.000	0.000	0.001	0.016	0.708	0.080	0.222

Notes: Source: LFTTD and authors' calculations. The top two rows of the table show percentiles of the distribution of importers' shares in the economy across HS10–country cells, separately by AL and RP imports. Last two columns show mean and standard deviation. Import shares are computed as the share of quantity imported by each importer–HS10–country–RP status cell within its corresponding HS10–country in 2017. The bottom two rows compute shares of the quantity exported to the U.S. by each foreign exporter–HS10–country–RP status cell within HS10–country markets.

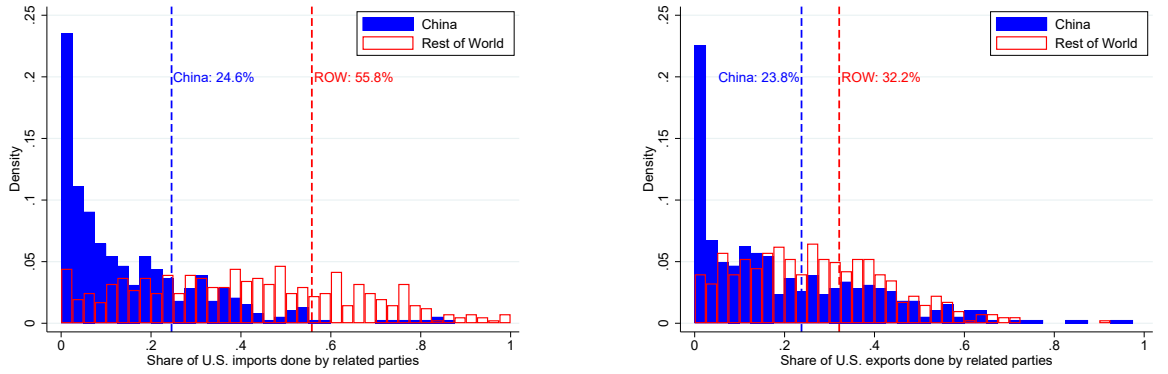
A.2 Variation in the Share of Related-Party Trade with China and Across Industries

We show that the share of related-party (RP) trade with China is relatively low but varies substantially across industries. This analysis uses publicly available information on related-party imports and exports for each 6-digit NAICS industry in 2017, available from the Census Bureau.[1]

[1] https://www.census.gov/foreign-trade/Press-Release/related_party/index.html.

Figure A.1 provides a histogram of the related-party share of U.S. imports (left panel) and U.S. exports (right panel) across 6-digit NAICS industries in 2017, for trade with China (blue) and with the rest of the world (red), based on publicly available data. For most industries, the share of related-party trade with China is relatively low: the import-value weighted mean is 24.6% for imports and 23.8% for exports (indicated by the blue vertical line), compared with 55.8% and 32.2%, respectively, for trade with the rest of the world (red vertical lines). Moreover, there are a large number of industries in which there is no related-party trade with China at all. These include distilleries, rice milling, and poultry processing for imports, and copper ore and nickel ore mining as well as bituminous coal mining for exports. However, there is considerable heterogeneity, and for some products the related-party share is as high as 96%. Industries with a high related-party share include frozen specialty food manufacturing (RP share of 86%) and printing ink manufacturing (RP share of 83%) for imports, and support activities for printing (RP share of 96%) and pharmaceutical preparation manufacturing (RP share of 76%) for exports. This heterogeneity suggests that the effects of tariffs may differ depending on the type of industry being tariffed.

Figure A.1: Share of U.S. RP Trade in 2017 across 6-Digit NAICS Industries



(a) Imports **(b)** Exports

Notes: These figures show a histogram of related-party trade shares across 6-digit NAICS industries in 2017. The left panel shows the histogram for imports. Blue bars present the distribution for China, red bars present the distribution for the rest of the world. The dashed blue vertical line presents the weighted average RP share for China, where industries are weighted by total imports. The red dashed vertical line presents the weighted average RP share for the rest of the world. The right panel presents an analogous histogram for exports.

RP trade with China is low compared to other countries even within the same industry. We run a regression in the import data of the form

$$ShareRP_{ij} = \beta_1 \mathbb{I}_{ij}(i = \text{China}) + \gamma_j + \epsilon_{ij} \tag{A.1}$$

where $ShareRP_{ij}$ is the share of imports in 6-digit NAICS industry j from country i that are under RP, $\mathbb{I}_{ij}(i = \text{China})$ is a dummy for China, and γ_j is an industry fixed effect. We weight the regression by imports in 2017, and cluster standard errors at the country level. We obtain $\beta_1 = -0.26^{***}$ (s.e.=0.04), indicating that the RP share from China is 26% lower than that from other countries in the average industry. Running the same regression for exports, we obtain $\beta_1 = -0.08^{***}$ (s.e.=0.02).

A.3 Regressions at the Country-Product-Month Level

In this appendix, we run standard regressions of changes in quantity, import value, and price (unit value) on changes in tariffs at the country-product-month level in our data, following Fajgelbaum et al. (2020). In particular, we run:

$$\Delta \ln y_{igt} = \eta_{gt} + \eta_{it} + \eta_{is(g)} + \beta \Delta \ln(1 + \tau_{igt}) + \varepsilon_{igt}, \tag{A.2}$$

where y_{igt} is the quantity, value imported, or price for imports from country i of good g in month t, η_{gt}, η_{it}, and $\eta_{is(g)}$ are product-time, country-time, and country-sector fixed effects, respectively, and τ_{igt} is the statutory tariff rate for the product and country.

We first run this regression for our sample period, 2016:m1–2021:m12. The tariff elasticities, reported in Table A.2, are similar to those in Fajgelbaum et al. (2020), at around -1.0 for quantity and -1.1 for import value over a one-month horizon, though these are still lower than the elasticities of around -1.5 they found.

Table A.2: Effect of Tariffs on Quantities, Values, and Price at the Country-Product-Month Level (2016–2021)

	1 mo	3 mo	12 mo	24 mo
Quantity				
$\Delta \ln(1 + \tau_{igt})$	-1.031***	-1.151***	-1.705***	-1.982***
	(0.103)	(0.078)	(0.079)	(0.093)
Value				
$\Delta \ln(1 + \tau_{igt})$	-1.079***	-1.189***	-1.734***	-1.987***
	(0.092)	(0.071)	(0.075)	(0.088)
Price				
$\Delta \ln(1 + \tau_{igt})$	-0.048	-0.038	-0.029	-0.005
	(0.053)	(0.037)	(0.036)	(0.040)
HS10-Time FE	Y	Y	Y	Y
Country-Time FE	Y	Y	Y	Y
Country-Sector FE	Y	Y	Y	Y
R^2	0.135	0.157	0.151	0.163
Observations	6,542,000	6,194,000	5,063,000	3,759,000

Source: Census Bureau and authors' calculations. Table reports the results of regressing the change in the quantity, value, or price (y_{igt}) on the change in the tariff (τ_{igt}) for the period 2016–2021. The regressions include product-time, country-time, and country-sector fixed effects. Standard errors, adjusted for clustering by HS8 product code are reported below coefficient estimates. ***, **, and * represent statistical significance at the 1, 5 and 10 percent levels.

We next re-run the regressions for the shorter time period of 2016:m1-2019:m4, which corresponds exactly to the time period used by Fajgelbaum et al. (2020). The results, in Table A.3, now rise to around -1.4 at the one-month horizon, and are statistically indistinguishable from the earlier findings. As before, we also do not find a significant effect of the tariffs on the tariff-exclusive price.

Table A.3: Effect of Tariffs on Quantities, Values, and Price at the Country-Product-Month Level (2016:m1–2019:m4)

	1 mo	3 mo	12 mo	24 mo
Quantity				
$\Delta \ln(1+\tau_{igt})$	-1.360***	-1.208***	-1.755***	-1.983***
	(0.148)	(0.121)	(0.136)	(0.151)
Value				
$\Delta \ln(1+\tau_{igt})$	-1.374***	-1.204***	-1.696***	-1.914***
	(0.132)	(0.108)	(0.121)	(0.130)
Price				
$\Delta \ln(1+\tau_{igt})$	-0.014	0.003	0.059	0.069
	(0.073)	(0.052)	(0.058)	(0.073)
HS10-Time FE	Y	Y	Y	Y
Country-Time FE	Y	Y	Y	Y
Country-Sector FE	Y	Y	Y	Y
R^2	0.138	0.158	0.142	0.160
Observations	3,308,000	3,050,000	2,185,000	1,168,000

Source: Census Bureau and authors' calculations. Table reports the results of regressing the change in the quantity, value, or price (y_{igt}) on the change in the tariff (τ_{igt}) for the period 2016:m1–2019:m4. The regressions include product-time, country-time, and country-sector fixed effects. Standard errors, adjusted for clustering by HS8 product code are reported below coefficient estimates. ***, **, and * represent statistical significance at the 1, 5 and 10 percent levels.

A.4 Interaction of MNE Status with RP Trade

Our findings that MNEs respond more strongly to tariffs than Non-MNEs could be driven by either the RP trade or the AL trade of MNEs. To test which type of trade is responsible for the finding, we include in regression (2) an additional interaction between the tariff change, the MNE status dummy, and another dummy for whether the MNE is trading with a related party. Table A.4 shows the results. For quantity, we find that MNEs respond more strongly to tariffs than Non-MNEs even for their arms'-length trade, for all horizons except one month. MNEs tend to have a stronger decline in RP trade than in AL trade, and the effect is significant at the 1-month and 24-month horizon.

A.5 Interaction of MNE Status with Importer Size

One question about our findings that MNEs respond more strongly to tariffs than Non-MNEs is whether this result is driven by the fact that MNEs are larger on average than other firms. To test this possibility, we include in regression (2) an additional interaction between the tariff change and firm size, $\mathbb{I}_{fg}(Large)$, which is a dummy that is equal to one if firm f's imports of product g were above the 90th percentile of imports across firms sourcing that product in 2016-17. Table A.5 shows the results. We still find that MNEs reduce their quantity imported more strongly than Non-MNEs, at all horizons. Greater size tends to further increase the elasticity of the response.

As an alternative, we measure size based on the number of countries a firm sources from. Firms that source a given product from several countries might find it easier to substitute across them, regardless of MNE status. In this specification, we therefore set a dummy $\mathbb{I}_{fg}(Multi\ Country)$ to one if firm f sources product g from at least two countries. The results in Table A.6 show that having more countries to source from does not significantly change the effect of tariffs on quantity or value for most time horizons.

Table A.4: Effect of Tariffs – MNEs vs Non-MNEs with RP Interaction

	1 mo	3 mo	12 mo	24 mo
Quantity				
$\Delta \ln(1+\tau_{igt})$	-0.236***	-0.170***	-0.207***	-0.183***
	(0.073)	(0.056)	(0.044)	(0.064)
$\Delta \ln(1+\tau_{igt})\mathbb{I}_{fg}(MNE)$	-0.124	-0.222***	-0.268***	-0.317***
	(0.092)	(0.068)	(0.062)	(0.086)
$\Delta \ln(1+\tau_{igt})\mathbb{I}_{fg}(MNE)\mathbb{I}_{fxgt}(RP)$	-0.238**	-0.041	-0.101	-0.171*
	(0.100)	(0.070)	(0.075)	(0.098)
Value				
$\Delta \ln(1+\tau_{igt})$	-0.372***	-0.382***	-0.528***	-0.519***
	(0.070)	(0.056)	(0.043)	(0.065)
$\Delta \ln(1+\tau_{igt})\mathbb{I}_{fg}(MNE)$	-0.039	-0.068	-0.071	-0.145*
	(0.089)	(0.065)	(0.061)	(0.083)
$\Delta \ln(1+\tau_{igt})\mathbb{I}_{fg}(MNE)\mathbb{I}_{fxgt}(RP)$	-0.234**	-0.089	-0.145*	-0.155
	(0.097)	(0.070)	(0.077)	(0.098)
Importer-Exporter-Country-HS10 FE	Y	Y	Y	Y
HS10-Time FE	Y	Y	Y	Y
Country-Time FE	Y	Y	Y	Y
R^2	0.093	0.117	0.181	0.285
Observations	19,150,000	16,740,000	11,320,000	7,028,000

Source: Census Bureau and authors' calculations. Table reports the results of regressing the change in the quantity or value (y_{igt}) on the change in the tariff (τ_{igt}). The regressions include importer firm-exporter firm-product-country, product-time, and country-time fixed effects. Standard errors, adjusted for clustering by HS8 product code are reported below coefficient estimates. ***, **, and * represent statistical significance at the 1, 5 and 10 percent levels.

Table A.5: Effect of Tariffs – MNEs vs Non-MNEs with Importer Size Interaction Based on Value

	1 mo	3 mo	12 mo	24 mo
Quantity				
$\Delta \ln(1+\tau_{igt})$	-0.153	-0.119*	0.095*	0.222***
	(0.094)	(0.067)	(0.052)	(0.072)
$\Delta \ln(1+\tau_{igt}) \cdot \mathbb{I}_{fg}(MNE)$	-0.211***	-0.222***	-0.207***	-0.283***
	(0.076)	(0.056)	(0.046)	(0.061)
$\Delta \ln(1+\tau_{igt}) \cdot \mathbb{I}_{fg}(Large)$	-0.149*	-0.086	-0.487***	-0.616***
	(0.089)	(0.065)	(0.049)	(0.062)
Value				
$\Delta \ln(1+\tau_{igt})$	-0.298***	-0.338***	-0.239***	-0.126*
	(0.090)	(0.064)	(0.053)	(0.075)
$\Delta \ln(1+\tau_{igt}) \cdot \mathbb{I}_{fg}(MNE)$	-0.128*	-0.096*	-0.039	-0.106*
	(0.074)	(0.053)	(0.045)	(0.060)
$\Delta \ln(1+\tau_{igt}) \cdot \mathbb{I}_{fg}(Large)$	-0.132	-0.078	-0.469***	-0.597***
	(0.085)	(0.061)	(0.049)	(0.061)
Importer-Exporter-Country-HS10 FE	Y	Y	Y	Y
HS10-Time FE	Y	Y	Y	Y
Country-Time FE	Y	Y	Y	Y
R^2	0.093	0.117	0.181	0.285
Observations	19,150,000	16,740,000	11,320,000	7,028,000

Source: Census Bureau and authors' calculations. Table reports the results of regressing the change in the quantity or value (y_{igt}) on the change in the tariff (τ_{igt}). $\mathbb{I}_{fg}(Large)$ is a dummy that is equal to one if firm f's imports of product g were above the 90th percentile of imports across firms sourcing that product in 2016-17. The regressions include importer firm-exporter firm-product-country, product-time, and country-time fixed effects. Standard errors, adjusted for clustering by HS8 product code are reported below coefficient estimates. ***, **, and * represent statistical significance at the 1, 5 and 10 percent levels.

Table A.6: Effect of Tariffs – MNEs vs Non-MNEs with Importer Size Interaction Based on Number of Countries

	1 mo	3 mo	12 mo	24 mo
Quantity				
$\Delta \ln(1+\tau_{igt})$	-0.255***	-0.132**	-0.194***	-0.126*
	(0.085)	(0.063)	(0.052)	(0.072)
$\Delta \ln(1+\tau_{igt}) \cdot \mathbb{I}_{fg}(MNE)$	-0.258***	-0.210***	-0.310***	-0.363***
	(0.080)	(0.055)	(0.047)	(0.062)
$\Delta \ln(1+\tau_{igt}) \cdot \mathbb{I}_{fg}(Multi\ Country)$	0.027	-0.086	-0.035	-0.133**
	(0.084)	(0.061)	(0.051)	(0.059)
Value				
$\Delta \ln(1+\tau_{igt})$	-0.411***	-0.386***	-0.556***	-0.498***
	(0.081)	(0.061)	(0.050)	(0.069)
$\Delta \ln(1+\tau_{igt}) \cdot \mathbb{I}_{fg}(MNE)$	-0.188**	-0.117**	-0.170***	-0.211***
	(0.077)	(0.053)	(0.046)	(0.060)
$\Delta \ln(1+\tau_{igt}) \cdot \mathbb{I}_{fg}(Multi\ Country)$	0.073	0.004	0.050	-0.057
	(0.080)	(0.061)	(0.049)	(0.057)
Importer-Exporter-Country-HS10 FE	Y	Y	Y	Y
HS10-Time FE	Y	Y	Y	Y
Country-Time FE	Y	Y	Y	Y
R^2	0.093	0.117	0.181	0.285
Observations	19,150,000	16,740,000	11,320,000	7,028,000

Source: Census Bureau and authors' calculations. Table reports the results of regressing the change in the quantity or value (y_{igt}) on the change in the tariff (τ_{igt}). $\mathbb{I}_{fg}(Multi\ Country)$ is a dummy that is equal to one if firm f's imports product g from at least two countries in 2016-17. The regressions include importer firm-exporter firm-product-country, product-time, and country-time fixed effects. Standard errors, adjusted for clustering by HS8 product code are reported below coefficient estimates. ***, **, and * represent statistical significance at the 1, 5 and 10 percent levels.

