Multinational Production and Trade Policy*

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Abstract

Multinational enterprises (MNEs) can respond to tariffs in ways that standard optimal-tariff theory ignores. Using confidential Census data on U.S. imports, we find that in response to the 2018–2019 tariffs, MNEs reduced their import volumes from affected countries more sharply than other firms, and lowered their related-party prices by more than their arm's-length prices, suggesting transfer pricing. We develop a quantitative model with MNEs that set transfer prices on intra-firm shipments, and derive sufficient-statistic formulas for optimal tariffs. MNEs attenuate standard terms-of-trade effects through the endogenous relocation of production, generate profit-repatriation motives arising from profits earned abroad by domestic firms, break Lerner symmetry so that tariffs imperfectly substitute for missing export taxes, and erode the tariff base through transfer pricing. Taking all these channels into account, the optimal unilateral tariff for the U.S. is 8.7 percent, far below the 17.4 percent implied by the 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 from the same country to the United States, RP border prices decline more than AL border prices 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 MNEs that can produce in multiple countries, facing bilateral frictions that reduce productivity at foreign affiliates. Firms endogenously select to become a multinational, trading off potentially lower production and trade costs against a fixed cost to become an MNE. 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. Households have nested-CES preferences, with separate elasticities governing substitution across varieties from different headquarter countries and substitution across production locations within an MNE; together, these determine how trade responds to tariff changes.[1]

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. Undervaluation rises with the tariff rate, since higher tariffs make underreporting more profitable. Transfer pricing is limited because the government imposes a penalty that rises with the deviation of the reported price from the arm's-length price. Because transfer pricing lowers the customs value on which tariffs are collected, it reduces the effective protection a given 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 sufficient 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.

Under perfect competition, only the first point applies. 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. For each Home-foreign country pair, the trade elasticity is a weighted average of the primitive elasticity of substitution across varieties and the primitive elasticity of substitution across production locations within an MNE. The weights on these two parameters are determined by the extent to which Home uses exports rather than foreign affiliates to serve the partner country. The optimal tariff is an export-share-weighted average of the bilateral trade elasticities between Home and all trading partners. If, as in our empirical estimates, substitution across production locations within MNEs is easier than substitution across varieties, a tariff-induced

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

rise in the Home wage encourages Home MNEs to shift production to cheaper foreign affiliates more strongly than the elasticity of substitution across 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.

With imperfect competition, the second and third point apply as well, and multinational profits become an additional channel through which tariffs affect Home welfare. With respect to the second point, a higher import tariff induces domestic multinationals to reallocate production toward their foreign affiliates, because the tariff raises the Home wage relative to foreign wages and makes producing abroad relatively cheaper. This reallocation increases the profits earned abroad by domestic firms, which are repatriated to Home households, widening Home's 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 in Home, a countervailing force emerges. Trade imbalances now reflect not only the repatriated profits of domestic MNEs but also the profits earned by foreign affiliates operating in Home, which accrue to foreign households. By raising Home's price level, import tariffs increase the value of these foreign profits for given world prices. An export tax could offset this effect while delivering the same terms-of-trade improvement: like an import tariff, it improves Home's terms of trade by raising the price that foreigners pay for Home's exports. But unlike a tariff, it lowers Home's price level. Without foreign affiliates, this distinction is irrelevant because Home consumers both earn and spend in Home prices. With foreign affiliates, however, it matters for the value of profits transferred abroad. Lerner symmetry thus breaks down in this case. A planner would prefer to combine an import tariff with an export tax, improving the terms of trade without increasing foreign affiliates' profits. When export taxes are unavailable, every terms-of-trade gain from the tariff comes with a larger transfer to foreign households, and the planner sets a lower tariff than when only domestic firms are multinationals. Whether the optimal tariff lies above or below a no-MNE benchmark with the same trade elasticity depends on which force dominates: the profit-repatriation motive for domestic MNEs, which pushes tariffs higher, or the missing-export-tax correction for foreign affiliates, which pushes them lower. 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 in Home by foreign affiliates.

The analytical results consider an economy without selection into MNE status and without transfer pricing. To analyze optimal tariffs in the full environment, we calibrate the model to match the U.S. economy and compute optimal tariffs numerically. The empirical patterns documented above pin down key parameters of the model: the differential quantity responses of MNEs and non-MNEs to tariffs determine the elasticities of substitution across varieties and across affiliates within a multinational, while the differential price response of RP versus AL transactions within

multinationals disciplines the model's transfer-pricing technology.

The forces identified by our theory are quantitatively large. We first consider a model that allows for selection into MNE status but continues to abstract from transfer pricing. In this setup, the optimal unilateral tariff for the U.S. is 9.8 percent. The terms-of-trade motive alone, the only motive present in models without multinational production, would call for a tariff of 17.4 percent, nearly twice 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 raising tariffs benefits these foreign-owned producers by further increasing their earnings. Without export taxes the planner cannot recover those gains. The optimal policy is therefore to lower import tariffs. A model in which selection into MNE status is shut down and all firms are multinationals delivers an even lower optimal tariff of 4.6 percent, both because MNEs respond more to tariffs than local firms, raising the aggregate trade elasticity, and because the MNE-specific forces due to the missing-export-tax correction are now stronger. The sufficient-statistic formula from our theory closely tracks the numerical optimum of the MNE-only model.

When we additionally allow for transfer pricing in the model, the optimal tariff falls by about one percentage point further, to 8.7 percent. In our model, transfer pricing does not change consumer prices, but it erodes the tariff base: MNEs pay tariffs on the declared value of their intra-firm imports, and they under-declare more when the tariff is higher. This force pushes the optimal tariff down, since part of the revenue that the tariff would otherwise raise stays with MNEs. Additionally, when the MNEs are foreign-owned, this revenue is lost to the United States, which further lowers the optimal tariff. The revenue at stake is large where tariffs are high: according to our estimates under the 2018–2019 tariffs, the United States would collect 23 percent more tariff revenue on related-party imports from China if they were declared at arm's-length prices. Transfer-pricing penalties collected by the government only recover close to half of the revenue lost.