A.6 Further Analysis of Transfer Pricing

In this appendix, we further analyze the response of exporter MNEs' prices in response to tariffs for AL versus RP relationships.

We first analyze whether exporter MNEs' reduce their prices more strongly for RP relationships than for AL relationships for differentiated products. Transfer pricing can more easily be disguised in differences in product quality or complexity for differentiated goods than for goods that are traded on organized exchanges. We therefore re-run regression (3), with the sample restricted to "differentiated" products according to Rauch (1999). Results, in Table A.7 below, are relatively similar to those for the full sample. The gap between AL and RP pricing is larger for the 12-month horizon, but slightly smaller at 24 months.

Next, we consider a more stringent version of regression (3) where instead of exporter-country-HS10 product, product-time, and country-time fixed effects we include exporter-HS10 product-time fixed effects. In this specification, only β_{RP}, the difference between AL and RP pricing, is identified, since the baseline effect is absorbed into the fixed effect. Table A.8 shows the results for the full sample and Table A.9 for differentiated products. The results are similar to before.

Table A.7: Effect of Tariffs on Prices - Differentiated Products

	1 mo	3 mo	12 mo	24 mo
Price				
$\Delta \ln(1+\tau_{igt})$	-0.332*	-0.261**	-0.242**	-0.160
	(0.193)	(0.112)	(0.121)	(0.206)
$\Delta \ln(1+\tau_{igt}) \cdot \mathbb{I}_{xigr}(RP)$	0.063	-0.050	-0.291**	-0.331**
	(0.131)	(0.084)	(0.118)	(0.139)
Exporter-Country-HS10 FE	Y	Y	Y	Y
HS10-Time FE	Y	Y	Y	Y
Country-Time FE	Y	Y	Y	Y
R^2	0.179	0.205	0.319	0.423
Observations	766,000	641,000	316,000	175,000

Notes: Source: Census Bureau and authors' calculations. Table reports the results of regressing the change in the tariff-exclusive unit value (y_{igt}) on the change in the tariff (τ_{igt}) for differentiated products. The regressions include exporter firm-product-country, product-time, and country-time fixed effects. Standard errors, adjusted for clustering by HS8 product code are reported below coefficient estimates. ***, **, and * represent statistical significance at the 1, 5 and 10 percent levels.

A.7 Regressions with Publicly Available RP Shares

In this appendix, we run country-product level regressions using publicly available data. We show that the publicly available data provides results consistent with our regression evidence in the main text that RP trade is more responsive to tariff shocks than AL trade.

The publicly available information on related-party imports and exports is available at the 6-digit NAICS industry level in each year, and was described in Appendix A.2. We compute from these data for each industry the share of imports from China that are obtained via RP in 2017, and map these RP shares to their associated HS10 codes in the publicly available monthly Census trade data. Since we do not observe monthly RP and AL imports, we cannot run the same regressions we run in the LFTTD data. Instead, we run regressions where we interact the tariff change with the Chinese RP share of the industry associated

Table A.8: Effect of Tariffs on Prices - All Products, *xht* FE

	1 mo	3 mo	12 mo	24 mo
Price				
$\Delta \ln(1+\tau_{igt}) \cdot \mathbb{I}_{xigr}(RP)$	0.015	-0.012	-0.128	-0.314***
	(0.113)	(0.065)	(0.084)	(0.109)
Exporter-HS10-Time FE	Y	Y	Y	Y
R^2	0.344	0.372	0.468	0.546
Observations	1,301,000	1,090,000	542,000	302,000

Notes: Source: Census Bureau and authors' calculations. Table reports the results of regressing the change in the tariff-exclusive unit value (y_{igt}) on the change in the tariff (τ_{igt}). The regressions include exporter firm-product-time fixed effects. Standard errors, adjusted for clustering by HS8 product code are reported below coefficient estimates. ***, **, and * represent statistical significance at the 1, 5 and 10 percent levels.

Table A.9: Effect of Tariffs on Prices - Differentiated Products, *xht* FE

	1 mo	3 mo	12 mo	24 mo
Price				
$\Delta \ln(1+\tau_{igt}) \cdot \mathbb{I}_{xigr}(RP)$	0.088	-0.043	-0.202**	-0.265**
	(0.136)	(0.082)	(0.101)	(0.131)
Exporter-HS10-Time FE	Y	Y	Y	Y
R^2	0.343	0.366	0.455	0.530
Observations	766,000	641,000	316,000	175,000

Notes: Source: Census Bureau and authors' calculations. Table reports the results of regressing the change in the tariff-exclusive unit value (y_{igt}) on the change in the tariff (τ_{igt}) for differentiated products. The regressions include exporter firm-product-time fixed effects. Standard errors, adjusted for clustering by HS8 product code are reported below coefficient estimates. ***, **, and * represent statistical significance at the 1, 5 and 10 percent levels.

with a given HS10 product. Specifically, let i index a source country, g an HS10 product, t a month between 2017:m1 and 2021:m12, and $s(g)$ and $n(g)$ the 4-digit and the 6-digit NAICS industry associated with good g, respectively. We then run specifications of the form

$$\Delta \ln m_{igt} = \eta_{gt} + \eta_{it} + \eta_{is(g)} + \sigma \Delta \ln(1+\tau_{igt}) + \rho \Delta \ln(1+\tau_{igt}) \cdot \text{RP Share}^{CN}_{n(g)} + \varepsilon_{igt}, \tag{A.3}$$

where m_{igt} is the quantity imported from country i of good g in month t, η_{gt}, η_{it}, and $\eta_{is(g)}$ are product-time, country-time, and country-sector fixed effects, respectively, and τ_{igt} is the statutory tariff rate for the product and country. The variable $\text{RP Share}^{CN}_{n(g)}$ is the share of imports of industry n associated with product g from China that is sourced via a related party in 2017. Our coefficient of interest is ρ, which captures whether the trade elasticity differs for products based on the related party share.[2]

We first run the regression excluding the related party term and report the results in column 1 of Table A.10. Standard errors are two-way clustered at the 8-digit HS code and country level. This regression corresponds to the reduced-form regression run by Fajgelbaum et al. (2020). The results indicate a tariff elasticity of about one, i.e., a one percent increase in tariffs is associated with a one percent decline in quantity

[2]Note that we do not need to include $\text{RP Share}^{CN}_{n(g)}$ on its own since it is absorbed by the product-time fixed effect.

imported. This elasticity is slightly lower than in Fajgelbaum et al. (2020) due to the different time period used, as described in Appendix A.3.

Table A.10: Tariffs and Related Party Share

	(1) No RP share	(2) Baseline	(3) P50 dummy	(4) Quarterly
$\Delta \ln(1+\tau_{igt})$	-1.065***	-0.621***	-0.630***	-0.522*
	(0.120)	(0.150)	(0.185)	(0.307)
$\Delta \ln(1+\tau_{igt}) \times$ RP Share^{CN}		-2.495***		-4.446***
		(0.500)		(0.703)
$\Delta \ln(1+\tau_{igt}) \times \mathbb{I}$(RP Share$^{CN} > P50$)			-0.629***	
			(0.180)	
Product-Time FE	Y	Y	Y	Y
Country-Time FE	Y	Y	Y	Y
Country-Sector FE	Y	Y	Y	Y
R^2	0.122	0.122	0.122	0.113
Observations	6,919,153	6,919,153	6,919,153	3,259,887

Source: Census Bureau and authors' calculations. Table reports the results of regressing the monthly change in the quantity imported (m_{igt}) on the change in the tariff (τ_{igt}) as well as the tariff change interacted with the related party share. The regressions include product-time, country-time, and country-sector fixed effects. Standard errors, adjusted for clustering by HS8 product code and country are reported below coefficient estimates. ***, **, and * represent statistical significance at the 1, 5 and 10 percent levels.

The second column runs our baseline specification (A.3). We find that the tariff elasticity is significantly higher in absolute value when the related party share is higher: at the mean tariff change (0.04), going from the 25th percentile to the 75th percentile of the related party share from China (from 0.05 to 0.21) is associated with an additional decline in imports of 1.8 log points.

In column 3, we re-run the regression but replace the continuous related party share for imports from China with a dummy variable that is equal to one if the related party share is above the median (0.12), $\mathbb{I}(\text{RP Share}^{CN}_{n(g)} > P50)$. The results are consistent with our earlier findings: at the mean tariff change, going from a related party share below the median to one above the median reduces imports by about 2.9 log points.

Since our regressions are run at the monthly level, our dataset contains many missing observations for cases when a particular country-product is not imported in a given month. This feature of the data may bias our results. In column 4, we therefore aggregate import quantities to the quarterly level, and use the average tariff rate of the quarter. We find similar results.

Overall, these regressions show that trade in industries with a higher RP share is more responsive to tariff changes. This finding suggests that RP trade might be more responsive to tariff shocks.

B Theoretical Appendix

B.1 Equilibrium

We close the model by specifying the selection of firms into *global* and *local* firms and how tariff revenue and transfer-pricing penalties are distributed in the economy, followed by a detailed description of the model's equilibrium. Recall that each firm produces a distinct variety ω (which are all equally liked by consumers). In what follows below, we indicate a variety by the firm's productivity, z.

Firm Selection and Productivity Thresholds. As in standard models of trade, profits are increasing functions in firm's productivity level. The presence of fixed costs for becoming a multinational enterprise and increasing profits imply that only the most productive firms in the economy become *global* firms. This leads to a productivity threshold, $\tilde{z}_m$, above which firms headquartered in country m with productivity $z > \tilde{z}_m$ operate as multinationals, producing in every location. Letting $\Phi(z)$ denote the ex-ante cumulative distribution of firm productivities, and given a fixed number of firms M_m, the number of global firms is given by

$$G_m = M_m \left[1 - \Phi\left(\tilde{z}_m\right)\right]. \tag{B.1}$$

Trade flows. Now we proceed to aggregate over the individual firms' choices between becoming local and global firms to derive expressions for trade flows between country l and country m.

There are two types of firms that export to country m. The local firms from country l, and global firms from all countries that use l as a production location to serve country m, this includes global firms from country l itself. Letting X_{lm} denote total exports from country l to country m, we have:

$$X_{lm} = M_l \int_0^{\tilde{z}_l} p_{l,lm}(z)\, q^d_{l,lm}(z)\, d\Phi(z) + \sum_{i=1}^{N} M_i \int_{\tilde{z}_i}^{\infty} p_{i,lm}(z)\, q_{i,lm}(z)\, d\Phi(z).$$

Government. The government in country m collects revenue from import tariffs t_{lm} on goods imported from countries $l \neq m$, and from transfer pricing penalties on *global* firms for these transactions. These are rebated as lump-sum transfers, T_m, to the representative household:

$$\begin{aligned} T_m = &\sum_{i=1}^{N} M_i \int_0^{\tilde{z}_i} (t_{im} - 1)\, p_{i,im}(z)\, q^d_{i,im}(z)\, d\Phi(z) + \sum_{i=1}^{N}\sum_{l=1}^{N} M_i \int_{\tilde{z}_i}^{\infty} (t_{lm} - 1)\, p^u_{i,lm}(z)\, q^u_{i,lm}(z)\, d\Phi(z) \\ &+ \sum_{i=1}^{N}\sum_{l\neq m} M_i \int_{\tilde{z}_i}^{\infty} T_{i,lm}(z)\, d\Phi(z), \end{aligned} \tag{B.2}$$

where the first and second component on the right represent the tariff revenue collected from exports of *local* and *global* firms, respectively. The third term represents the penalties collected from exports of *global* firms when those set prices that deviate from the arm's length principle. Consequently, household income E_m is given by

$$E_m = w_m L_m + \Pi_m + T_m, \tag{B.3}$$

where Π_m represents the aggregate profits of firms headquartered in m, the sum of the profits of *local* firms and *global* firms minus penalty costs and fixed costs from becoming a MNE

$$\Pi_m = \sum_{j=1}^{N} M_m \left[\int_0^{\tilde{z}_m} \pi_{m,mj}(z)\, d\Phi(z) + \int_{\tilde{z}_m}^{\infty} \left(\Pi_{m,j}(z) - \sum_{l \neq m} T_{m,lj}(z) \right) d\Phi(z) \right] - w_m f_m G_m.$$

Equilibrium Definition. An equilibrium, given import tariffs $\mathbf{t} = \{t_{lm}\}_{l,m}$, consists of an allocation, prices, measures of *global* firms, and productivity thresholds that satisfy the following conditions: (i) households maximize utility subject to their budget constraint, i.e., equations (6) holds (ii) *local* firms set prices according to equation (8), while *global* firms set prices according to equation (11), (12), and (16); (iii) firms select into global and local firms, as stated in equations (B.1); (iv) the government runs a balanced budget, provided in (B.2); and (v) labor markets clear

$$w_m L_m = G_m w_m f_m + \sum_{i=1}^{N} M_i \sum_{j=1}^{N} \int_0^{\infty} w_m \ell_{i,mj}(z)\, d\Phi(z). \tag{B.4}$$

The labor market condition equates the total supply of labor to total demand, which includes the fixed cost payments associated with multinational operations in country m, the labor used by domestic local and global firms in m for production, and specific to our model, the labor employed by foreign multinationals operating in m.

The definition of equilibrium is standard, however, it does not impose balanced trade. The balance-of-payments identity states that the current account equals the sum of net exports and net income from abroad

$$CA_m = NX_m + NI_m = 0. \tag{B.5}$$

Since our economy is static, we abstract from international borrowing and lending. If a country spends more than the value of its production ($NX_m < 0$), the profits by its MNEs abroad exceed the profits of foreign MNEs in its domestic economy. The profits generated by foreign firms located at home include the subsidiaries of foreign global firms that locate in country m to serve the domestic household or as an export platform to serve foreign household, plus the profits of the foreign distributors located in m net of transfer-pricing penalties paid to the domestic government. The profits generated by domestic firms located abroad include the profits of domestic subsidiaries and distributors located abroad net of transfer-pricing penalties paid to foreign governments.

B.2 Details for the Small Open Economy limit

We consider the environment described in Section 3 but impose the three assumptions of Section 4: (i) country m is an Small open economy, (ii) all firms are global, (iii) transfer pricing is shut down. Relative to the analysis in the main text, here we also consider export taxes. The (one plus) export tax set by country m when exporting to country l is denoted with x_{ml}.

In Section B.2.1 we first describe the system of equations that pins down the equilibrium for the large open economy under assumptions (ii) and (iii). Then, in Section B.2.2, we impose the parametrization in equation (17) and compute the limit as $n \to 0$. Finally, in Section B.2.3, we solve for country m's optimal import and export taxes. The formulas in this section correspond to those displayed in the main text in Section 4.

B.2.1 Equilibrium with Large Open Economies

Definition of Equilibrium in the Simple Model. Under assumptions (ii) and (iii) internal prices equal a constant markup over marginal cost:

$$p_{i,lm}^{d} = t_{lm} x_{lm} p_{i,lm}^{u}, \qquad p_{i,lm}^{u} = \mu \frac{\tau_{lm} \gamma_{i,l}}{A_i} w_l. \tag{B.6}$$

Country m's price indexes in turn satisfy:

$$P_{i,m} = \left[\sum_{l=1}^{N} \left(p_{i,lm}^{d} \right)^{1-\varepsilon} \right]^{\frac{1}{1-\varepsilon}}, \qquad P_m = \left[\sum_{i=1}^{N} P_{i,m}^{1-\sigma} \right]^{\frac{1}{1-\sigma}}. \tag{B.7}$$

An equilibrium given import tariffs $\mathbf{t} = \{t_{lm}\}_{l,m}$ and export taxes $\mathbf{x} = \{x_{ml}\}_{m,l}$, consists of an allocation and prices such that: (i) households maximize utility subject to their budget constraint, i.e., equations (6) and (B.7) hold; (ii) *global* firms set prices according to equations (B.6); (iii) the government runs a balanced budget;

$$T_m = \sum_{i=1}^{N} \sum_{l=1}^{N} \left(t_{lm} - 1 \right) x_{lm} p_{i,lm}^{u} q_{i,lm}^{u} + \sum_{i=1}^{N} \sum_{l=1}^{N} \left(x_{ml} - 1 \right) p_{i,ml}^{u} q_{i,ml}^{u}; \tag{B.8}$$

and (iv) labor markets clear

$$w_m L_m = \sum_{i=1}^{N} \sum_{j=1}^{N} w_m \ell_{i,mj}. \tag{B.9}$$

Characterizing the Equilibrium We first show that to compute the equilibrium is enough to know the wages in each country w_m. We then described the system of equations that pins down $\{w_i,\}_i$. This formulation of the equilibrium will be useful when computing the small open economy limit. We let wages in country N to be the numeraire, i.e, $w_N = 1$.

We start by defining two expenditure shares:

$$\lambda_{i,lm} \equiv \frac{t_{lm} x_{lm} p_{i,lm}^{u} q_{i,lm}^{u}}{\sum_{j=1}^{N} t_{jm} x_{jm} p_{i,jm}^{u} q_{i,jm}^{u}}, \qquad \lambda_{i,m} = \frac{P_{i,m} Q_{i,m}}{\sum_{j=1}^{N} P_{j,m} Q_{j,m}}.$$

The share $\lambda_{i,lm}$ represents the expenditure share on goods originated in i that are produced in l and imported by m with $x_{lm} p_{i,lm}^{u}$ the price at the port of destination. The share $\lambda_{i,m}$ is instead country m's overall expenditure share on goods originated in i. The CES structure in demand for the household, along with the pricing equations (B.6) and (B.7) allow us to express these shares as functions of countries wages and fundamental parameters:

$$\lambda_{i,lm} = \frac{\left(t_{lm} x_{lm} \tau_{lm} \gamma_{i,l} w_l \right)^{1-\varepsilon}}{\sum_{r=1}^{N} \left(t_{rm} x_{rm} \tau_{rm} \gamma_{i,r} w_r \right)^{1-\varepsilon}}, \qquad \lambda_{i,m} = \frac{\left(\gamma_{i,l} / A_i \right)^{1-\sigma} \lambda_{i,lm}^{-\frac{1-\sigma}{1-\varepsilon}}}{\sum_{r=1}^{N} \left(\gamma_{r,l} / A_r \right)^{1-\sigma} \lambda_{r,lm}^{-\frac{1-\sigma}{1-\varepsilon}}}. \tag{B.10}$$

Note that the share of total expenditure (inclusive of tariffs) in country m that is spent on imported goods from l can be express in terms of these two shares, and therefore, it is also a function of wages only:

$$\lambda_{lm} = \sum_{i=1}^{N} \lambda_{i,m} \lambda_{i,lm}. \tag{B.11}$$

The vector of equilibrium wages solves the system of labor market clearing conditions (B.9). The next step is to show how express the demand for labor as functions of the equilibrium wage. We start from equation (B.9) for country m and use the production technology of the production-subsidiary, the prices in equation (B.6), and the shares in (B.10) to re-write the labor market clearing condition as:

$$w_m L_m = \sum_{j=1}^{N} \sum_{i=1}^{N} \frac{1}{\mu} \frac{\lambda_{i,mj} \lambda_{i,j}}{t_{mj} x_{mj}} E_j, \tag{B.12}$$

where E_j is given in equation (B.3). Note that similar steps can be applied to the government revenues in equation (B.8), and to the aggregate profits to obtain

$$T_m = \sum_{i=1}^{N} \sum_{l=1}^{N} (t_{lm} - 1) \frac{\lambda_{i,lm} \lambda_{i,m}}{t_{lm}} E_m + \sum_{i=1}^{N} \sum_{l=1}^{N} (x_{ml} - 1) \frac{\lambda_{i,ml} \lambda_{i,l}}{x_{ml} t_{ml}} E_l \tag{B.13}$$

$$\Pi_m = \sum_{i=1}^{N} \sum_{j=1}^{N} \left(1 - \frac{1}{\mu}\right) \frac{\lambda_{m,ij} \lambda_{m,j}}{t_{ij} x_{ij}} E_j \tag{B.14}$$

And so, combining equation (B.3) with equation (B.13) we can express household income as

$$E_m = \frac{Y_m}{\sum_{l=1}^{N} \lambda_{lm} / t_{lm}}, \qquad Y_m \equiv w_m L_m + \Pi_m + T_m^x, \tag{B.15}$$

where T_m^x is the component in the government revenue coming from export instruments, and thefore, Y_m represents the household income excluding import tariff revenues. Substituting E_m back into equations (B.12) and (B.13), and using the definition of Y_m we can write the following recursion for Y_m

$$Y_m = \sum_{j=1}^{N} \sum_{i=1}^{N} \left(\Lambda_{i,mj} - \left(1 - \frac{1}{\mu}\right) \frac{\Lambda_{i,mj}}{x_{mj}} + \left(1 - \frac{1}{\mu}\right) \frac{\Lambda_{m,ij}}{x_{ij}} \right) Y_j, \tag{B.16}$$

where we defined

$$\Lambda_{i,mj} \equiv \frac{\lambda_{i,mj} \lambda_{i,j} / t_{mj}}{\sum_r \sum_h \lambda_{h,rj} \lambda_{h,j} / t_{rj}}. \tag{B.17}$$

Equation (B.16) defines implicitly household income as a function of the vector of equilibrium wages. Therefore, the vector of equilibrium wages can be computed from the labor market conditions

$$w_m L_m = \sum_{j=1}^{N} \sum_{i=1}^{N} \frac{1}{\mu} \frac{\Lambda_{i,mj}}{x_{mj}} Y_j, \qquad m = 1, 2, \ldots, N-1 \tag{B.18}$$

with the normalization $w_N = 1$.

B.2.2 The Small Open Economy Limit

We impose the parametrization in equation (17) and consider the sequence of equilibria indexed by n. We are interested in characterizing the equilibrium as n goes to zero. From the discussion in Appendix B.2.1, the equilibrium of the limit economy solves the system described by equations (B.16) and (B.18) as $n \to 0$. In the analysis that follows, we let $\bar{x} \equiv \lim_{n \to 0} x$ and $\hat{x} \equiv \lim_{n \to 0} n^{-\frac{1-\sigma}{1-\varepsilon}} x$, with x denoting an endogenous equilibrium variable in the model.

We begin by computing the limit as $n \to 0$ for the four different shares defined in the previous section,

$\lambda_{i,lj}$, $\lambda_{i,j}$, λ_{lj}, and $\Lambda_{i,lj}$. We guess, and later verify, that in the limit the vector of equilibrium wages is positive and finite. Using equation (B.10), we compute the limit for $\lambda_{i,lj}$ under the assumption of positive and finite wages, we obtain:

$$\begin{aligned}
\bar{\lambda}_{i,lj} &= \frac{\left(t_{lj}x_{lj}\tau_{lj}\gamma_{i,l}\bar{w}_l\right)^{1-\varepsilon}}{\sum_{r\neq m}\left(t_{rj}x_{rj}\tau_{rj}\gamma_{i,r}\bar{w}_r\right)^{1-\varepsilon}}, \qquad i,j,l \neq m \\
\bar{\lambda}_{i,lm} &= \frac{\left(t_{lm}x_{lm}\tau_{lm}\gamma_{i,l}\bar{w}_l\right)^{1-\varepsilon}}{\sum_{r}\left(t_{rm}x_{rm}\tau_{rm}\gamma_{i,r}\bar{w}_r\right)^{1-\varepsilon}}, \qquad i \neq m, \ \forall l \\
\bar{\lambda}_{m,lj} &= \frac{\left(t_{lj}x_{lj}\tau_{lj}\bar{\gamma}_{m,l}\bar{w}_l\right)^{1-\varepsilon}}{\sum_{r}\left(t_{rj}x_{rj}\tau_{rj}\bar{\gamma}_{m,r}\bar{w}_r\right)^{1-\varepsilon}}, \qquad j \neq m, \ \forall l \\
\bar{\lambda}_{i,mj} &= \bar{\lambda}_{m,im} = 0, \qquad i,j \neq m \\
\bar{\lambda}_{m,mm} &= 1.
\end{aligned} \tag{B.19}$$

Using equation (B.10) and (B.19), we compute the limit for $\lambda_{i,j}$ under the assumption of positive and finite wages, obtaining:

$$\begin{aligned}
\bar{\lambda}_{i,j} &= \frac{\bar{\lambda}_{i,jj}^{-\frac{1-\sigma}{1-\varepsilon}}\left(\gamma_{i,j}/A_i\right)^{1-\sigma}}{\sum_{r\neq m}\bar{\lambda}_{r,jj}^{-\frac{1-\sigma}{1-\varepsilon}}\left(\gamma_{r,j}/A_r\right)^{1-\sigma}}, \qquad i,j \neq m \\
\bar{\lambda}_{i,m} &= \frac{\bar{\lambda}_{i,mm}^{-\frac{1-\sigma}{1-\varepsilon}}\left(\gamma_{i,m}/A_i\right)^{1-\sigma}}{\sum_{r}\bar{\lambda}_{r,mm}^{-\frac{1-\sigma}{1-\varepsilon}}\left(\gamma_{r,m}/A_r\right)^{1-\sigma}}, \qquad \forall i \\
\bar{\lambda}_{m,j} &= 0, \\
\hat{\lambda}_{m,j} &= \frac{\bar{\lambda}_{m,jj}^{-\frac{1-\sigma}{1-\varepsilon}}\left(\bar{\gamma}_{m,j}/A_m\right)^{1-\sigma}}{\sum_{r\neq m}\bar{\lambda}_{r,jj}^{-\frac{1-\sigma}{1-\varepsilon}}\left(\gamma_{r,j}/A_r\right)^{1-\sigma}}, \qquad j \neq m.
\end{aligned} \tag{B.20}$$

Note that for $\lambda_{m,j}$ we compute both types of limits.

Using equation (B.17), (B.19), and (B.20) we compute the limit for $\Lambda_{i,lj}$ under the assumption of positive and finite wages. Under the assumption that $\sigma < \varepsilon$, we obtain:

$$\begin{aligned}
\bar{\Lambda}_{i,lj} &= \frac{\bar{\lambda}_{i,lj}\bar{\lambda}_{i,j}/t_{lj}}{\sum_{h\neq m}\sum_{r\neq m}\bar{\lambda}_{h,rj}\bar{\lambda}_{h,j}/t_{rj}}, \qquad i,l,j \neq m \\
\bar{\Lambda}_{i,lm} &= \frac{\bar{\lambda}_{i,lm}\bar{\lambda}_{i,m}/t_{lm}}{\sum_{h}\sum_{r}\bar{\lambda}_{h,rm}\bar{\lambda}_{h,m}/t_{rm}}, \qquad \forall i,l \\
\bar{\Lambda}_{m,im} &= \bar{\Lambda}_{i,mj} = \hat{\Lambda}_{i,mj} = 0, \qquad i,j \neq m \\
\bar{\Lambda}_{m,lj} &= 0, \qquad j \neq m, \ \forall l \\
\hat{\Lambda}_{m,lj} &= \frac{\bar{\lambda}_{m,lj}\hat{\lambda}_{m,j}/t_{lj}}{\sum_{h\neq m}\sum_{r\neq m}\bar{\lambda}_{h,rj}\bar{\lambda}_{h,j}/t_{rj}}, \qquad j \neq m, \ \forall l.
\end{aligned} \tag{B.21}$$

Finally, we work with equation (B.16) and (B.18). Note that our guess that wages are finite and positive in the limit implies that $\bar{Y}_j$ for all $j \neq m$ must also be finite and positive. Using equations (B.19), (B.20), and

(B.21), it follows that for all country $j \neq m$ we have:

$$\bar{Y}_j = \sum_{r \neq m} \sum_{i \neq m} \left(\bar{\Lambda}_{i,jr} - \left(1 - \frac{1}{\mu}\right) \frac{\bar{\Lambda}_{i,jr}}{x_{jr}} + \left(1 - \frac{1}{\mu}\right) \frac{\bar{\Lambda}_{j,ir}}{x_{ir}} \right) \bar{Y}_r, \qquad j \neq m \tag{B.22}$$

$$\bar{w}_j L_j = \sum_{r \neq m} \sum_{i \neq m} \frac{1}{\mu} \frac{\bar{\Lambda}_{i,jr}}{x_{jr}} \bar{Y}_r$$

A closer look at equation (B.22) reveals that this equation is independent of country m's equilibrium variables. Therefore, in this limit, the wages of foreign countries can be solved independently of country m's equilibrium objects. Furthermore, if a solution to this system exists, it features both positive and finite wages.

For country m, we focus on the limit of equilibrium variables in per-capita terms as in Caliendo and Feenstra (2024) and Demidova et al. (2024). In our parametrization in equation (17), the labor endowment for country m goes to zero in the limit. This implies that even with finite wages the household income must go to zero. However, income per-capita stays positive and finite. Using equations (B.19), (B.20), and (B.21), it follows that for country m the limit versions of equations (B.16) and (B.18) are given by

$$\hat{Y}_m = \sum_{r \neq m} \left(\sum_{i \neq m} \left(1 - \frac{1}{\mu}\right) \frac{\hat{\Lambda}_{m,ir}}{x_{ir}} + \hat{\Lambda}_{m,mr} \right) \bar{Y}_r + \left(\sum_{i=1}^{N} \frac{1}{\mu} \bar{\Lambda}_{i,mm} + \left(1 - \frac{1}{\mu}\right) \bar{\Lambda}_{m,mm} \right) \hat{Y}_m \tag{B.23}$$

$$\bar{w}_m \bar{L}_m = \sum_{j \neq m} \frac{1}{\mu} \frac{\hat{\Lambda}_{m,mj}}{x_{mj}} \bar{Y}_j + \sum_i \frac{1}{\mu} \frac{\bar{\Lambda}_{i,mm}}{x_{mm}} \hat{Y}_m.$$

Equation (B.23) determines the equilibrium wage for country m in the Small Open Economy limit. Note that in this limit, welfare per-capita equals household per-capita real income. Hence:

$$\hat{U}_m = \frac{\hat{Y}_m / \bar{P}_m}{\sum_{l=1}^{N} \bar{\lambda}_{lm} / t_{lm}}, \qquad \bar{P}_m = \frac{\mu}{A_m} \bar{\lambda}_{m,m}^{-\frac{1}{1-\sigma}} \bar{w}_m. \tag{B.24}$$

B.2.3 The Domestic Planner's Optimal Trade Policy

The domestic planner in country m unilaterally chooses its combinations of import and export taxes $\{t_{jm}, x_{mj}\}_{j \neq m}$ to maximize domestic household welfare (equation (B.24)), subject to the equilibrium constraints (B.19), (B.20), (B.21), and (B.23). Since foreign wages do not depend on country m's equilibrium variables, and in particular its trade policy, equation (B.22) is not a constraint for the domestic planner in country m.

Before solving for the optimal trade taxes it is useful to re-write equation (B.23) in more familiar terms:

$$\hat{Y}_m - \sum_{i=1}^{N} \bar{\Lambda}_{i,mm} \hat{Y}_m - \sum_{j \neq m} \hat{\Lambda}_{m,mj} \bar{Y}_j = \sum_{j \neq m} \sum_{i \neq m} \left(1 - \frac{1}{\mu}\right) \frac{\hat{\Lambda}_{m,ij}}{x_{ij}} \bar{Y}_j - \sum_{i \neq m} \left(1 - \frac{1}{\mu}\right) \bar{\Lambda}_{i,mm} \hat{Y}_m. \tag{B.25}$$

Note that the left-hand side of this equation represents country m's net imports, while the right-hand side is the net foreign income, i.e. the difference between the profits of domestic MNEs earned abroad and the profits of foreign MNEs operating in country m. Hence, the domestic planner chooses its optimal trade policy to maximize domestic welfare subject to two equilibrium constraints: (i) country m's labor market clearing condition, and (ii) country m's balance-of-payments identity.

We also impose the constraint that trade taxes satisfy $t_{jm} \geq 0$ and $x_{mj} \geq 0$. In most of the cases we

consider in this Appendix, the solution is interior, and hence these constraints can be ignored. However, in our full model with imperfect competition and both domestic and foreign firms engaging in multinational production, these constraints occasionally bind and we need to take them into account.

B.2.4 The Domestic Planner's First-Order Conditions

We solve this problem in several steps by log-differentiating the objective function and its two constraints, with respect to log-changes in trade taxes, and finally combining these results to construct the domestic planner's first-order conditions.