We use these results to evaluate the welfare consequences of optimal policy and compare them to the effects of the 2018–2019 U.S. tariffs. Three main results emerge. First, the gains from optimal policy are small: in our model without transfer pricing, implementing the optimal tariff is equivalent to a 0.19 percent increase in consumption. The gains are smaller than in an economy without MNEs because the presence of multinationals reduce the optimal tariff, thereby bringing it closer to the existing U.S. tariffs before 2018. Second, the cost of getting policy wrong is relatively large compared to these gains. A planner who ignores multinational production and sets the tariff implied by the terms-of-trade motive alone achieves less than half of the gains from the optimal tariff. Third, the 2018–2019 U.S. tariffs reduce welfare by 0.03 percent, in contrast with the modest gains found in models without multinational production (see, for example, Antràs et al., 2024b). These losses are not driven by the level of the 2018–19 tariffs, which on average remains below the optimum, but by their concentration on China: MNEs relocate production for the U.S. market from China to locations that do not face higher tariffs, and so the tariff on China yields small terms-of-trade gains

while distorting sourcing decisions.[2] Transfer pricing also increases the losses from the 2018–2019 tariffs, since part of the tariff revenue stays with foreign-owned MNEs. 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 multinational production and how it is shaped by trade policy. 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. Our transfer pricing block builds 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, 1953; Gros, 1987) has been extended to environments with intermediate inputs, global value chains, and firm heterogeneity (Costinot et al., 2015, 2020; Caliendo and Parro, 2022; Lashkaripour and Lugovskyy, 2023). In all of these frameworks, however, firms are domestically owned and trade is balanced in the aggregate. 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, as do Li et al. (2025), who study the joint design of import tariffs, export taxes, and taxes on multinational producers. Because they work under perfect competition, aggregate trade remains balanced in their analysis as well. Our framework differs in two respects: first, we derive sufficient-statistic formulas for the optimal tariff, and second we allow for imperfect competition, so that multinational profits enter the planner's problem and cross-border profit flows generate aggregate trade imbalances. It is through this channel that foreign ownership of domestic production fundamentally alters the optimal tariff.[3]

Among frameworks that study optimal trade policy with aggregate trade imbalances, the closest to ours are 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)

[2] Utar et al. (2025) and Fadinger et al. (2026) provide empirical evidence on the reallocation of production after the 2018–19 tariffs on China.

[3] In related work, Dyrda et al. (2024) study optimal corporate income taxation in a model with multinational production and profit shifting.

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 the tariffs led to a decline in imports and very limited pass-through into import prices. Alviarez et al. (2025) and He et al. (2026) document positive pass-through of tariffs into import prices at more disaggregated levels. We complement these findings by analyzing the differential response of multinationals, both in terms of imports and in terms of pricing. Our finding of a strong import response of MNEs is consistent with Utar et al. (2025) and Fadinger et al. (2026), who show that multinationals reallocated their production towards third countries. We also demonstrate that related-party border prices fall more sharply than arm's-length prices 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). Relative to the previous literature on the heterogeneous effects of the 2018–19 tariffs, we use our findings to discipline a general equilibrium model with multinationals and to derive optimal tariff results.

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 Motivating Empirical Facts

In 2018–2019, the U.S. imposed tariffs on solar panels, washing machines, and steel and aluminum products, as well as four waves of Section 301 tariffs on a wide variety of products from China. In this section, we present two empirical facts regarding related-party imports and tariffs during this episode to motivate the setup of our model: first, import quantities decline more strongly in RP than in AL relationships in response to tariffs; second, MNE exporters' RP prices decline more than their AL prices. We first describe the data and then present the two 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.[4] We use the data for the period 2016–2021 and construct tariff-exclusive 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.[5] 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). In the month in which a new tariff rate comes into effect we use a "scaled" tariff that weighs the old and the new tariff rates by the number of days they were in effect. Our final dataset contains an ad valorem tariff rate for each country-product-month triplet.[6]

2.2 Two Empirical Facts on Related-Party Trade and the 2018–2019 Trade War

We now document two empirical facts on multinational trade and the tariffs in 2018–2019.

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 of changes in import quantities and values on tariff changes, 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

[4] Following Monarch and Schmidt-Eisenlohr (2023), Heise (2024), and Eaton et al. (2025), we use the Manufacturer ID (MID) in the LFTTD to identify foreign suppliers. Earlier work by Kamal and Monarch (2018) shows that the MID is a reasonably accurate identifier of foreign suppliers, and Redding and Weinstein (2017) find that using the MID as exporter identifier recovers many salient features of exporting activity. 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."

[5] In the publicly available data, this step is only possible at the product-country level, not at the level of individual transactions.

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

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.

$fxigt$ 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.[7] 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 percent increase in tariffs reduces the quantity imported by 3.5 percent for AL trade but by 5.6 percent for RP trade. The response is slightly larger over a 24-month horizon, rising to 3.8 percent for arm's-length trade and 6.9 percent for related-party trade. The pattern is similar for the value imported, but the percentage decline in import value is larger than

[7]This property is time-varying because some pairs may be at arm's length in some years and then become related parties in others, or vice versa.

for quantity. Over a 24-month horizon, a 10 percent rise in tariffs lowers import value by 6.3 percent for arm's-length trade and by 8.3 percent for related-party trade. Overall, it appears that firms with related-party links find it easier to move production away from the tariffed location than do firms with AL suppliers. This finding is consistent with Utar et al. (2025) and with Fadinger et al. (2026), who show that MNEs relocated their supply chains 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.1, we aggregate the LFTTD data to the country-product level and run the standard reduced-form regression in Fajgelbaum et al. (2020) for the period 2016–2021 with our data. We obtain 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.[8]

In our theory below, 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 therefore next examine whether the response of MNE imports to tariff changes differs from that of non-MNEs. Since the LFTTD does not contain a specific identifier for MNEs, we define multinationals using the RP flag in the data. We do so 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 AL trade to source a product in 2016–17 but then also uses RP trade in 2019–20, or vice versa.

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.

Consistent with the results for RP trade above, 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 percent increase in tariffs reduces the quantity imported by non-MNEs by 2.4 percent, while MNEs

[8] 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.

lower their imports by 4.9 percent. Over 24 months, the reduction is 1.9 percent for non-MNEs and 6.0 percent 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 percent of the import value included in regression (1), and about 90 percent over 24 months.