Step 1 - Log-differentiate the objective function (B.24). We start by log-differentiating the domestic planner's objective function (B.24), we obtain:

$$d\log\hat{U}_m = d\log\hat{Y}_m - \sum_{i=1}^{N}\bar{\Lambda}_{im}d\log\bar{\lambda}_{im} - \bar{\lambda}_{mm}d\log\bar{w}_m + \sum_{i\neq m}\left(\bar{\Lambda}_{im}-\bar{\lambda}_{im}\right)d\log t_{im}, \tag{B.26}$$

with $\bar{\Lambda}_{lm}\equiv\sum_i\bar{\Lambda}_{i,lm}$, and where $d\log\bar{\lambda}_{im}$ is given by

$$d\log\bar{\lambda}_{im} = \sum_{j\neq m}\frac{\partial\bar{\lambda}_{im}}{\partial t_{jm}}\frac{t_{jm}}{\bar{\lambda}_{im}}d\log t_{jm} + \frac{\partial\bar{\lambda}_{im}}{\partial\bar{w}_m}\frac{\bar{w}_m}{\bar{\lambda}_{im}}d\log\bar{w}_m, \qquad i=1,\ldots,N. \tag{B.27}$$

Step 2 - Log-differentiate the constraint equation (B.25). We start by defining the following elasticities with respect to country m's wage. We let θ_{mi} denote the trade elasticity with respect to wages, and $\bar{\theta}_m$ the average elasticity which uses export shares as weights:

$$\theta_{mi}\equiv-\frac{\partial\log\left(\bar{\lambda}_{mi}/\bar{\lambda}_{ii}\right)}{\partial\log\bar{w}_m}, \quad \bar{\theta}_m\equiv\sum_{i\neq m}\frac{\Lambda_{mi}Y_i}{\sum_{j\neq m}\Lambda_{mj}Y_j}\theta_{mi}. \tag{B.28}$$

We also define:

$$\vartheta_{m,lj}\equiv\frac{\partial\log\left(\hat{\Lambda}_{m,lj}/\bar{\Lambda}_{j,jj}\right)}{\partial\log\bar{w}_m}, \qquad l,j\neq m. \tag{B.29}$$

The elasticity $\vartheta_{m,lj}$ measures how exports from country l to country j of products originated in country m change as $\bar{w}_m$ changes. Hence, this elasticity informs us about the extent to which profits of domestic MNEs abroad respond to a change in the domestic wage. Consistent with equation (B.28), we let $\bar{\vartheta}_m$ be the average response of those exports across all production locations and destination markets, using production-destination-specific sales as weights:

$$\bar{\vartheta}_{m,j}\equiv\sum_{l\neq m}\frac{\hat{\Lambda}_{m,lj}\bar{Y}_j/x_{lj}}{\sum_{l\neq m}\hat{\Lambda}_{m,lj}\bar{Y}_j/x_{lj}}\vartheta_{m,lj}, \qquad \bar{\vartheta}_m\equiv\sum_{j\neq m}\frac{\sum_{l\neq m}\hat{\Lambda}_{m,lj}\bar{Y}_j/x_{lj}}{\sum_{j\neq m}\sum_{l\neq m}\hat{\Lambda}_{m,lj}\bar{Y}_j/x_{lj}}\bar{\vartheta}_{m,j}. \tag{B.30}$$

Using the previous definitions, one can show that:

$$d\log\hat{\Lambda}_{mi} = -\theta_{mi}\left(d\log\bar{w}_m + d\log x_{mi}\right), \qquad d\log\hat{\Lambda}_{m,li} = \vartheta_{m,li}\left(d\log x_{mi} + d\log\bar{w}_m\right), \qquad l,i\neq m.$$

Therefore, log-differentiating equation (B.25), we obtain:

$$
\begin{aligned}
-\left(Ex_m\bar{\theta}_m-\Pi_m^{mne}\bar{\vartheta}_m\right)d\log\bar{w}_m=&-\bar{\Lambda}_{mm}\hat{Y}_m d\log\Lambda_{mm}+\left(Im_m+\Pi_{-m}^{mne}\right)d\log\hat{Y}_m\\
&+\sum_{i\neq m}\left(1-\frac{1}{\mu}\right)\bar{\Lambda}_{i,mm}\hat{Y}_m d\log\bar{\Lambda}_{i,mm}\\
&+\sum_{j\neq m}\left(Ex_{mj}\theta_{mj}-\Pi_{m,j}^{mne}\bar{\vartheta}_{m,j}\right)d\log x_{mj},
\end{aligned}
\tag{B.31}
$$

where $Ex_m=\sum_{r\neq m}\hat{\Lambda}_{mr}\bar{Y}_r$ and $Im_m=\left(1-\bar{\Lambda}_{mm}\right)\hat{Y}_m$ are country m's total exports and imports, respectively; $\Pi_{m,j}^{mne}=\sum_{l\neq m}\left(1-\frac{1}{\mu}\right)\frac{\hat{\Lambda}_{m,lj}\bar{Y}_j}{x_{lj}}$ and $\Pi_m^{mne}=\sum_{j\neq m}\Pi_{m,j}^{mne}$ are m's aggregate profits from its multinational activity; and $\Pi_{-m}^{mne}\equiv\sum_{i\neq m}\bar{\Lambda}_{i,mm}\hat{Y}_m\left(1-\frac{1}{\mu}\right)$ are the profits generated in country m by the MNE activity of foreign firms.

We now compute $d\log\bar{\Lambda}_{i,mm}$. Relative to the previous elasticities, the change in $\hat{\Lambda}_{i,mm}$ includes not only the indirect effect through $d\log w_m$, but also the direct effect of changing the tariffs to country j, $d\log t_{jm}$. Note, however, that these shares do not depend directly on export taxes. This implies

$$
d\log\bar{\Lambda}_{i,mm}=-\varphi_{i,m}d\log\bar{w}_m+\sum_{j\neq m}\varrho_{i,j}^m d\log t_{jm},
\tag{B.32}
$$

where

$$
\begin{aligned}
\varphi_{i,m}&\equiv-\frac{\partial\log\bar{\Lambda}_{i,mm}}{\partial\log\bar{w}_m}, \qquad \bar{\varphi}_m=\sum_{i\neq m}\frac{\bar{\Lambda}_{i,mm}}{\sum_{r\neq m}\bar{\Lambda}_{r,mm}}\varphi_{i,m},\\
\varrho_{i,j}^m&\equiv\frac{\partial\log\bar{\Lambda}_{i,mm}}{\partial\log t_{jm}}, \qquad \bar{\varrho}_j^m\equiv\sum_{i\neq m}\frac{\bar{\Lambda}_{i,mm}}{\sum_{r\neq m}\bar{\Lambda}_{r,mm}}\varrho_{i,j}^m.
\end{aligned}
$$

Finally, we compute $d\log\bar{\Lambda}_{mm}$, which depends only on import tariffs and the domestic wage:

$$
d\log\bar{\Lambda}_{mm}=\sum_{i\neq m}\left(\bar{\Lambda}_{im}+\left(1-\bar{\Lambda}_{mm}\right)\bar{\rho}_i^m\right)d\log t_{im}-\left(1-\bar{\Lambda}_{mm}\right)\bar{\phi}_m d\log\bar{w}_m,
\tag{B.33}
$$

where

$$
\begin{aligned}
\phi_{im}&\equiv\frac{\partial\log\left(\bar{\lambda}_{im}/\bar{\lambda}_{mm}\right)}{\partial\log\bar{w}_m}, \qquad \bar{\phi}_m\equiv\sum_{i\neq m}\frac{\bar{\Lambda}_{im}}{1-\bar{\Lambda}_{mm}}\phi_{im},\\
\rho_{ij}^m&\equiv-\frac{\partial\log\left(\bar{\lambda}_{im}/\bar{\lambda}_{mm}\right)}{\partial\log t_{jm}}, \qquad \bar{\rho}_j^m\equiv\sum_{i\neq m}\frac{\bar{\Lambda}_{im}}{1-\bar{\Lambda}_{mm}}\rho_{ij}^m.
\end{aligned}
$$

Putting together equations (B.31), (B.32) and (B.33), we obtain:

$$
\begin{aligned}
-\left(Ex_m\bar{\theta}_m-\Pi_m^{mne}\bar{\vartheta}_m-\Pi_{-m}^{mne}\bar{\varphi}_m\right)d\log\bar{w}_m=&-\bar{\Lambda}_{mm}\hat{Y}_m d\log\bar{\Lambda}_{mm}+\left(Im_m+\Pi_{-m}^{mne}\right)d\log\hat{Y}_m\\
&+\Pi_{-m}^{mne}\sum_{j\neq m}\bar{\varrho}_j^m d\log t_{jm}\\
&+\sum_{j\neq m}\left(Ex_{mj}\theta_{mj}-\Pi_{m,j}^{mne}\bar{\vartheta}_{m,j}\right)d\log x_{mj}
\end{aligned}
\tag{B.34}
$$

Step 3 - Log-differentiate the constraint (B.23). Log-differentiating the labor market clearing condition in equation (B.23), we obtain

$$\left(\bar{w}_m \bar{L}_m + \frac{1}{\mu}\sum_{j\neq m}\frac{Ex_{mj}}{x_{mj}}\bar{\theta}^x_m\right) d\log \bar{w}_m = \frac{1}{\mu}\bar{\Lambda}_{mm}\hat{Y}_m\left(d\log\bar{\Lambda}_{mm} + d\log\hat{Y}_m\right) - \frac{1}{\mu}\sum_{j\neq m}\frac{Ex_{mj}}{x_{mj}}\left(\theta_{mj}+1\right)d\log x_{mj}, \tag{B.35}$$

where we defined $\bar{\theta}^x_m \equiv \sum_{j\neq m}\frac{\hat{\Lambda}_{mj}\bar{Y}_j/x_{mj}}{\sum_{j\neq m}\hat{\Lambda}_{mj}\bar{Y}_j/x_{mj}}\theta_{mj}$, with θ_{mj} given by equation (B.28).

Step 4 - Characterize $d\log\bar{w}_m$. We want to compute $d\log w_m$ as a function of $\{d\log t_{jm}, d\log x_{mj}\}_j$ only:

$$d\log\bar{w}_m = \sum_{j\neq m}\frac{\partial\log\bar{w}_m}{\partial\log t_{jm}}d\log t_{jm} + \sum_{j\neq m}\frac{\partial\log\bar{w}_m}{\partial\log x_{mj}}d\log x_{mj}.$$

Using the system defined by equations (B.33), (B.34), and equation (B.35), we can compute the following partial derivatives:

$$\frac{\partial\log\bar{w}_m}{\partial\log t_{jm}} = \frac{\frac{Im_m\left(\frac{\bar{\Lambda}_{jm}}{1-\bar{\Lambda}_{mm}}+\bar{\rho}^m_j\right)}{Im_m+\Pi^{mne}_{-m}} + \frac{\Pi^{mne}_{-m}\left(\bar{\Lambda}_{jm}+\left(1-\bar{\Lambda}_{mm}\right)\bar{\rho}^m_j-\bar{\varrho}^m_j\right)}{Im_m+\Pi^{mne}_{-m}}}{\frac{\hat{Y}_m+\Pi^{mne}_{-m}}{Im_m+\Pi^{mne}_{-m}}\left(1-\bar{\Lambda}_{mm}\right)\bar{\phi}_m + \frac{\mu\bar{w}_m\bar{L}_m}{\bar{\Lambda}_{mm}\hat{Y}_m} + \sum_{j\neq m}\frac{Ex_{mj}/x_{mj}}{\bar{\Lambda}_{mm}\hat{Y}_m}\bar{\theta}^x_m + \frac{Ex_m\bar{\theta}_m-\Pi^{mne}_m\bar{\vartheta}_m-\Pi^{mne}_{-m}\bar{\varphi}_m}{Im_m+\Pi^{mne}_{-m}}}, \tag{B.36}$$

$$\frac{\partial\log\bar{w}_m}{\partial\log x_{mj}} = -\frac{\frac{Ex_{mj}\theta_{mj}-\Pi^{mne}_{m,j}\bar{\vartheta}_{m,j}}{Im_m+\Pi^{mne}_{-m}} + \frac{Ex_{mj}}{x_{mj}}\left(\theta_{mj}+1\right)}{\frac{\hat{Y}_m+\Pi^{mne}_{-m}}{Im_m+\Pi^{mne}_{-m}}\left(1-\bar{\Lambda}_{mm}\right)\bar{\phi}_m + \frac{\mu\bar{w}_m\bar{L}_m}{\bar{\Lambda}_{mm}\hat{Y}_m} + \sum_{j\neq m}\frac{Ex_{mj}/x_{mj}}{\bar{\Lambda}_{mm}\hat{Y}_m}\bar{\theta}^x_m + \frac{Ex_m\bar{\theta}_m-\Pi^{mne}_m\bar{\vartheta}_m-\Pi^{mne}_{-m}\bar{\varphi}_m}{Im_m+\Pi^{mne}_{-m}}}.$$

Step 5 - Compute the First-Order Conditions. The first-order conditions for the planner at an interior solution are given by the following equations:

$$\frac{\partial\log\hat{U}_m}{\partial\log t_{im}} = 0, \qquad \frac{\partial\log\hat{U}_m}{\partial\log x_{mi}} = 0 \quad \forall i\neq m.$$

We can compute these partial derivatives by combining our results from equation (B.26), equation (B.33), and equation (B.34). For any import tariff t_{jm}, we have:

$$0 = -\left[\frac{\partial\log\bar{\lambda}_{mm}}{\partial\log\bar{w}_m} + \bar{\lambda}_{mm} + \bar{\phi}_m + \frac{Ex_m\bar{\theta}_m - \Pi^{mne}_m\bar{\vartheta}_m - \Pi^{mne}_{-m}\left(\bar{\varphi}_m + \bar{\phi}_m\bar{\Lambda}_{mm}\right)}{Im_m+\Pi^{mne}_{-m}}\right]\frac{\partial\log\bar{w}_m}{\partial\log t_{jm}} + \frac{Im_m}{\Pi^{mne}_{-m}+Im_m}\frac{\bar{\Lambda}_{jm}}{1-\bar{\Lambda}_{mm}} + \frac{\Pi^{mne}_{-m}\left(\bar{\Lambda}_{jm}-\bar{\rho}^m_j\bar{\Lambda}_{mm}-\bar{\varrho}^m_j\right)}{\Pi^{mne}_{-m}+Im_m} + \bar{\rho}^m_j - \frac{\partial\bar{\lambda}_{mm}}{\partial t_{jm}}\frac{t_{jm}}{\bar{\lambda}_{mm}} - \bar{\lambda}_{jm} \tag{B.37}$$

For any export tax x_{mj}, we have:

$$0 = -\left[\frac{\partial\log\bar{\lambda}_{mm}}{\partial\log\bar{w}_m} + \bar{\lambda}_{mm} + \bar{\phi}_m + \frac{Ex_m\bar{\theta}_m - \Pi^{mne}_m\bar{\vartheta}_m - \Pi^{mne}_{-m}\left(\bar{\varphi}_m + \bar{\phi}_m\bar{\Lambda}_{mm}\right)}{Im_m+\Pi^{mne}_{-m}}\right]\frac{d\log\bar{w}_m}{d\log x_{mj}} - \frac{Ex_{mj}\theta_{mj} - \Pi^{mne}_{-mj}\bar{\vartheta}_{mj}}{Im_m+\Pi^{mne}_{-m}}, \tag{B.38}$$

where $\frac{\partial \log \bar{w}_m}{\partial \log t_{jm}}$ and $\frac{d \log \bar{w}_m}{d \log x_{mj}}$ are given by equation (B.36).

B.2.5 Optimal Trade Taxes

In this section, we compute optimal import and export taxes under the different scenarios discussed in the main text: (i) Optimal Import and Export Taxes under Perfect Competition; (ii) Optimal Export Taxes under Perfect Competition; (iii) Optimal Import Taxes under Perfect Competition; (iv) Optimal Import and Export Taxes under Imperfect Competition with no Foreign MP; (v) Optimal Export Taxes under Imperfect Competition with no Foreign MP; (vi) Optimal Import Taxes under Imperfect Competition with no Foreign MP; (vii) Optimal Import and Export Taxes under Imperfect Competition; (viii) Optimal Export Taxes under Imperfect Competition; and finally (ix) Optimal Homogeneous Import Taxes under Imperfect Competition.