We next run 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 next 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 percent of its imports via RP trade and the remainder via AL 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.2 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 possible confounding factor in our analysis so far 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.3 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.4, we run regressions using publicly available data on industry-level RP shares from the Census Bureau in which we interact the tariff change with an industry's share of RP trade as the right-hand side variable. While this analysis does not capture whether individual firms engage in RP trade, it can shed light on whether industries engaging in more RP trade display a greater responsiveness of trade to tariffs. Consistent with our previous results, we find that industries with more RP trade decrease imports by more in response to tariffs.

Fact 2: MNE Exporters' RP Prices Fall More than AL Prices in Response to Tariffs

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 2018–2019, 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 percent is associated with a decline in the tariff-exclusive import price of 3.4 percent for non-MNEs (as quantities fall by 1.9 percent and import values fall by 5.2 percent). For MNEs, a 10 percent

increase in tariffs is associated with a decline in prices of 1.5 percent. These findings are 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 new relationships and importers, 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. We therefore 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.

We define exporter-product pairs that are MNEs in a similar way to MNEs on the import side: specifically, an exporter-product pair is an MNE if it engages in at least one RP transaction in 2016–17 and another RP transaction in the period 2019–20. For these exporter MNEs, we aggregate the data to the exporter-country-HS10 product-related party status-month level and run:

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

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 has related-party status r =RP. To compare price setting within the same MNE, we restrict our sample to only those exporter-country-product-month observations for which we can compute both a price change for AL trade and for RP trade. Thus, by construction, our sample includes for every exporter and month both at least one AL and one RP transaction of the same product. Across all horizons, this sample includes about 10 percent 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 RP prices by significantly more than their AL prices. At the 12-month horizon, a 10 percent increase in tariffs is associated with a fall in the RP price that is 2 percent greater than the decline in the AL price. This difference grows to 3.8 percent 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 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 intuition, we restrict our sample to "differentiated" products according to Rauch (1999), and re-run regression (3). Results, in Appendix A.5, indicate a stronger average price response: at the 12-month horizon, the average tariff-exclusive price for AL

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.

transactions falls by 2.4 percent instead of an (insignificant) 1.7 percent in the baseline for a 10 percent 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 percent increase in tariffs is associated with a 2.9 percent 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.5, 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). To shed light on the role of transfer pricing for the optimal tariff, we will consider both a baseline economy without transfer pricing and an economy with transfer pricing calibrated to the findings of Table 3 in our theory below.

Additional Results

In Appendix A.6, we document an additional fact. 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 percent of imports within an HS10–country cell in 2017, compared with 7.7 percent for the

average AL importer. Similarly, the average RP exporter accounts for 8.0 percent of U.S. imports within HS10–country compared to 6.0 percent for AL exporters. This result will support a model with selection into multinational firms versus local firms below.

3 Theoretical Framework

We now develop a model of international trade with multinationals and transfer pricing. We use the model to characterize optimal tariffs.

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 $l \in \mathcal{N}$.[9]

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

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

where $q_{i,lm}^{d}(\omega)$ is the quantity sourced from location l. We use the superscript d to indicate destination market prices, after, e.g., tariffs are paid, to distinguish them from the producer price. The set of varieties Ω_i originating in country i is exogenous, and $\sigma > 1$ and $\varepsilon > 1$ are the elasticities of substitution across distinct varieties and across production locations within a given variety, respectively.[10]

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

[10] 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, P_m and $P_{i,m}(\omega)$ are country m's dual price indexes to equations (4) and (5), and $p_{i,lm}^{d}(\omega)$ is the price of an individual variety.

3.2 Global and Local Firms

We consider two types of firms, *local* and *multinational*. Local firms are headquartered in country i and operate from i as their single production location. They therefore serve destination market m only through exports from i. Multinational 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.

For simplicity, we assume that multinational firms operate globally; hence, we refer to them as *global firms*. This choice abstracts from heterogeneity in plant location decisions across multinational enterprises (e.g., Tintelnot, 2017), which is not the focus of our study. The assumption 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. 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.[11] Since local firms have a single location of production, $q_{i,im}^{d}(\omega) = Q_{i,m}(\omega)$.

We do not impose a specific market structure for local firms. Instead, we assume that firms charge prices equal to a constant markup $\mu \geq 1$ over marginal cost. Accordingly, the producer price charged by a local firm is

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

[11] 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 (one plus) the tariff rate on goods imported by country m from country i. The consumer price paid in m for variety ω 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 headquarter 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, which allows them to engage in transfer pricing.

Production for a global firm involves two stages. 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.[12]

The distribution-subsidiary 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.

We assume that total firm-level markups for global firms are identical to those of local firms. However, global firms 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:

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

[12] 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 and equal to the markup of a local firm.[13] 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 $1 \leq \mu^d_{i,lm}(\omega) \leq \mu$.

Global firms can reduce the tariffs collected by customs, and therefore their tariff burden, without affecting the price charged to consumers, i.e., they can engage in transfer pricing. 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 μ at the border. By contrast, the global firm can shift markups across stages: it may set a low markup $\mu^u_{i,lm}$ for the intra-firm transaction at the border and apply a higher markup $\mu^d_{i,lm}$ 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 global firm profits from sales to market m equal the sum of the distributors' profits in that market and the profits of all production subsidiaries:

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

Of the household expenditure on the component of variety ω produced in country l, $p^d_{i,lm}(\omega)q^d_{i,lm}(\omega)$, 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 production subsidiaries receive payments net of import tariffs, their contribution is weighted by $\frac{1}{t_{lm}}$.

Two features of the global firms' 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, the optimal markup split for each location l is independent of the splits chosen at all other production locations because household expenditures only depend on μ, not on $\mu^u_{i,lm}(\omega)$ or $\mu^d_{i,lm}(\omega)$. Since production-subsidiary revenues are discounted by tariffs while distribution-subsidiary revenues are not, the firm would ideally set $\mu^u_{i,lm}(\omega) = 1$ and $\mu^d_{i,lm}(\omega) = \mu$ whenever cross-border transactions are subject to an import tariff. This split would ensure that all profits are booked at the distributor

[13] We assume that the firm-level markups of global and local firms are equal so that any differences between the two firm types' prices are not driven by exogenous differences in markups.

stage, minimizing the tariff burden on intra-firm transactions.[14]

Engaging in transfer pricing, however, is costly for the firm. A firm that uses transfer pricing may be found out by the customs authority, in which case it has to pay a penalty. Following Egger and Seidel (2013), we assume that the penalty depends on the misreported price according to the *Arm's length principle*.[15] Global firms should set internal prices as if they were arm's-length transactions, implying that they should 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[16]

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

with $c_{i,lm}(\omega) = \tau_{lm}\gamma_{i,l}w_l/A_i z(\omega)$ being the production-subsidiary's 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.[17]

The global firm 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[18]

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

It follows from our previous discussion that if $\kappa \to 0$, lowering the tariff burden by shifting profits to

[14] Import subsidies would flip the result: the firm would want to set a higher markup at the production stage relative to the distributor. In the main text, we discuss the solution for import tariffs only.

[15] 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.

[16] 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 depends on the percentage deviation of the reported transfer price from the arm's-length price. Finally, in Davies et al. (2018) the penalty only depends on THE price deviation and a fixed payment. Our choice of penalty function is guided by tractability.

[17] 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.

[18] 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 distributor carries no penalty and therefore the global firm 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 the global firm sets $\mu^u_{i,lm}(\omega) = \mu$ and $\mu^d_{i,lm}(\omega) = 1$.

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 global firm'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. 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 global firm to economize on tariff payments, despite the associated penalties, and this incentive is higher for more productive MNEs. In the limit, the firm sets $\mu^u_{i,lm}(\omega) = 1$, which is the lowest markup the production-subsidy is allowed to set.

This adjustment in $\mu^u_{i,lm}(\omega)$ has direct implications for tariff pass-through. When tariffs increase, the production-subsidiary lowers $\mu^u_{i,lm}(\omega)$ and therefore its price, leading to lower tariff pass-through at the border of global firms than of local firms. This prediction is consistent with Empirical Fact 2 in Section 2. 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.

Endogenous Choice of Firm Type. Becoming a global firm 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 governs firms' selection into local or multinational status.

3.3 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 its country's 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

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 the difference between profits generated by domestic firms located abroad and the 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, 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. Since solving this problem in the full environment described in Section 3 is analytically challenging, we first build intuition and isolate the primitive economic forces shaping optimal tariffs by characterizing the optimal tariff under three simplifying assumptions. We then compute the optimal tariff in the full model numerically in Section 5 below.

4.1 Three Simplifying Assumptions

Assumption 1 (A Small Open Economy). We first assume that country m is a small open economy that chooses its trade policy unilaterally. In standard trade models with only exporting, a country can be small in two senses. On the one hand, it may have a small population and therefore produce little relative to the rest of the world. On the other hand, it may 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, i.e., L_m (Alvarez and Lucas Jr, 2007; Demidova and Rodríguez-Clare, 2013). However, Caliendo and Feenstra (2024) and Demidova et al. (2024) showed that, under this method, country m's domestic expenditure share goes to zero and, in some models, its wage grows without bound, and that scaling export costs τ_{mj} alongside population resolves both problems. Scaling both variables delivers a well-behaved limit with finite wages in which foreign prices are independent of country m's policies, and domestic expenditure shares are strictly between zero and one, consistent with observed expenditure patterns in the data.

In our economy with multinational production, however, scaling only population and trade costs is still 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 possibility out, we also need to scale multinational production frictions $\gamma_{m,j}$, shown 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.[19] 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 global firm, f_i, equal to zero in all countries. In equilibrium, all firms are therefore global and operate production facilities in every location, serving foreign markets through both exporting and multinational production. As a result, in each headquarter country there is a representative multinational firm. This assumption provides a polar benchmark in which all firms are multinationals, in contrast to standard optimal tariff analyses where trade is conducted exclusively by local exporters.

Assumption 3 (**Infinite Transfer Pricing Penalties).** Finally, we restrict strategic transfer pricing and focus on how multinational production decisions affect optimal trade policy by setting the penalty on transfer pricing $\kappa \to \infty$. 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 follows the same rule that governs prices for local exporting firms by setting prices at the border at a markup μ over marginal cost.

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 $\{Y_i\}$.[20] 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.

[19] See Appendix B.2 for details.

[20] 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). These describe how Home's wage w_m and income level Y_m respond to changes in trade policy. The maximization problem is:

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

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, consisting of labor demand by the domestic multinational (first term) and of the affiliates of foreign multinationals (second term).[21] 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

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

and $\lambda_{i,j}$ and $\lambda_{i,mj}$ are CES expenditure shares defined by our preference structure in equations (4) and (5), respectively.[22]

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: $\sum_i \Lambda_{i,mm} Y_m$ 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. 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.[23]

[21] 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.

[22] Specifically, $\lambda_{i,mj} \equiv \frac{\int_{\omega \in \Omega_i} p_{i,mj}(\omega) q_{i,mj}(\omega) d\omega}{\sum_{l=1}^N \int_{\omega \in \Omega_i} p_{i,lj}(\omega) q_{i,lj}(\omega) d\omega}$ and $\lambda_{i,j} \equiv \frac{\sum_{l=1}^N \int_{\omega \in \Omega_i} p_{i,lj}(\omega) q_{i,lj}(\omega) d\omega}{\sum_{i'=1}^N \sum_{l=1}^N \int_{\omega \in \Omega_{i'}} p_{i',lj}(\omega) q_{i',lj}(\omega) d\omega}$.

[23] 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.

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 its own terms of trade through the effect of import tariffs on its relative wage.

Second, due to the presence of multinationals' profits trade does not have to be balanced. Because multinational profits depend on where production takes place, the planner can also influence the distribution of profits across countries, and thereby the size of Home's trade imbalance, by using import tariffs to affect multinationals' production decisions.[24]

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, hence there are no profits and trade is balanced. We then introduce imperfect competition, but only allow Home firms to produce abroad while foreign firms cannot produce via affiliates in Home. Finally, we present optimal tariffs when both domestic and foreign firms can produce in the other country

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 in that case trade is balanced, (LMC) and (BoP) collapse to the same equation, and 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 bilateral trade elasticity between m and i, θ_{mi}, is endogenous and given

[24] 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).

by[25]

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

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, where $Ex_{mi} \equiv \Lambda_{m,mi} Y_i$ denotes Home's exports to country i and $Ex_m \equiv \sum_{i \neq m} Ex_{mi}$ its aggregate exports.