1. Import and Export Taxes under Perfect Competition. When the domestic planner has access to both policy instruments, its optimal trade policy is characterized by equations (B.36), (B.37), and (B.38). Under perfect competition, i.e., $\mu = 1$, these equations reduce to:

$$\frac{\left(\frac{\partial \log \bar{\lambda}_{mm}}{\partial \log \bar{w}_m} + \bar{\lambda}_{mm} + \bar{\phi}_m + \bar{\theta}_m\right)\left(\frac{\bar{\Lambda}_{jm}}{1-\bar{\Lambda}_{mm}} + \bar{\rho}_j^m\right)}{\bar{\phi}_m + \frac{\bar{w}_m \bar{L}_m}{\bar{\Lambda}_{mm}\hat{Y}_m} + \sum_{j \neq m} \frac{Ex_{mj}/x_{mj}}{\bar{\Lambda}_{mm}\hat{Y}_m}\bar{\theta}_m^x + \bar{\theta}_m} = \frac{\bar{\Lambda}_{jm}}{1-\bar{\Lambda}_{mm}} + \bar{\rho}_j^m - \frac{\partial \log \bar{\lambda}_{mm}}{\partial \log t_{jm}} - \bar{\lambda}_{jm}, \tag{B.39}$$

$$\frac{\left(\frac{\partial \log \bar{\lambda}_{mm}}{\partial \log \bar{w}_m} + \bar{\lambda}_{mm} + \bar{\phi}_m + \bar{\theta}_m\right)\left(\frac{Ex_{mj}}{Ex_m}\theta_{mj} + (\theta_{mj}+1)\frac{Ex_{mj}}{x_{mj}}\right)}{\bar{\phi}_m + \frac{\bar{w}_m \bar{L}_m}{\bar{\Lambda}_{mm}\hat{Y}_m} + \sum_{j \neq m} \frac{Ex_{mj}/x_{mj}}{\bar{\Lambda}_{mm}\hat{Y}_m}\bar{\theta}_m^x + \bar{\theta}_m} = \frac{Ex_{mj}}{Ex_m}\theta_{mj}. \tag{B.40}$$

Taking equation (B.40) for countries i and j with $i \neq j$, we obtain:

$$\frac{1}{x_{mi}}\left(1 + \frac{1}{\theta_{mi}}\right) = \frac{1}{x_{mj}}\left(1 + \frac{1}{\theta_{mj}}\right).$$

Therefore, optimal export taxes are given by:

$$x_{mj} = \left(1 + \frac{1}{\theta_{mj}}\right)\bar{x}_m, \qquad \forall j \neq m \tag{B.41}$$

with $\bar{x}_m$ a constant to be determined.

Taking equation (B.39) for countries i and j with $i \neq j$, we obtain:

$$\frac{\frac{\partial \bar{\lambda}_{mm}}{\partial t_{im}}\frac{t_{im}}{\bar{\lambda}_{mm}} + \bar{\lambda}_{im}}{\bar{\Lambda}_{im} + \left(1-\bar{\Lambda}_{mm}\right)\bar{\rho}_i^m} = \frac{\frac{\partial \bar{\lambda}_{mm}}{\partial t_{jm}}\frac{t_{jm}}{\bar{\lambda}_{mm}} + \bar{\lambda}_{jm}}{\bar{\Lambda}_{jm} + \left(1-\bar{\Lambda}_{mm}\right)\bar{\rho}_j^m}. \tag{B.42}$$

We guess that optimal import tariffs are homogeneous across countries. For our guess to be correct, it should satisfy the previous equation. We note that with homogeneous tariffs we have:

$$\frac{\partial \bar{\lambda}_{mm}}{\partial t_{im}}\frac{t_{im}}{\bar{\lambda}_{mm}} = \bar{\rho}_i^m\left(1-\bar{\lambda}_{mm}\right), \qquad \bar{\Lambda}_{jm} = \frac{\bar{\lambda}_{jm}}{\left(1-\bar{\lambda}_{mm}\right) + t_{im}\bar{\lambda}_{mm}},$$

Plugging these equations back into equation (B.42), the guess is immediately verified. Hence,

$$t_{im} = t_{jm} = t_m. \tag{B.43}$$

Homogeneous tariffs also imply that:

$$\frac{\partial \log \bar{\lambda}_{mm}}{\partial \log \bar{w}_m} = -\bar{\phi}_m \left(1 - \bar{\lambda}_{mm}\right), \qquad \frac{\partial \log \bar{\lambda}_{mm}}{\partial \log t_{jm}} = \bar{\rho}_j^m \left(1 - \bar{\lambda}_{mm}\right), \qquad \bar{\phi}_m = \sum_{i \neq m} \bar{\rho}_i^m.$$

Combining the homogeneity result in equation (B.43), along with these relationships, with equation (B.39), we obtain:

$$\frac{\left(1 + \bar{\phi}_m\right) \bar{\lambda}_{mm} \bar{\Lambda}_{mm} + \bar{\Lambda}_{mm} \bar{\theta}_m}{\bar{\phi}_m \bar{\Lambda}_{mm} + \bar{\Lambda}_{mm} \bar{\theta}_m + \frac{\bar{w}_m \bar{L}_m}{\hat{Y}_m} + \sum_{j \neq m} \frac{E x_{mj}/x_{mj}}{\hat{Y}_m} \bar{\theta}_m^x} = \bar{\lambda}_{mm}$$

Finally, we note that $\frac{\bar{w}_m \bar{L}_m}{\bar{\Lambda}_{mm} \hat{Y}_m} = 1 + \sum_{j \neq m} \frac{E x_{mj}/x_{mj}}{\bar{\Lambda}_{mm} \hat{Y}_m}$. Using this expression along with the optimal export tax equation (B.41), we can solve for the optimal homogeneous tariff:

$$t_{jm} = \frac{1}{\bar{x}_m}, \qquad \forall j \neq m.$$

We conclude that optimal import and export taxes are given by:

$$x_{mj} = \left(1 + \frac{1}{\theta_{mj}}\right) \bar{x}_m, \quad \text{and} \quad t_{jm} = \frac{1}{\bar{x}_m}, \qquad \forall j \neq m. \tag{B.44}$$

The optimal policy is not uniquely determined in this case since $\bar{x}_m$ can take any arbitrary value, a consequence of Lerner Symmetry.

2. Export Taxes under Perfect Competition. As we showed in the previous case, when the planner has access to both instruments, it can dispense with the use of import tariffs. Hence, we can set $\bar{x}_m = 1$ in equation (B.44) and obtain the optimal export taxes under perfect competition

$$x_{mj} = \left(1 + \frac{1}{\theta_{mj}}\right), \qquad \forall j \neq m. \tag{B.45}$$

3. Import Taxes under Perfect Competition. When the domestic planner has only access to import tariffs, its optimal trade policy is characterized by equations (B.36) and (B.37). Under perfect competition, i.e., $\mu = 1$, these two equations reduce to:

$$\frac{\left(\frac{\bar{\Lambda}_{jm}}{1 - \bar{\Lambda}_{mm}} + \bar{\rho}_j^m\right) \left(\frac{\partial \log \bar{\lambda}_{mm}}{\partial \log \bar{w}_m} + \bar{\lambda}_{mm} + \bar{\phi}_m + \bar{\theta}_m\right)}{\bar{\phi}_m + \frac{\bar{w}_m \bar{L}_m}{\bar{\Lambda}_{mm} \hat{Y}_m} + \frac{E x_m}{\bar{\Lambda}_{mm} \hat{Y}_m} \bar{\theta}_m + \bar{\theta}_m} = \frac{\bar{\Lambda}_{jm}}{1 - \bar{\Lambda}_{mm}} + \bar{\rho}_j^m - \frac{\partial \bar{\lambda}_{mm}}{\partial t_{jm}} \frac{t_{jm}}{\bar{\lambda}_{mm}} - \bar{\lambda}_{jm}. \tag{B.46}$$

Using this equation for countries i and j with $i \neq j$, we obtain equation (B.42). It follows then that optimal import tariffs are homogeneous across countries in this case as well.

To compute the level of the optimal import tariff, we use equation (B.46), impose that tariff are homogeneous, and use the fact that $\frac{\bar{w}_m \bar{L}_m}{\bar{\Lambda}_{mm} \hat{Y}_m} = 1 + \frac{E x_m}{\bar{\Lambda}_{mm} \hat{Y}_m}$ to obtain

$$\frac{\left(1 - \bar{\lambda}_{mm}\right) \bar{\lambda}_{mm}}{1 - \bar{\lambda}_{mm} + t_m \bar{\lambda}_{mm}} = \bar{\theta}_m \left(\bar{\Lambda}_{mm} - \bar{\lambda}_{mm}\right).$$

Solving for t_m yields:

$$t_{jm} = 1 + \frac{1}{\bar{\theta}_m} = t_m, \qquad \forall j \neq m. \tag{B.47}$$

Note that with $N = 2$, equation (B.47) reduces to $t_{im} = \left(1 + \frac{1}{\theta_{mi}}\right)$ which coincides with the optimal export tax derived in equation (B.45). Under perfect competition, our economy satisfies Lerner Symmetry, and therefore with $N = 2$ the import tariff is a perfect substitute for the missing export tax.[3]

4. Import and Export Taxes under Imperfect Competition with no Foreign MP. We now consider the case with imperfect competition ($\mu > 1$), but in an environment where foreign firms lack the technology to produce outside of their headquarter location ($\gamma_{i,j} \to \infty$ for $i \neq m$). In this case, profits of foreign firms in country m are trivially $\Pi^{mne}_{-m} = 0$. Note, however, that under these assumptions, country m's net exports are not zero $NX_m = -\Pi^{mne}_m$, and therefore trade is not balanced.

Optimal import and export taxes are now described by equations (B.36), (B.37) and (B.38), where we impose $\mu > 1$ and $\Pi^{mne}_{-m} = 0$:

$$\frac{\left(\frac{\partial \log \bar{\lambda}_{mm}}{\partial \log \bar{w}_m} + \bar{\lambda}_{mm} + \bar{\phi}_m + \frac{Ex_m \bar{\theta}_m - \Pi^{mne}_m \bar{\vartheta}_m}{Im_m}\right)\left(\frac{\bar{\Lambda}_{jm}}{1-\bar{\Lambda}_{mm}} + \bar{\rho}^m_j\right)}{\bar{\phi}_m + \frac{\mu \bar{w}_m \bar{L}_m}{\bar{\Lambda}_{mm}\hat{Y}_m} + \sum_{j \neq m} \frac{Ex_{mj}/x_{mj}}{\bar{\Lambda}_{mm}\hat{Y}_m}\bar{\theta}^x_m + \frac{Ex_m \bar{\theta}_m - \Pi^{mne}_m \bar{\vartheta}_m}{Im_m}} - \frac{\bar{\Lambda}_{jm}}{1-\bar{\Lambda}_{mm}} - \bar{\rho}^m_j = -\frac{\partial \log \bar{\lambda}_{mm}}{\partial \log t_{jm}} - \bar{\lambda}_{jm}, \tag{B.48}$$

$$\frac{\left(\bar{\lambda}_{mm}\left(1+\bar{\phi}_m\right) + \frac{Ex_m \bar{\theta}_m - \Pi^{mne}_m \bar{\vartheta}_m}{Im_m}\right)\left(\frac{Ex_{mj}\theta_{mj} - \Pi^{mne}_{m,j}\bar{\vartheta}_{m,j}}{Im_m} + \frac{Ex_{mj}}{x_{mj}}\left(\theta_{mj}+1\right)\right)}{\bar{\phi}_m + \frac{\mu \bar{w}_m \bar{L}_m}{\bar{\Lambda}_{mm}\hat{Y}_m} + \sum_{j \neq m} \frac{Ex_{mj}/x_{mj}}{\bar{\Lambda}_{mm}\hat{Y}_m}\bar{\theta}^x_m + \frac{Ex_m \bar{\theta}_m - \Pi^{mne}_m \bar{\vartheta}_m}{Im_m}} = \frac{Ex_{mj}\theta_{mj} - \Pi^{mne}_{m,j}\bar{\vartheta}_{m,j}}{Im_m}. \tag{B.49}$$

As before, we can take equation (B.49) for i and j with $i \neq j$, and solve for the export tax to obtain

$$x_{mj} = \left(1 + \frac{1}{\theta_{mj}}\right)\frac{\theta_{mj} Ex_{mj}}{\theta_{mj} Ex_{mj} - \bar{\vartheta}_{m,j}\Pi^{mne}_{m,j}}\bar{x}_m \qquad \forall j \neq m, \tag{B.50}$$

with $\bar{x}_m$ an arbitrary constant.

Similarly, we can take equation (B.48) for i and j with $i \neq j$ to obtain again equation (B.42). We conclude that as in cases 1. and 3., the optimal import tariff is homogeneous across countries. To recover the level of the import tariff, we use the that tariff are homogeneous, so that equation (B.48) becomeS:

$$\frac{\left(1+\bar{\phi}_m\right)\bar{\lambda}_{mm}\bar{\Lambda}_{mm} + \bar{\Lambda}_{mm}\frac{Ex_m \bar{\theta}_m - \Pi^{mne}_m \bar{\vartheta}_m}{Im_m}}{\bar{\phi}_m \bar{\Lambda}_{mm} + \frac{\mu \bar{w}_m \bar{L}_m}{\hat{Y}_m} + \sum_{j \neq m}\frac{Ex_{mj}/x_{mj}}{\hat{Y}_m}\theta_{mj} + \bar{\Lambda}_{mm}\frac{Ex_m \bar{\theta}_m - \Pi^{mne}_m \bar{\vartheta}_m}{Im_m}} = \bar{\lambda}_{mm}.$$

Finally, using that $\frac{\mu \bar{w}_m \bar{L}_m}{\bar{\Lambda}_{mm}\hat{Y}_m} = 1 + \sum_{j \neq m}\frac{Ex_{mj}/x_{mj}}{\bar{\Lambda}_{mm}\hat{Y}_m}$ and the value of the optimal export taxes in equation (B.50), we can solve for the optimal tariff. We obtain:

$$t_{jm} = \frac{1}{\bar{x}_m}, \qquad \forall j \neq m. \tag{B.51}$$

As in case 1., the optimal policy is not uniquely determined. While trade is not balanced in this environment, Lerner Symmetry still holds in the knife-edge case when there is no multinational production done by foreign firms.

5. Export Taxes under Imperfect Competition with no Foreign MP. As we showed in the previous case, when the planner has access to both instruments, it can dispense with the use of import tariffs.

[3] In a previous version of this paper, we also computed optimal import tariffs for two large open economies with multinational production and perfect competition. In this case, the optimal import tariff is given by $t_{jm} = 1 + \frac{1}{\Lambda_{ii}\theta_m}$.

Hence, we can set $\bar{x}_m = 1$ in equation (B.50) and obtain that the optimal export taxes are given by

$$x_{mj} = \left(1 + \frac{1}{\theta_{mj}}\right) \frac{\theta_{mj} E x_{mj}}{\theta_{mj} E x_{mj} - \bar{\vartheta}_{m,j} \Pi^{mne}_{m,j}} \qquad \forall j \neq m. \tag{B.52}$$

6. Import Taxes under Imperfect Competition with no Foreign MP. The optimal import taxes in this case are characterized by equations (B.36) and (B.37) with $\Pi^{mne}_{-m} = 0$:

$$\frac{\left(\frac{\partial \log \bar{\lambda}_{mm}}{\partial \log \bar{w}_m} + \bar{\lambda}_{mm} + \bar{\phi}_m + \frac{E x_m \bar{\theta}_m - \Pi^{mne}_m \bar{\vartheta}_m}{I m_m}\right)\left(\frac{\bar{\Lambda}_{jm}}{1-\bar{\Lambda}_{mm}} + \bar{\rho}^m_j\right)}{\bar{\phi}_m + \frac{\mu \bar{w}_m \bar{L}_m}{\bar{\Lambda}_{mm} \bar{Y}_m} + \frac{E x_m}{\bar{\Lambda}_{mm} \bar{Y}_m} \bar{\theta}_m + \frac{E x_m \bar{\theta}_m - \Pi^{mne}_m \bar{\vartheta}_m}{I m_m}} = \frac{\bar{\Lambda}_{jm}}{1 - \bar{\Lambda}_{mm}} + \bar{\rho}^m_j - \frac{\partial \log \bar{\lambda}_{mm}}{\partial \log t_{jm}} - \bar{\lambda}_{jm}.$$

Taking this equation for i and j with $i \neq j$, we obtain equation (B.42). It follows that the solution to this system requires homogeneous tariffs across countries.