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. Instead, when firms in country 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 global 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 global firms' trade more elastic than that of local firms, consistent with our Fact 1 in Section 2. The easier trade substitution of global firms 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.[26]

4.2.2 Trade Policy with No Foreign MP under Imperfect Competition

We next consider the case in which firms set prices above marginal cost ($\mu > 1$). In this case, 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 first impose the following assumption.

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

Under this assumption, foreign multinationals cannot produce in Home, and hence do not repatriate profits from the Home economy. 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

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

[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 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.

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.

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) below, and 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 headquarter country.

To understand the intuition behind the optimal tariff formula (24), note that a higher import tariff, by increasing the domestic wage, 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, reallocating 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.[27] 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.

[27] Blanchard et al. (2025) show that optimal tariffs are lower when foreign-produced goods embody domestic value added, since a tariff lowers the price received by foreign producers and, with it, the income of domestic suppliers of their inputs. In our model, the analogous margin consists of sales by the foreign affiliates of Home multinationals to Home. This margin is absent in the small open economy limit, where Home's multinationals never use their foreign affiliates to serve the Home market: in equation (21), the profits of Home's foreign affiliates come only from sales to foreign destinations. It is present in the calibrated economy of Section 5, where a higher tariff lowers the profits these affiliates earn on sales to Home and therefore works against the profit-repatriation motive.

The bilateral elasticity $\vartheta_{m,lj}$ captures the rate at which production is reallocated toward Home's foreign affiliate in l 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 1 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 affiliate in l. 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.[28] Therefore, optimal import tariffs remain uniform across country m's trading partners.[29]

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. To understand why, note that an import tariff and an export tax both improve Home's terms of trade by raising the price that foreigners pay for Home's exports, while moving Home's price level in opposite directions: the tariff raises it and the export tax lowers it. In an economy without foreign affiliates or when only domestic multinationals repatriate profits, this difference does not matter since Home's expenditures and income are valued at the same price. Foreign affiliates, however, earn their profits at Home prices and spend them abroad at world prices. Therefore, a lower price level in Home reduces the value of the profits they repatriate. As a result, import and export taxes are no longer equivalent instruments, and the planner would like to use both together: raising the export tax and lowering the import tariff by the same factor leaves the terms of trade unchanged but lowers Home's price level, which amounts to a pure transfer from the foreign owners of affiliates to Home.

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.[30]

[28] Specifically, $\bar{\vartheta}_m = \sum_{j\neq m}\sum_{l\neq m} \frac{Ex_{m,lj}}{\sum_{j'\neq m}\sum_{l'\neq m} Ex_{m,l'j'}}\, \vartheta_{m,lj}$, where $Ex_{m,lj} \equiv \Lambda_{m,lj} Y_j$ denotes the sales to country j of the affiliate in country l of Home's multinational.

[29] 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.

[30] Our result that the planner would like to extract the profits of foreign affiliates operating in Home, generating a transfer from foreign countries to Home, while using an import subsidy to ensure the optimal degree of terms-of-trade manipulation 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 reallocation decisions, yet this

To abstract from this extreme outcome and maintain comparability with the preceding subsections, we restrict the planner to a uniform import tariff.[31] 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 headquarter 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 term capturing the terms-of-trade motive, and the profit-repatriation term that amplifies the tariff 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 that import tariffs play 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, at the price of a smaller improvement in the terms-of-trade.

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.

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.

[31] 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 uniform.

Whether the optimal tariff is larger or smaller than in models that abstract from multinationals altogether remains an empirical question. The profit-repatriation motive due to Home affiliates abroad 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. We show that 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 goods trade in the manufacturing, agriculture, and utilities sectors.[32] 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 expenditures for each country, normalizing the expenditure in the U.S. to one. Bilateral *output* shares, measuring the fraction of 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 MNE domestic output share, which measures the fraction of output produced in country l by firms headquartered in l that is accounted for by multinationals rather than by local firms.

We use Teti (2024) for the tariffs of non-U.S. trading partners and the tariff dataset described in Section 2 for the United States, aggregated across products and countries within country groups using import-value weights from 2016. Following Caselli (2004) and Waugh (2010), we construct countries' labor endowment as $L_i = K_i^{1/3}(h_i N_i)^{2/3}$, where K_i is the PPP-adjusted capital stock, h_i is human capital per worker, and N_i is employment in country i. These variables come from Penn World Table 10.01. We normalize US labor endowment to one. Appendix C.1 describes the construction of these moments in more detail and reports summary statistics by country group.

Elasticities of Substitution. We use estimates from Fact 1 in Section 2 to pin down values

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

for the elasticities σ and ϵ. Absent transfer pricing, our model implies restricted gravity equations relating U.S. imports from continuing local (L) and global (G) firms producing in country l to import tariff changes. These differ from our empirical specifications in the U.S. import data, however, because our model only contains a single sector. To bring the model closer to the data, we therefore develop a multi-sector extension to our model with K sectors in Appendix C.2. This version of the model generates gravity equations for the two types of firms, sector k, and variety ω of the form

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

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

where $X_{l,lt}^{k,L}(\omega)$ and $X_{i,lt}^{k,G}(\omega)$ are local and global firms imports, 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 U.S., 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 empirical counterpart to these gravity equations is equation (2) in Section 2, run separately for continuing non-MNE and MNE relationships, which delivers the estimates in Panel B of Table 2. The empirical specification departs from the 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, the empirical specification omits the headquarter-sector-time fixed effect $\xi_{it}^{k,G}$ from the MNE regression, since headquarter origins are not directly observed in the data. To examine the potential effect of this omission on our results, we run our multi-sector gravity equations in simulated firm-level data, using random draws of tariffs and a random set of firm-level productivity draws for each sector, and find that omitting this fixed effect does not affect the estimated tariff elasticity ε (see Appendix C.2). We can therefore use the estimates from Panel B of Table 2 as our elasticities.

Since our model captures variation across long-run equilibria while the elasticity estimates from Section 2 capture short-run responses, we scale the 24-month elasticities from Panel B of Table 2. Anderson and Yotov (2025) estimate trade elasticities over different time horizons, finding that the long-run elasticity (after eighteen years) is about fourteen times larger than the short-run elasticity (after three years). Applying this scaling factor to our estimates, we obtain $\varepsilon = 7.96$ 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) for a nine-year relative to a three-year horizon, 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 U.S. 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 curvature of the penalty function α, the probability of being caught δ, and the scale of the penalty κ. We set $\alpha = 2$ based on Swenson (2001) and Bernard et al. (2006). Since the probability of being caught and the scale of the penalty cannot be separately identified, we calibrate $\delta\kappa$ as part of our estimation procedure described below, using two moments. The first is the 24-month differential price response between related-party and arm's-length transactions, equal to -0.375, reported in Table 3. The model's counterpart is computed using the differential price response to a tariff change 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 adhered to the arm's-length principle, $\mu c_{i,lm}(\omega)$. We evaluate this response at the factual change in U.S. import tariffs between 2016 and 2018–2019, the same variation that identifies the empirical estimate, and aggregate the resulting heterogeneous responses across all global firms exporting to $m =$ U.S. We provide details in Appendix C.3. The second moment is the ratio of customs fines and penalties to tariff revenue in the United States, equal to 0.2 percent.[33] Its model counterpart is the ratio of transfer-pricing penalties to tariff revenue collected by the United States in the calibrated 2016 equilibrium. Because the data cover all fines and penalties collected by the Department of Homeland Security, and not only those related to transfer pricing, this ratio likely overstates the penalties on transfer pricing. In our baseline model with both local and global firms, the calibrated scale parameter equals $\delta\kappa = 1.6$.

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). Following Bernard et al. (2003) we use $\varsigma/(\sigma-1) = 1.29$. Together with our estimate of $\sigma = 5.19$ this gives $\varsigma = 6.70$.

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

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

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

[33] In fiscal year 2016, the U.S. government collected \$65 million in fines and penalties and \$35.1 billion in customs duties (U.S. Department of Homeland Security, 2017).

where dist_{il}, lang_{il}, bord_{il} are import-weighted averages of the corresponding CEPII variables in 2016.

We 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, $A_{i,l} = A_i A_l$ and the fixed costs to become a global firm, which we set common across origin countries, $f_i = f$, by matching model-implied moments to their empirical counterparts.[34] 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 MNE domestic output share.[35] The set of moments also includes the 24-month differential price response between arm's-length and related-party transactions of MNEs estimated in Fact 2 and the ratio of customs penalties to tariff revenue, which we use to calibrate the transfer pricing penalty, as described earlier. We set the mass of firms in each country equal to its measured labor endowment, $M_i = L_i$, 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. In our baseline model with local and global firms, a 10 percent increase in distance between a country pair raises trade costs by about 0.5 percent and MP costs by about 2 percent.[36] A common border lowers trade costs by about 21 percent and MP costs by about 28 percent. By contrast, a common language lowers MP costs by only about 7 percent and trade costs by about 8 percent. Allowing for local firms substantially reduces the estimated MP frictions: the average γ falls from 2.3–2.4 in the Global Firms calibration to about 2.1 in the Local & Global calibration, while average trade costs remain nearly unchanged across variants. The introduction of transfer pricing in columns 3 and 4 does not change these parameters much.

Panel B shows the root mean squared error of the targeted moments. All four model variants fit the targeted moments closely, with two exceptions that reflect model structure rather than poor fit. The Global Firms calibrations cannot reproduce the observed MNE domestic output share since all firms are global by construction: the calibration assigns a value of one to this share,

[34] We assume common fixed costs since we allow for differences in productivity, trade costs, and multinational frictions, leaving little variation to separately identify heterogeneous fixed costs.

[35] For trade shares, we include only the off-diagonal elements, as in Ramondo and Rodríguez-Clare (2013). For bilateral output shares we also include the diagonal elements, assigning equal weights to the seven non-US regions and the residual weight to the United States. This places more weight on the US moment, so that the model captures MNE activity in the US, which is important for our analysis of optimal US policy.

[36] Distance is measured in thousands of kilometers, and all effects are on the gross costs τ_{il} and γ_{il}, averaged across country pairs. Since τ_{il} is linear in distance, a 10 percent increase in distance raises it by approximately $0.1 \times \beta^{\tau}_{\text{dist}} \, \overline{\text{dist}}/\bar{\tau}$, where $\overline{\text{dist}} = 8.8$ is the average distance and $\bar{\tau}$ is the average trade cost in Table 4. A common border changes τ_{il} by approximately $-(1 - \beta^{\tau}_{\text{bord}})(\bar{\tau} - 1)/\bar{\tau}$, and a common language by the same expression with $\beta^{\tau}_{\text{lang}}$. The same formulas apply to γ_{il}.