Under homogeneous tariffs, the first-order condition simplifies to:

$$\frac{\left(1 + \bar{\phi}_m\right) \bar{\lambda}_{mm} \bar{\Lambda}_{mm} + \bar{\Lambda}_{mm} \frac{E x_m \bar{\theta}_m - \Pi^{mne}_m \bar{\vartheta}_m}{I m_m}}{\bar{\phi}_m \bar{\Lambda}_{mm} + \frac{\mu \bar{w}_m \bar{L}_m}{\bar{Y}_m} + \frac{E x_m \bar{\theta}_m}{\bar{Y}_m} + \bar{\Lambda}_{mm} \frac{E x_m \bar{\theta}_m - \Pi^{mne}_m \bar{\vartheta}_m}{I m_m}} = \bar{\lambda}_{mm}.$$

Using $\mu \frac{\bar{w}_m \bar{L}_m}{\bar{Y}_m} - 1 = \frac{E x_m - I m_m}{\bar{Y}_m}$, and the fact that with no foreign MP $I m_m - E x_m = \Pi^{MNE}_m$ we can solve for t_{jm}:

$$t_{jm} = \left(1 + \frac{1}{\bar{\theta}_m}\right) \frac{\bar{\theta}_m E x_m}{\bar{\theta}_m E x_m - \bar{\vartheta}_m \Pi^{mne}_m}, \qquad \forall j \neq m. \tag{B.53}$$

Note that with $N = 2$, equation (B.53) reduces to $t_{jm} = \left(1 + \frac{1}{\theta_{mj}}\right) \frac{\theta_{mj} E x_{mj}}{\theta_{mj} E x_{mj} - \bar{\vartheta}_{m,j} \Pi^{mne}_{m,j}}$, which coincides with the optimal export tax derived in equation (B.52). In this knife-edge case where Lerner Symmetry holds despite having trade imbalances, the import tariff becomes a perfect substitute for the missing export tax.

7. Import and Export Taxes under Imperfect Competition. We now consider optimal import and export taxes under imperfect competition and foreign firms producing outside their headquarters country. In this case, Lerner Symmetry no longer holds (see, for example, Blanchard, 2009; Costinot and Werning, 2019). The optimal import and export taxes in this case involve infinite export taxes in combination with import subsidies as in Itskhoki and Mukhin (2025). Even though the framework we consider here differs from theirs in that real trade imbalances in our model are endogenous and determined by MNEs' production decisions, this is not enough to break their result.

We show that by limiting the space of feasible import tariffs for the domestic planner to $t_{jm} \geq \underline{t}_m > 0$, we recover finite values for trade taxes. We now state the following Lemma 1 for a two-country model.

Lemma 1. *In a two-country economy, where the Home government chooses import and export taxes subject to the constraint $t_{jm} \geq \underline{t}_m > 0$, its optimal combination of trade taxes is given by:*

$$t_{jm} = \underline{t}_m, \qquad x_{mj} = \left(1 + \frac{1}{\theta_{mj}}\right) \frac{\theta_{mj} E x_{mj}}{\theta_{mj} E x_{mj} - \bar{\vartheta}_{m,j} \Pi^{mne}_{m,j}} \chi_m \qquad \forall j \neq m,$$

where χ_m is an endogenous object that depends on the value of $\underline{t}_m$. Furthermore, welfare decreases with the value of $\underline{t}_m$. Hence, in the limit for $\underline{t}_m \to 0$, the planner sets infinitely large import subsidies $t_{jm} \to 0$.

To prove Lemma 1 we start by computing the optimal export tax at an interior solution. The solution is

described by equations (B.36) and (B.38). Taking the ratio of this first-order condition for countries i and j with $i \neq j$, and solving for the optimal tax, we obtain:

$$x_{mj} = \left(1 + \frac{1}{\theta_{mj}}\right) \frac{\theta_{mj} E x_{mj}}{\theta_{mj} E x_{mj} - \bar{\vartheta}_{m,j} \Pi^{mne}_{m,j}} \chi_m$$

with χ_m an endogenous object that depends on the value of $\underline{t}_m$.

We show next that given the optimal export tax, welfare decreases in the value of the import tariff $\frac{\partial \log U_m}{\partial \log t_{jm}} < 0$, and therefore it is optimal for the planner to set $t_{jm} = \underline{t}_m$. Since the constraint binds, welfare is non-increasing in $\underline{t}_m$.

We start by using equations (B.36), (B.37), and (B.38) to compute $\frac{\partial \log U_m}{\partial \log t_{jm}}$. We obtain:

$$\frac{\partial \log U_m}{\partial \log t_{jm}} = \frac{\frac{\bar{\Lambda}_{jm}}{1-\bar{\Lambda}_{mm}} + \bar{\rho}^m_j}{\frac{\chi_m}{Im_m + \Pi^{mne}_{-m}} + 1} - \frac{\partial \log \bar{\lambda}_{mm}}{\partial \log t_{jm}} - \bar{\lambda}_{jm} - \frac{\Pi^{mne}_{-m}}{Im_m + \Pi^{mne}_{-m}} \frac{\bar{\Lambda}_{mm}\left(\frac{\bar{\Lambda}_{jm}}{1-\bar{\Lambda}_{mm}} + \bar{\rho}^m_j\right) + \bar{\varrho}^m_j}{\frac{\chi_m}{Im_m + \Pi^{mne}_{-m}} + 1}, \tag{B.54}$$

where $\bar{\Lambda}_{mm}\left(\frac{\bar{\Lambda}_{jm}}{1-\bar{\Lambda}_{mm}} + \bar{\rho}^m_j\right) + \bar{\varrho}^m_j > 1$. Consider now equation (B.54) at $\Pi^{mne}_{-m} = 0$. In this case, we know from case 4. that the optimal tariff is a uniform import tax equal to $t_{jm} = \frac{1}{\bar{x}_m}$, with $\bar{x}_m$ an arbitrary constant. Because $\bar{x}_m$ is arbitrary, we can choose it such that $t_{jm} = \underline{t}_m$. In this case, equation (B.54) reduces to

$$0 = \left.\frac{\partial \log U_m}{\partial \log t_{jm}}\right|_{\Pi^{mne}_{-m}=0} = \frac{1}{\frac{\chi_m}{Im_m + \Pi^{mne}_{-m}} + 1}\left(\frac{\bar{\Lambda}_{jm}}{1-\bar{\Lambda}_{mm}} + \bar{\rho}^m_j\right) - \left(\frac{\partial \log \bar{\lambda}_{mm}}{\partial \log t_{jm}} + \bar{\lambda}_{jm}\right).$$

Therefore, for positive (but small) values of Π^{mne}_{-m}, it follows from equation (B.54) that $\frac{\partial \log U_m}{\partial \log t_{jm}} < 0$. The planner would like to reduce tariffs even further, which makes the constraint for t_{jm} binding. This concludes the proof.

Two points are worth mentioning regarding Lemma 1. First, while we characterized what happens with import tariffs as we loosen the constraint, the lemma remains silent on the associated export tax.[4] However, we explored numerically the effects of loosening the constraint on the optimal export tax. We found that the associated optimal export policy rises, as we decrease the value of $\underline{t}_m$, and approaches infinity as in Itskhoki and Mukhin (2025).

Second, Lemma 1 focuses on the two-country case. We have confirmed numerically that the previous results extend to an environment with multiple countries. The domestic planner sets uniform import taxes equal to $t_{jm} = \underline{t}_m$, and export taxes according to Lemma 1.

8. Export Taxes under Imperfect Competition. We restrict the domestic planner to use only export taxes. The optimal export taxes are characterized by equations (B.36) and (B.38). Using these first-order conditions for country i and j with $i \neq j$, we obtain:

$$\frac{E x_{mi}/x_{mi}}{E x_{mi}\theta_{mi} - \Pi^{mne}_{m,i}\bar{\vartheta}_{m,i}}(\theta_{mi} + 1) = \frac{E x_{mj}/x_{mj}}{E x_{mj}\theta_{mj} - \Pi^{mne}_{m,j}\bar{\vartheta}_{m,j}}(\theta_{mj} + 1).$$

Hence, optimal export taxes are given by

$$x_{mj} = \left(1 + \frac{1}{\theta_{mj}}\right) \frac{\theta_{mj} E x_{mj}}{\theta_{mj} E x_{mj} - \Pi^{mne}_{m,j}\bar{\vartheta}_{m,j}} \chi_m, \tag{B.55}$$

[4] We have not characterized the value of χ_m nor how it depends on $\underline{t}_m$.

with χ_m an endogenous object that affects all export taxes equally. The value of χ_m can be computed by combining equations (B.36) and (B.38) with equation (B.55).

The optimal export taxes in equation (B.55) match those derived under imperfect competition without foreign MP, up to the term χ_m. With import tariffs constrained to $t_{jm} = 1$, Lerner symmetry fails: export taxes become second-best instruments, and χ_m adjusts them downward to compensate for the missing import subsidies discussed in case 7.

9. Homogeneous Import Taxes under Imperfect Competition. We finally consider optimal import tariffs in an environment with imperfect competition and foreign firms producing outside their headquarters. In all cases considered so far, optimal import tariffs were homogeneous across countries. This result breaks in this environment when export instruments are not available to the domestic planner. The lack of homogeneity reflects the planner's need to compensate for the lack of export taxes when Lerner Symmetry fails.

To maintain comparability with the formulas provided in the previous scenarios, we restrict the planner to choosing homogeneous tariffs. The first-order conditions under this restriction can be derived from equations (B.36) and (B.37), imposing $d\log t_{jm} = d\log t_{im}$, which yields:

$$\frac{\left(1+\bar{\phi}_m\right) + \frac{1}{\bar{\lambda}_{mm}}\frac{1}{t_m}\frac{Ex_m}{Im_m}\left(1+\bar{\theta}_m\right)}{1+\bar{\phi}_m + \frac{1-\bar{\Lambda}_{mm}}{\bar{\Lambda}_{mm}}\frac{Ex_m}{Im_m}\left(1+\bar{\theta}_m\right) + \frac{Ex_m\bar{\theta}_m - \Pi_m^{mne}\bar{\vartheta}_m - \Pi_{-m}^{mne}\left(\bar{\varphi}_m + \bar{\Lambda}_{mm}\bar{\phi}_m\right)}{Im_m + \Pi_{-m}^{mne}}} = \frac{1}{1 - \frac{\Pi_{-m}^{mne}}{Im_m + \Pi_{-m}^{mne}}\left(\bar{\Lambda}_{mm} + \frac{\sum_{j\neq m}\bar{\varrho}_j^m}{1+\bar{\phi}_m}\right)}.$$

Using $\bar{\varphi}_m - \bar{\Lambda}_{mm} - \sum_{j\neq m}\bar{\varrho}_j^m = -1$, we can express the optimal import tariff as:

$$t_m = \left(1 + \frac{1}{\bar{\theta}_m}\right)\frac{Ex_m\bar{\theta}_m}{Ex_m\bar{\theta}_m - \bar{\vartheta}_m\Pi_m^{mne}}\Upsilon_m, \tag{B.56}$$

where

$$\Upsilon_m \equiv \frac{Ex_m\bar{\theta}_m - \Pi_m^{mne}\bar{\vartheta}_m}{Ex_m\bar{\theta}_m - \Pi_m^{mne}\bar{\vartheta}_m + \Pi_{-m}^{mne}}\left(1 + \frac{\Pi_{-m}^{mne}}{Im_m}\left(1 - \frac{\bar{\Lambda}_{mm}}{\bar{\lambda}_{mm}} - \frac{\sum_{j\neq m}\bar{\varrho}_j^m}{\bar{\lambda}_{mm}\left(1+\bar{\phi}_m\right)}\right)\right). \tag{B.57}$$

Note that $\Upsilon_m = 1$ whenever $\Pi_{-m}^{mne} = 0$.

To conclude the proof we need to show that $\Upsilon_m \leq 1$. It suffices to show that the term within brackets is less than one, or equivalently that $\bar{\Lambda}_{mm} - \bar{\lambda}_{mm} + \frac{\sum_{j\neq m}\bar{\varrho}_j^m}{1+\bar{\phi}_m} \geq 0$. In our small open economy,

$$\bar{\Lambda}_{mm} - \bar{\lambda}_{mm} + \frac{\sum_{j\neq m}\bar{\varrho}_j^m}{1+\bar{\phi}_m} = 1 - \bar{\lambda}_{mm} + (\varepsilon - \sigma)\frac{\sum_{r=1}^N \frac{\bar{\lambda}_{r,mm}\times\bar{\lambda}_{r,m}}{\bar{\lambda}_{mm}}\bar{\lambda}_{r,mm} - \sum_{i\neq m}\frac{\bar{\Lambda}_{i,mm}}{\sum_{r\neq m}\bar{\Lambda}_{r,mm}}\bar{\lambda}_{i,mm}}{1+\bar{\phi}_m},$$

with

$$1 + \bar{\phi}_m = \varepsilon + (\varepsilon - \sigma)\left(\frac{\bar{\lambda}_{mm}}{1-\bar{\lambda}_{mm}} - \sum_{j=1}^N \frac{\bar{\lambda}_{j,mm}\bar{\lambda}_{j,m}\bar{\lambda}_{j,mm}}{\left(1-\bar{\lambda}_{mm}\right)\bar{\lambda}_{mm}}\right) > 0$$

$$\sum_{r=1}^N \frac{\lambda_{r,mm}\times\lambda_{r,m}}{\lambda_{mm}}\lambda_{r,mm} - \sum_{i\neq m}\frac{\Lambda_{i,mm}}{\sum_{r\neq m}\Lambda_{r,mm}}\lambda_{i,mm} > 0$$

Because $\varepsilon > \sigma$ it follows that $\bar{\Lambda}_{mm} - \bar{\lambda}_{mm} + \frac{\sum_{j\neq m}\bar{\varrho}_j^m}{1+\bar{\phi}_m} \geq 0$, and therefore $\Upsilon_m \leq 1$.

B.3 An Alternative Transfer Pricing Model

In this appendix, we present an alternative way to model transfer pricing. Rather than choosing markups $\mu^u_{i,lm}(\omega)$ and $\mu^d_{i,lm}(\omega)$ subject to the constraint $\mu^u_{i,lm}(\omega)\mu^d_{i,lm}(\omega) = \mu$, the MNE directly chooses the internal (border) price $p^u_{i,lm}(\omega)$ and the consumer price $p^d_{i,lm}(\omega)$, subject to the constraint that neither price can be set below unit cost.

The MNE's profits from selling variety ω in market m are:

$$\Pi_{i,m}(\omega) = \sum_{l=1}^{N} \left[p^d_{i,lm}(\omega) - t_{lm} p^u_{i,lm}(\omega)\right] q^d_{i,lm}(\omega) + \sum_{l=1}^{N} \left[p^u_{i,lm}(\omega) - c_{i,lm}(\omega)\right] q^d_{i,lm}(\omega),$$

where household demand for variety ω produced in country l satisfies equation (6). To simplify the exposition, suppose there is a single production location, so that $Q_{i,m}(\omega) = q^d_{i,lm}(\omega)$. The MNE's problem reduces to:

$$\max_{p^d_{i,lm}(\omega),\, p^u_{i,lm}(\omega) \geq c_{i,lm}(\omega)} \left[p^d_{i,lm}(\omega) - (t_{lm} - 1) p^u_{i,lm}(\omega) - c_{i,lm}(\omega)\right] p^d_{i,lm}(\omega)^{-\sigma} B_m,$$

where $B_m \equiv (P_m)^{\sigma-1} E_m$ a demand shifter the firm takes as given.

Absent import tariffs ($t_{lm} = 1$), the internal price drops out of the problem and the MNE sets the consumer price to the standard CES markup. When $t_{lm} > 1$, the internal price enters linearly with a negative coefficient, so the firm sets it as low as possible: $p^u_{i,lm}(\omega) = c_{i,lm}(\omega)$. The consumer price then satisfies:

$$p^d_{i,lm}(\omega) = \frac{\sigma}{\sigma - 1}\, t_{lm}\, c_{i,lm}(\omega).$$

Comparison with the baseline model. In the baseline model with no transfer pricing penalties, prices satisfy $p^d_{i,lm}(\omega) = \mu t_{lm} c_{i,lm}(\omega)$ and $p^u_{i,lm}(\omega) = c_{i,lm}(\omega)$. The two frameworks coincide whenever $\mu = \sigma/(\sigma - 1)$.