Table 4: Calibrated Parameters and Models' Fit

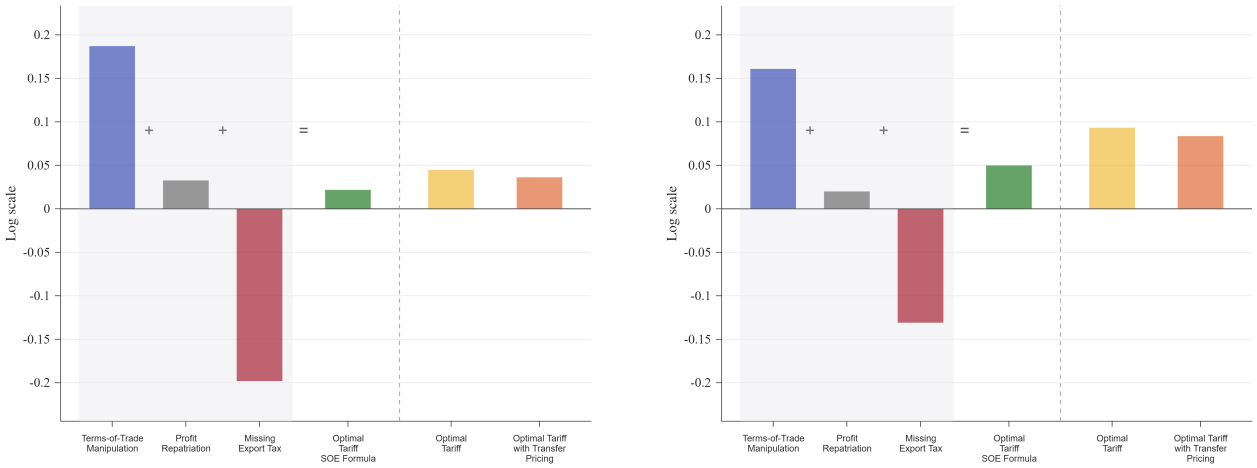
	Without strategic transfer pricing		With strategic transfer pricing	
	Global Firms	Local & Global Firms	Global Firms	Local & Global Firms
Panel A: Estimated parameters				
Transfer pricing				
Scale parameter $\delta \times \kappa$			0.898	1.597
Trade costs, eq. (29)				
Constant	0.905	1.038	0.826	1.035
Distance	0.026	0.013	0.032	0.013
Common border	0.677	0.583	0.722	0.586
Common language	0.961	0.846	0.974	0.844
Average τ	2.100	2.085	2.078	2.080
MP frictions, eq. (30)				
Constant	0.754	0.646	0.748	0.653
Distance	0.082	0.054	0.075	0.053
Common border	0.599	0.453	0.610	0.453
Common language	0.821	0.885	0.825	0.870
Average γ	2.403	2.062	2.341	2.054
Panel B: Goodness of fit (RMSE)				
Targeted moments				
Bilateral trade shares	0.0134	0.0140	0.0133	0.0139
Bilateral output shares	0.0214	0.0213	0.0215	0.0213
Expenditure relative to US	0.0023	0.0299	0.0025	0.0297
MNE domestic output share	0.6128	0.0623	0.6128	0.0621
Differential price response	0.3750	0.3750	0.0414	0.0020
Penalties to tariff revenue	0.0200	0.0200	0.1199	0.0270

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 is fixed at 2; the scale parameter $\delta \times \kappa$ governs the transfer pricing technology and is estimated only in the two columns with strategic transfer pricing, where it targets two moments: the differential price response of -0.375 and the ratio of customs fines and penalties to tariff revenue of 0.2 percent. We multiply the second moment by 10, both in the estimation and in Panel B. Panel B reports the root mean squared error (RMSE) between model-generated and data moments.

generating an RMSE of 61 percentage points in columns 1 and 3. Likewise, the calibrations without strategic transfer pricing generate neither a differential price response nor transfer pricing penalties, giving an RMSE of 37.5 percentage points for the price response in columns 1 and 2. Setting these two moments aside, every targeted moment is matched to within 6.2 percentage points in all four variants.[37] Appendix D.1 shows the estimated values of the productivity and fixed cost parameters and provides scatterplots of the model's fit. Appendix D.3 presents the same statistics for the model calibration with the more conservative elasticities of substitution.

[37] For the ratio of penalties to tariff revenue, this requires dividing the entries in Panel B of Table 4 by 10, as described in the table notes.

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 orange column is the log of the numerically computed optimal tariff in the model with strategic transfer pricing.

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 4.6 percent (in yellow, $\exp(0.045)-1$). We compare it with the sufficient-statistic formula of Proposition 3, evaluated at the calibrated equilibrium, which gives 2.2 percent (in green, $\exp(0.022)-1$). 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 delivers a tariff of the same order of magnitude as 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, in the left three bars: 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, the only motive present in models without multinational production, would call for a tariff of 20.6 percent (in blue, $\exp(0.187)-1$),

more than four times the optimal tariff itself. The profit-repatriation motive amplifies this effect as described above, calling 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.

We next allow for selection into multinational status (right panel). When the selection margin is active, the numerical optimal tariff rises from 4.6 percent to 9.8 percent, and the gap between the formula and the optimum widens to around 5 percentage points. As the share of exports accounted for by local firms rises, the aggregate trade elasticity falls since local firms are less responsive to tariffs than global firms, raising the optimal tariff. The sufficient-statistic formula cannot capture this effect. The formula is derived for an economy in which all trade is carried out by global firms, so its terms-of-trade motive ignores the lower responsiveness of local firms, and the formula therefore understates the optimum. With fewer global firms in equilibrium, both the profit-repatriation motive and the missing-export-tax correction are smaller, but the latter shrinks by more, so on net the MNE-specific forces pull the tariff down by less than in the left panel, reinforcing the effect of the lower elasticity. The terms-of-trade motive alone would still call for a tariff of 17.4 percent, nearly twice the numerical optimum. In both models the MNE-specific channels substantially change the optimal tariff.

Allowing for strategic transfer pricing reduces the optimal tariff from 4.6 percent to 3.7 percent in the global-firms model and from 9.8 percent to 8.7 percent in the model with local and global firms (orange bars). Transfer pricing does not affect consumer prices, but it changes who receives the revenue from the tariff because it allows multinationals to appropriate part of the tariff revenue the government would collect at arm's-length prices. When the MNE is U.S.-owned, this is a transfer within the U.S.; when it is foreign-owned, it is a loss for the U.S. Since global firms under-declare their import value more the higher the tariff, as shown in equation (16), transfer pricing adds to the force behind the missing-export-tax correction: raising tariffs also raises the tariff savings of foreign MNEs, and the planner recovers only part of these savings through transfer-pricing penalties, implying a lower optimal tariff. Relative to the level of the optimal tariff, the reduction 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 2018–2019 US Tariffs

We now evaluate the welfare consequences of implementing the optimal policy and of the 2018–2019 US tariffs. Table 5 reports welfare effects, in consumption-equivalent terms, across the model variants considered in Section 5.2. For each variant, we consider three policies: the optimal uniform tariff, the tariff prescribed by models without MNEs, and the 2018–2019 US tariffs. Two main results emerge. First, the MNE-specific forces bring the optimal tariff closer to the 2016 US tariffs, which reduces the welfare gains from optimal policy. Second, the welfare cost of ignoring MNEs

Table 5: Welfare Effects of Tariffs Across Model Variants

	Without strategic transfer pricing			With strategic transfer pricing		
	Optimal	No-MNE Formula	2018–19 U.S.	Optimal	No-MNE Formula	2018–19 U.S.
Global Firms	0.0313	-0.3878	-0.0839	0.0233	-0.5045	-0.1031
Local & Global Firms	0.1912	0.0878	-0.0275	0.1637	0.0250	-0.0358