Adding transfer pricing penalties. With transfer pricing penalties, the MNE's problem becomes:

$$\max_{p^d_{i,lm}(\omega),\, p^u_{i,lm}(\omega) \geq c_{i,lm}(\omega)} \left[p^d_{i,lm}(\omega) - (t_{lm} - 1) p^u_{i,lm}(\omega) - c_{i,lm}(\omega) - \frac{\kappa}{\alpha}\left(\frac{\sigma}{\sigma - 1} c_{i,lm}(\omega) - p^u_{i,lm}(\omega)\right)^{\alpha}\right] p^d_{i,lm}(\omega)^{-\sigma} B_m,$$

where penalties are assessed relative to the arm's length price $(\sigma/(\sigma-1))c_{i,lm}(\omega)$. The first-order condition for the consumer price gives:

$$p^d_{i,lm}(\omega) = \frac{\sigma}{\sigma - 1}\left[(t_{lm} - 1) p^u_{i,lm}(\omega) + c_{i,lm}(\omega) + \frac{\kappa}{\alpha}\left(\frac{\sigma}{\sigma - 1} c_{i,lm}(\omega) - p^u_{i,lm}(\omega)\right)^{\alpha}\right].$$

Consumer prices equal a markup $\sigma/(\sigma-1)$ times the effective marginal cost, which now also includes the penalty per unit sold. The first-order condition for the internal price gives:

$$\frac{\sigma}{\sigma - 1} c_{i,lm}(\omega) - p^u_{i,lm}(\omega) = \left(\frac{t_{lm} - 1}{\kappa}\right)^{\frac{1}{\alpha - 1}}.$$

For low tariffs ($t_{lm} \approx 1$), the internal price approaches the arm's length price $(\sigma/(\sigma-1))c_{i,lm}(\omega)$. Since consumer prices are then a markup over this internal price, the framework generates double marginalization: both the subsidiary and the distributor apply a markup over unit cost, raising consumer prices above those in the baseline model.

C Quantitative Appendix

C.1 Additional Details on Data Construction

The AMNE database consists of 76 countries, which we group into eight regions based on a geographic criterion: Europe; Canada; Mexico; United States; South America; Asia excluding China; China; and Rest of World. South America comprises Argentina, Brazil, Chile, Colombia, and Peru. Asia excluding China includes the remaining South, East, and Southeast Asian economies in the sample, including Japan and Korea. Rest of World contains the remaining countries in the sample, including Australia, New Zealand, Russia, Turkey, countries in the Middle East and Africa, Costa Rica, and Kazakhstan.

We focus our analysis on the manufacturing sector and construct, for these regions, a matrix of bilateral trade flows, measuring the total expenditure in country m on goods produced in country l, as well as a matrix of bilateral output, measuring the amount of output produced in country l that is accounted for by firms with headquarters in country i. Additionally, we construct, for each region, separate measures of domestic output produced by non-MNEs and by MNEs. To do this we use the following datasets.

OECD AMNE Database The OECD AMNE Database is used directly to construct matrices of bilateral trade shares, bilateral output shares, and separate measures of domestic output produced by non-MNEs and by MNEs for each region. Data are available from 2000 to 2020, and we calibrate our model to 2016.

The AMNE database provides transformed OECD Inter-Country Input-Output (ICIO) tables splitting entries according to domestic and foreign ownership. We use this dataset to construct total expenditure by country, as well as the share of expenditure in country m on goods produced in country l. Since our model does not feature intermediate inputs, we sum exports of intermediate inputs to exports of final goods to construct trade flows from country l to country m.

This database also provides a Matrix of Bilateral Output, which reports gross output produced in each country, differentiating by country of ownership. We use this dataset directly to compute the share of output in country l produced by firms headquartered in country i.

It also includes the AMNE Domestic MNEs database which contains information on output, value-added, exports, and imports of domestic-owned firms split into domestic MNEs and non-MNEs. We use this dataset to compute the share of domestic output produced by MNEs and non-MNEs, as well as the share of a region's exports accounted for by MNEs.

ORBIS Historical Data We use Orbis Historical Data to construct the measure of global and local firms in each region. This requires several steps.

We start with the *Firm Description* data, which provides each firm's identifier (BVDID) and merge this dataset with the *Links* files in the *Ownership* data. We restrict the sample to global ultimate owners at the 50% stake (GUO 50). When the GUO 50 and GUO 50 C nationalities differ, we keep only the former.

We define a firm as independent if its owner corresponds to one of the following categories: *Individuals and Families*, *Public authorities/State*, *Employees/Managers/Directors* or if it has no shareholder with more than 50% of ownership stake.[5] We then restrict the sample to independent firms and to the links between a subsidiary and their global ultimate owner (GUO 50).[6]

[5]We therefore use a loose definition of independence, which includes both firms with no shareholders with more than 25% and firms with a B independence indicator, i.e. no shareholder above 50%.

[6]An implication of this choice is that if there is a chain of linkages, e.g., a domestic affiliate is owned by a domestic

Mapping the data into the model requires three adjustments. First, when one shareholder holds multiple subsidiaries in the same country, we collapse them into a single establishment. Second, since the model assumes each global firm operates an affiliate in every production location, which is counterfactual in the data, we set the cumulative number of affiliates in country l owned by country i equal to the median number of affiliates held by global firms headquartered in i. Finally, a firm is *local* if it does not own subsidiaries or it owns only domestic ones, and a firms is *global* if it owns at least one subsidiary abroad.

Summary Statistics across Regions. Table C.1 provides summary statistics for each of the eight regions for the data described above.

Table C.1: Summary Statistics by Region

Country Group	Labor Endowment Relative to US	Expenditure Relative to US	NX/ Exp	Trade/ Exp	Domestic Output Share	Domestic MNE Output Share	MNE Export Share	MNE Import Share
Europe	1.57	1.32	3.861	24.912	87.487	45.571	75.467	71.488
Canada	0.12	0.10	-8.063	68.232	57.234	31.625	73.645	75.006
Mexico	0.21	0.10	-2.854	71.866	70.642	43.662	76.962	74.023
United States	1.00	1.00	-9.252	32.333	75.335	49.429	75.782	74.382
South America	0.57	0.25	-1.854	22.772	79.724	31.359	53.521	57.665
Asia excluding China	2.83	1.35	4.852	27.443	92.365	43.320	68.761	59.244
China	2.53	2.19	4.650	15.585	91.915	24.670	36.537	36.405
Rest of World	1.88	0.98	-11.354	29.430	87.109	31.234	55.821	54.950

Source: OECD AMNE Database, ORBIS, Penn World Table 10.01, OECD Inter-Country Input-Output Tables. Authors' calculations. Table reports summary statistics by regions. Labor endowment and total expenditure are expressed relative to the United States level. Domestic output share is the share of output produced by domestic firms, computed as the diagonal of the bilateral output share matrix. The Domestic MNE Output Share is the share of domestic output produced by domestic multinational firms, out of total output produced by domestic firms. MNE Export and Import shares compute the share of exports and imports accounted for by domestic and foreign MNEs, respectively. NX/Exp and Trade/Exp denote net exports and total trade (exports plus imports) divided by total expenditure.

C.2 Restricted gravity equations to pin down σ and ε

In this section, we provide details for our multi-sector extension and derive the extended gravity equations (27) and (28) presented in Section 5.1. These equations are useful because they show how can variations across goods and time can be use to recover estimates of σ and ε that can the be applied directly to our model.

C.2.1 A Multi-sector Extension

Relative to Section 3 the model now features N countries and K sectors. Letters i, l, and m denote countries, while k and s denote sectors. Goods are identified by their variety $\omega \in \Omega_i^k$, the country of origin $i \in \mathcal{N}$, the location of production $l \in \mathcal{N}$, and the sector $k \in \mathcal{K}$.

Households. In each country, a representative household supplies labor inelastically and consumes goods produced by both local and global firms from all countries. Labor is freely mobile across sectors within a

owner which is owned by a foreign global ultimate owner, we are treating both firms as being owned by the foreign owners. We then follow two alternative approaches: in the baseline approach, we treat these two firms as a single foreign-owned affiliate, consistently with the interpretation that the model does not feature multi-establishment firms. In the second, we maintain both firms in the sample and effectively count them as owned by two different foreign owners.

country, implying a single wage in country m, denoted by w_m. The representative household in country m has preferences given by

$$U_m = \prod_{k=1}^{K} \left(Q_m^k\right)^{e^k},$$

where Q_m^k denotes consumption of the sector-k composite good in country m, and $e^k \in (0,1)$ is the expenditure share on sector-k goods. The sectoral composite good Q_m^k is a nested CES aggregate over sector-k varieties ω with origin in country i, produced at location l. This nested CES aggregate is given by equations (4) and (5) in the main text.

This preference structure implies the following demand system for each variety:

$$p_{i,lm}^{k,d}(\omega)\, q_{i,lm}^{k,d}(\omega) = \left(\frac{p_{i,lm}^{k,d}(\omega)}{P_{i,m}^k(\omega)}\right)^{1-\varepsilon} \left(\frac{P_{i,m}^k(\omega)}{P_m^k}\right)^{1-\sigma} e^k E_m, \tag{C.1}$$

where E_m denotes household income, and P_m^k and $P_{i,m}^k(\omega)$ are country m's price indexes in sector k dual to equations (4) and (5).

Global and Local Firms. Local and global firms in the multi-sector model operate the same technologies as in the single-sector economy, but now the country component in productivity, and the bilateral trade- and mp-frictions are assumed to be also sector specific. Absent transfer pricing posibilities for global firm, border prices then are given by $\mu \frac{\tau_{im}^k \gamma_{i,l}^k}{A_i^k z(\omega)} w_l$. Becoming a global firm is still an endogenous choice which requires fixed cost of f_i^k units of labor from the headquarters country.

Equilibrium. An equilibrium, given import tariffs, consists of an allocation, prices, measures of *global* firms, and productivity thresholds that satisfy the following conditions: (i) households maximize utility subject to their budget constraint, i.e., equations (C.1) holds; (ii) firms set prices equal to $\mu \frac{\tau_{im}^k \gamma_{i,l}^k}{A_i^k z(\omega)} w_l$, (iii) firms select into global and local firms; (iv) the government collects tariff revenue and rebates them lump-sum to the household; and (v) markets clear.

C.2.2 Deriving the Restricted Gravity Equations

Our starting point is the household's demand, equation (C.1), along with the prices for each location-specific variety $\mu \frac{\tau_{im}^k \gamma_{i,l}^k}{A_i^k z(\omega)} w_l$. For a local firm, there is only one location-specific variety, the one produced in the hearquarters country. Hence:

$$P_{i,m}^k(\omega) = p_{i,im}^{k,d}(\omega) = t_{im} \mu \frac{\tau_{im}^k}{A_i^k z(\omega)} w_i.$$

Using this into equation (C.1) allow us to derive the pre-tariff value of country m's imports from a local firm producing sector k's variety ω in country i with productivity z, $X_{i,im}^k(\omega)$:

$$X_{i,im}^k(\omega) = \frac{1}{t_{im}^k} \left(t_{im}^k \mu \frac{\tau_{im}^k}{A_i^k z(\omega)} w_i\right)^{1-\sigma} \left(P_m^k\right)^{\sigma-1} e^k E_m. \tag{C.2}$$

We take logs on both side of this equation, and augment its notation adding a time subscript t to capture changes in equilibrium variables to either changes in bilateral tariff and/or firm's idiosyncratic productivity, we obtain:

$$\Delta \log X_{i,im}^k(\omega) = -\sigma \Delta \log t_{im}^k + \xi_{it}^L + \xi_{mt}^{k,L} + u_{it}^{k,L}(\omega), \tag{C.3}$$

for a variety ω produced by a continuing local firm. In equation (C.3), the country-time fixed effect $\xi_{it}^{L} \equiv (1-\sigma)\Delta \log w_{it}$ capture changes in wages in the production location, the sector-time fixed effects $\xi_{mt}^{k,L} \equiv (\sigma-1)\log P_{mt}^{k} + \log e_{t}^{k} + \log E_{mt}$ controls for changes in the price index and aggregate expenditure in country m, and the error term $u_{it}^{k,L}(\omega) \equiv (\sigma-1)\Delta \log(A_{it}^{k} z(\omega))$ reflect productivity shocks which are assumed to be uncorrelated with tariff changes.[7] The upperscript L on the right-hand side of this equation reflect that these variables are specific to local firms. Since in the data we only focus on transactions to the US, the dependence of these objects on the destination market m can be ignore, which yield equation (27) in the main text.

Analogously, we can compute the pre-tariff value of m's imports from a global firm headquartered in i, producing in location l a sector k good by combining the demand equation with the price set by the firm, we obtain:

$$X_{i,lm}^{k}(\omega) = \frac{1}{t_{lm}^{k}} \left(t_{lm}^{k} \mu \tau_{im}^{k} \gamma_{i,l}^{k} w_{l}\right)^{1-\varepsilon} \left(A_{i}^{k} z(\omega)\right)^{\sigma-1} \left(\bar{P}_{i,m}^{k}\right)^{\varepsilon-\sigma} \left(P_{m}^{k}\right)^{\sigma-1} e^{k} E_{m}, \tag{C.4}$$

where $\bar{P}_{i,m}^{k}$ is the part of sector-k variety-ω price index in country m that does not depend on variety ω:

$$\bar{P}_{i,m}^{k} \equiv \left[\sum_{l=1}^{N} \left(t_{lm}^{k} \mu \tau_{lm}^{k} \gamma_{i,l}^{k} w_{l}\right)^{1-\varepsilon}\right]^{\frac{1}{1-\varepsilon}}.$$

As before, we take logs on both side of this equation, and augment its notation adding a time subscript t to capture changes in equilibrium variables to either changes in bilateral tariff and/or firm's idiosyncratic productivity, we obtain:

$$\Delta \log X_{i,lm}^{k}(\omega) = -\varepsilon \Delta \log t_{lm}^{k} + \xi_{lt}^{G} + \xi_{imt}^{k,G} + u_{it}^{k,G}(\omega), \tag{C.5}$$

for a variety ω produced by a continuing global firm. In equation (C.5), the country-time fixed effect $\xi_{lt}^{G} \equiv (1-\varepsilon)\Delta \log w_{lt}$ capture changes in wages in the production location, the sector-time fixed effects $\xi_{mt}^{k,G} \equiv (\sigma-1)\log P_{mt}^{k} + \log e_{t}^{k} + \log E_{mt}$ controls for changes in the price index and aggregate expenditure in country m, the headquarter-sector-time fixed effect $\xi_{mt}^{k,G} \equiv (\varepsilon-\sigma)\log \bar{P}_{i,mt}^{k}$ controls for the price index of bundled final good for variety ω, and the error term $u_{it}^{k,G}(\omega) \equiv (\sigma-1)\Delta \log(A_{it}^{k} z(\omega))$ reflect productivity shocks which are assumed to be uncorrelated with tariff changes.[8] The upperscript G on the right-hand side of this equation reflect that these variables are specific to global firms. Since in the data we only focus on transactions to the US, the dependence of these objects on the destination market m can be ignore, which yield equation (28) in the main text.

C.2.3 Simulation-based Validation

Panel B of Table 2 reports estimates from equation (2), run separately for continuing non-MNE and MNE relationships, whose model counterparts are equations (27) and (28). The empirical specification departs from these model equations in two ways. First, in equation (2) we add a relationship fixed effect η_{fxlg} to control for differential trends across exporter-importer-product relationships. Second, in equation (2) we omit the headquarter-sector-time fixed effect $\xi_{it}^{k,G}$ from the MNE regression, since headquarter origins are not directly observed. In this appendix section, we show that omitting this fixed effect does not prevent recovery of ε.

[7] Bilateral trade-frictions are parameterized as functions of distance, border and language effects, and therefore, these are time invariant.

[8] Bilateral mp-frictions are parameterized as functions of distance, border and language effects, and therefore, these are time invariant.

We validate the recovery of the gravity elasticities by estimating equations (C.3) and (C.5) on model simulated firm-level data. To do so, we start from our calibrated parameters and generate 199 counterfactual tariff vectors by drawing random gross import tariff applied by the US to each foreign region in the model across the different sectors. Tariffs are drawn from a uniform distribution on $[1, 1.2]$, and are independent across both production countries and sectors. For each tariff draw, we solve for the corresponding equilibrium before and after the tariff shock. We save for each origin 100 productivities values from the distributions of firms that remain local/global in every counterfactual, and construct each firm's change in export values.

Table **??** reports the coefficient on the tariff change when we run the regression in equations (C.3) and (C.5) separately for local and global firms in the simulated data. In all cases, the coefficient on the tariff change recovers σ for local firms and ε for global firms.

C.3 Constructing the Differential Response for RP and AL Prices in the Model

As part of the targeted moments in the calibration we target the differential response between related-party prices and arm's length prices estimated in Fact 3 in Section 2. This appendix section describes the construction of the model's analogue. From now on, we drop in our notation the dependence on the variety ω and index variables by firm productivity level z.

In our model in Section 3, internal or related-party prices are given by $p^u_{i,lm}(z)$, the price at which the production-subsidiary with headquarteres country in i sells at the distribution-subsidiary located in country m. Multinational firms conduct all their trade intra-firm. However, we construct their arm's length price as $\mu c_{i,lm}(z)$, the price the as the price a local firm with the same marginal cost would charge production subsidiary would set if it adhere to the arm's legnth principle. Therefore, the ratio between the internal and the arm's length price can be computed using equation (16), and it equals

$$\frac{p^u_{i,lm}(z)}{\mu c_{i,lm}(z)} = \frac{\mu^u_{i,lm}(z)}{\mu} = \max\left\{1 - \frac{1}{\mu c_{i,lm}(z)}\left(\frac{t_{lm}-1}{\delta\kappa}\right)^{\frac{1}{\alpha-1}}, \frac{1}{\mu}\right\}. \tag{C.6}$$

We let $\bar{z}_{i,lm}$ denote the productivity level for firms with headquarters country in i, producing in country l, selling to market m such that if $z \geq \bar{z}_{i,lm}$, the markup set by the production-subsidiary equals $\mu^u_{i,lm}(z) = 1$. Taking logs to equation (C.6) and taking the derivative with respect to log-tariff, we obtain the differential price response for a firm with productivity z headquartered in country i producing in country $l \neq m$:

$$\frac{\partial \log\left(p^u_{i,lm}(z)/\mu c_{i,lm}(z)\right)}{\partial \log t_{lm}} = \begin{cases} -\frac{1}{\alpha-1}\left(\frac{\mu}{\mu^u_{i,lm}(z)} - 1\right)\frac{t_{lm}}{t_{lm}-1} & \text{if } z \in [\tilde{z}_i, \bar{z}_{i,lm}] \\ 0 & \text{o.w.} \end{cases}, \tag{C.7}$$

where $\tilde{z}_i$ is the productivity threshold above which firms headquartered in country i select into global firms.

The differential price response estimated in Fact 3 in Section 2 constitutes the average response of continuing MNEs that export to the US. Therefore, the model counterpart to this model aggregates equation (C.7) across all firms with heaquarters country in i, producing in country $l \neq m$, selling to country $m =$ US. For a given (i, l, m) triple, we have:

$$\mathbb{E}\left[\frac{\partial \log\left(p^u_{i,lm}(z)/\mu c_{i,lm}(z)\right)}{\partial \log t_{lm}}, \middle| z \geq \tilde{z}_i\right] = -\frac{1}{\alpha-1}\int_{\tilde{z}i}^{\bar{z}_{i,lm}}\left(\frac{\mu}{\mu^u_{i,lm}(z)} - 1\right)\frac{t_{lm}}{t_{lm}-1}\frac{d\Phi(z)}{1-\Phi(\tilde{z}_i)},$$

where we use that the response is zero for $z \geq \bar{z}_{i,lm}$. Since Fact 3 pools all RP transactions to country m we also need to aggregate across origin-production pairs, weighted by the mass of active global firms on each route. We construct the moment for the average price response of the related party price compared to arm's length price as:

$$\beta_{\text{model}} = \sum_{i=1}^{N} \sum_{l \neq m} \frac{[1 - \Phi(\tilde{z}_i)] M_i}{\sum_{i=1}^{N} \sum_{l \neq m} [1 - \Phi(\tilde{z}_i)] M_i} \mathbb{E} \left[\frac{\partial \log \left(p^u_{i,lm}(z) / \mu c_{i,lm}(z) \right)}{\partial \log t_{lm}}, \middle| z \geq \tilde{z}_i \right], \tag{C.8}$$

where M_i is the mass of potential firms headquartered in i.

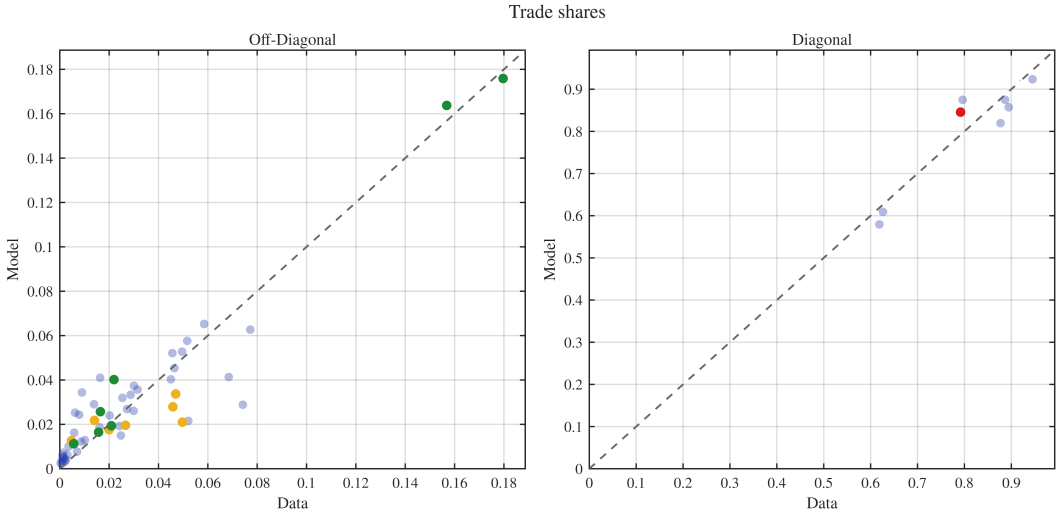
D Additional Quantitative Results

Table D.1: Additional Calibrated Parameters

	Without strategic transfer pricing		With strategic transfer pricing	
	Global Firms	Local & Global Firms	Global Firms	Local & Global Firms
Estimated Origin Productivity, A_i^{orig}				
Europe	1.308	1.292	1.310	1.293
Canada	1.213	1.372	1.210	1.373
Mexico	1.055	1.166	1.050	1.166
United States	1.042	1.260	1.035	1.262
S. America	0.912	1.014	0.911	1.015
Asia excluding China	1.020	1.004	1.026	1.005
China	0.978	0.999	0.981	0.999
Rest of the World	1.000	1.000	1.000	1.000
Estimated Production-Location Productivity, A_l^{loc}				
Europe	1.331	1.315	1.329	1.315
Canada	1.670	1.486	1.678	1.484
Mexico	1.182	1.060	1.200	1.061
United States	2.277	1.798	2.289	1.795
S. America	1.072	0.957	1.069	0.956
Asia excluding China	0.852	0.857	0.846	0.856
China	1.840	1.801	1.833	1.799
Rest of the World	1.000	1.000	1.000	1.000
Estimated Fixed Costs, f_i				
Europe		10.203		10.216
Canada		10.203		10.216
Mexico		10.203		10.216
United States		10.203		10.216
S. America		10.203		10.216
Asia excluding China		10.203		10.216
China		10.203		10.216
Rest of the World		10.203		10.216

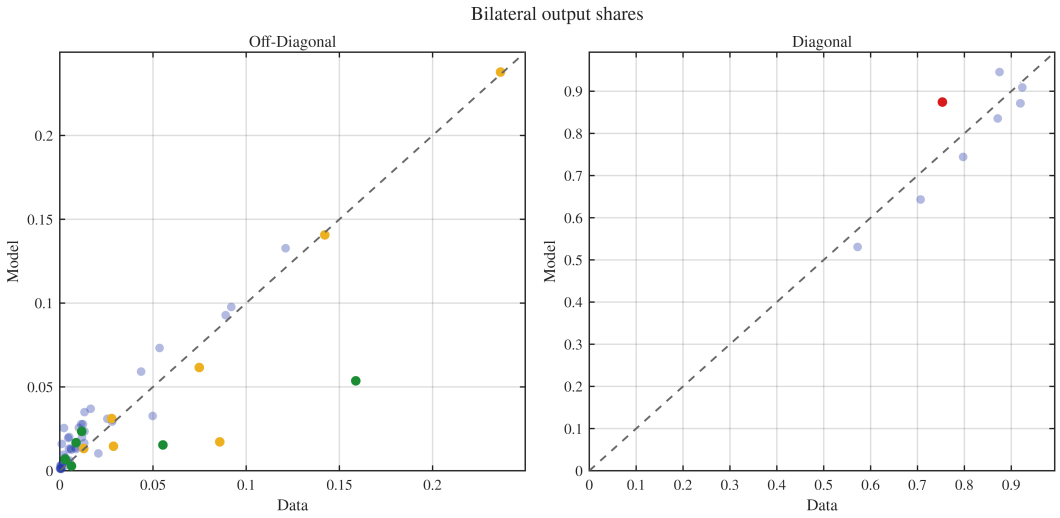
Notes: This table reports the remaining parameters from the high-elasticity calibration corresponding to Table 4. The productivity shifters A_i are normalized relative to the Rest of World. The fixed costs f_i apply only to specifications with local and global firms.

Figure D.1: Correlation between Model-simulated Moments and Empirical Moments: Trade Shares



Notes: Each dot corresponds to a bilateral trade share in the data (x-axis) and in the model (y-axis). Off-diagonal elements (left panel) are plotted in level, while diagonal elements (right panel) are shown in levels. In the left panel, yellow dots correspond to trade shares where the U.S. are the importing country, while green dots correspond to trade shares where the U.S. are the exporting country. In the right panel, the red dot is the U.S. own trade share.

Figure D.2: Correlation between Model-simulated Moments and Empirical Moments: Bilateral Output Shares



Notes: Each dot corresponds to a bilateral output share (i.e., the share of country l's output produced by firms headquartered in i, in sector k), in the data and in the model. Off-diagonal elements (left panel) are plotted in level, while diagonal elements (right panel) are shown in levels. In the left panel, yellow dots correspond to output shares where the U.S. are the headquarter-origin country, while green dots correspond to trade shares where the U.S. are the host country. In the right panel, the red dot is the U.S. own output share.

Table D.2: Calibrated Parameters and Models' Fit, $\varepsilon = 4.07, \sigma = 2.65$

	Without strategic transfer pricing		With strategic transfer pricing	
	Global Firms	Local & Global Firms	Global Firms	Local & Global Firms
Panel A: Estimated parameters				
Transfer pricing				
Curvature parameter α			2.173	1.413
Scale parameter $\delta \times \kappa$			0.279	0.279
Trade costs, eq. (29)				
Constant	3.664	4.200	3.333	4.176
Distance	0.261	0.241	0.253	0.238
Common border	0.534	0.506	0.578	0.508
Common language	0.955	1.014	0.976	1.014
Average τ	6.726	7.101	6.377	7.051
MP frictions, eq. (30)				
Constant	3.296	1.083	3.173	1.085
Distance	0.623	0.199	0.686	0.200
Common border	0.463	0.570	0.438	0.567
Common language	0.873	0.375	0.924	0.367
Average γ	9.372	3.480	9.840	3.480
Panel B: Model fit (RMSE)				
Targeted moments				
Bilateral trade shares	0.0130	0.0124	0.0131	0.0124
Bilateral output shares	0.0205	0.0201	0.0204	0.0201
Inward foreign-owned firm share	0.8416	0.0270	0.8416	0.0270
Expenditure relative to US	0.0016	0.0019	0.0017	0.0019
Differential price response	0.3750	0.3750	0.0001	0.0000
Untargeted moments				
MNE domestic output share	0.6295	0.2128	0.6295	0.2145
MNE export share	0.3796	0.5330	0.3796	0.5414

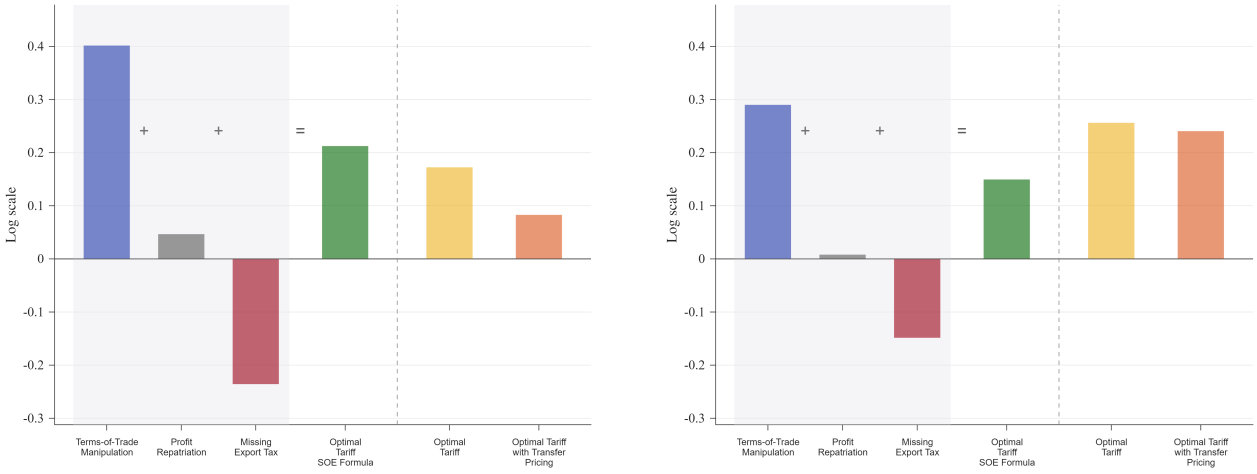
Notes: The four columns correspond to four model variants: whether strategic transfer pricing is allowed or shut down, and whether the firm population includes only global firms (*Global Firms*) or both local and global firms (*Local & Global Firms*). Panel A reports the parameters estimated. Trade costs and MP frictions follow the functional forms in equations (29) and (30). In the transfer-pricing models, α is fixed at 2 and the penalty intensity $\delta \times \kappa$ is estimated. Panel B reports the root mean squared error (RMSE) between model-generated and data moments. The differential price response, which targets 0.152, is used to calibrate $\delta \times \kappa$ in the models with strategic transfer pricing.

Table D.3: Additional Calibrated Parameters Low Elasticities

	Without strategic transfer pricing		With strategic transfer pricing	
	Global Firms	Local & Global Firms	Global Firms	Local & Global Firms
Estimated Origin Productivity, A_i^{orig}				
Europe	1.965	1.933	1.992	1.938
Canada	1.630	2.207	1.544	2.208
Mexico	1.239	1.509	1.176	1.509
United States	1.164	1.792	1.071	1.799
S. America	0.908	1.085	0.879	1.087
Asia excluding China	0.996	0.991	1.019	0.995
China	0.905	0.980	0.910	0.983
Rest of the World	1.000	1.000	1.000	1.000
Estimated Production-Location Productivity, A_l^{loc}				
Europe	1.055	0.991	1.044	0.989
Canada	1.756	1.279	1.839	1.274
Mexico	1.242	1.015	1.310	1.015
United States	2.582	1.617	2.793	1.610
S. America	1.248	1.056	1.281	1.053
Asia excluding China	0.833	0.815	0.813	0.811
China	2.109	1.993	2.097	1.986
Rest of the World	1.000	1.000	1.000	1.000
Estimated Fixed Costs, f_i				
Europe		10.396		10.379
Canada		10.396		10.379
Mexico		10.396		10.379
United States		10.396		10.379
S. America		10.396		10.379
Asia excluding China		10.396		10.379
China		10.396		10.379
Rest of the World		10.396		10.379

Notes: This table reports the remaining parameters from the high-elasticity calibration corresponding to Table 4. The productivity shifters A_i are normalized relative to the Rest of World. The fixed costs f_i apply only to specifications with local and global firms.

Figure D.3: Decomposition of Optimal Import Tariffs, $\varepsilon = 4.07, \sigma = 2.65$



(a) Model with only Global Firms

(b) Model with Local and Global Firms

Notes: The first three columns in both panels correspond to the components of the optimal tariff formula derived in Proposition 3. The first column plots the log of $1 + \frac{1}{\bar{\theta}_m}$ and captures the standard terms-of-trade manipulation motive which depends on the reciprocal of the trade elasticity. The second column computes the log of $\frac{\bar{\theta}_m Ex_m}{\bar{\theta}_m Ex_m - \bar{\vartheta}_m \Pi_m^{mne}}$ and captures the profit-shifting motive. The third column reports the log of Υ_m, which arises from the lack of export tariffs. The green column corresponds to the sum of the three components, and the yellow column reports the log of the optimal import tariff computed numerically in the quantitative model.