Notes: The table reports welfare changes relative to the calibrated 2016 equilibrium, in percent and in consumption-equivalent terms. *Optimal* imposes the model-specific optimal uniform import tariff. *No-MNE Formula* imposes the uniform tariff $1/\bar{\theta}_m$ prescribed by models without multinational production, where $\bar{\theta}_m$ is the export-share-weighted average trade elasticity. The formula is the same in all columns, but $\bar{\theta}_m$ is evaluated at each model's own calibrated equilibrium. *2018–2019 U.S.* imposes the bilateral U.S. import tariffs in place in 2019, with no retaliation by trading partners. *Global Firms* is the model in which all firms are global, with no selection into multinational status. *Local & Global Firms* is the baseline model, with local and global firms and endogenous selection into multinational status.

when setting tariffs, or of concentrating tariffs on a single trading partner, is large relative to these gains.

We start with the optimal tariff, which serves as a benchmark for the other policies. In our model with local firms and without strategic transfer pricing, implementing the optimal tariff of 9.8 percent is equivalent to a 0.19 percent increase in consumption. The gains from optimal policy depend on how far the 2016 U.S. tariffs are from the optimum. By pulling the optimal tariff toward the existing 2016 U.S. tariffs (an average of 1.62 percent), the MNE-specific forces narrow this distance and limit the gains. As a consequence, in the global-firms model, where the missing-export-tax correction lowers the optimal tariff to 4.6 percent (Figure 1), the welfare gain is only 0.03 percent. Strategic transfer pricing lowers the optimal tariff further and reduces the welfare gains accordingly, from 0.19 to 0.16 percent in the baseline and from 0.03 to 0.02 percent in the global-firms model.

Given that the gains from optimal policy are limited, how costly is it to ignore MNEs when setting tariffs? A planner who ignores multinationals would impose the No-MNE optimal tariff, the inverse of the trade elasticity, which captures only the terms-of-trade motive. In our model with local firms and without transfer pricing, this tariff equals 17.4 percent, nearly twice the optimal tariff, and achieves less than half of its welfare gains, 0.09 percent. When all trade is carried by global firms, the cost of ignoring multinationals is far starker. The No-MNE formula prescribes a tariff of 20.6 percent and yields a welfare loss of 0.39 percent, turning what would be a 0.03 percent gain under the optimal tariff into an outright loss. The cost of ignoring MNEs therefore grows with their share of trade, as the forces omitted by the formula, in particular the missing-export-tax correction, become more important. When strategic transfer pricing is present, the cost of using the No-MNE formula is larger because transfer pricing further lowers the optimal tariff.

Finally, we evaluate the 2018–2019 U.S. tariffs. The tariffs imposed by the U.S. range from 0.02 percent (Canada) to 17.6 percent (China), and raise the average U.S. tariff, weighted using 2016 import values, from 1.62 to 5.43 percent. In our model with local firms and without transfer pricing, these tariffs are equivalent to a reduction in consumption of 0.03 percent. The losses are larger in the model with only global firms, 0.08 percent, where all firms can reallocate production in response to tariffs. These results contrast with the modest welfare gains from these tariffs found in

Table 6: Transfer Pricing Statistics

	U.S. import tariffs		
	2016 U.S.	2018–2019 U.S.	Optimal
Panel A: Global Firms			
Transfer-pricing penalties			
Share of gov. revenue	0.014	0.045	0.023
Imports at AL-prices / declared imports			
All U.S. imports	1.020	1.038	1.051
Related-party U.S. imports	1.020	1.038	1.051
U.S. imports from China	1.037	1.173	1.047
Related-party U.S. imports from China	1.037	1.173	1.047
Differential price response			
Import-value weighted	–	−0.932	−1.470
Panel B: Local & Global Firms			
Transfer-pricing penalties			
Share of gov. revenue	0.005	0.012	0.017
Imports at AL-prices / declared imports			
All U.S. imports	1.006	1.010	1.039
Related-party U.S. imports	1.016	1.027	1.120
U.S. imports from China	1.013	1.042	1.030
Related-party U.S. imports from China	1.051	1.226	1.133
Differential price response			
Import-value weighted	–	−1.158	−1.390

Notes: The table reports transfer-pricing statistics in the models with strategic transfer pricing. *2016 U.S.* is the calibrated 2016 equilibrium. *2018–2019 U.S.* imposes the bilateral U.S. import tariffs in place in 2019, with no retaliation by trading partners. *Optimal* imposes the model-specific optimal uniform import tariff. Transfer-pricing penalties are reported as a share of total government revenue. Arm's-length values hold quantities and marginal costs fixed and value each related-party transaction at the full markup μ instead of μ^u. The differential price response is the response of the declared value of related-party imports, relative to their arm's-length value, to the change in tariffs from 2016, weighting transactions by import value.

models without multinational production (see, for example, Antràs et al., 2024b). In contrast to the tariffs computed with the No-MNE formula, these welfare losses are not driven by the level of the 2018–2019 tariffs, which on average remains below the optimal tariff of 9.8 percent in our baseline. Instead, the losses arise because the tariff increase is concentrated on China. When global firms are present, they can respond to these tariffs by reallocating production for the U.S. market from China to locations that do not face higher tariffs, so the tariff on China yields small terms-of-trade gains while distorting sourcing decisions. Transfer pricing further increases the losses because some of the potential tariff revenue is appropriated by foreign multinationals.

5.4 Transfer Pricing and Tariff Revenue

We close our discussion by examining how much transfer pricing MNEs engage in and what it implies for government revenue. This analysis sheds further light on why, in Table 5, strategic

transfer pricing lowers the welfare gains from the optimal tariff, reduces the gains from the No-MNE formula, and increases the losses from the 2018–2019 tariffs.

MNEs respond to tariffs along two margins: the quantity they ship from each production location and the value they report for those shipments at the border. In our model, consumer prices are not affected by this valuation response, since global firms charge the same markup to consumers as local firms. However, by reporting lower values, global firms pay less in tariffs to the U.S. government. Table 6 reports statistics on transfer pricing under the 2016 baseline tariffs, the 2018–2019 tariffs, and the optimal tariff implied by our calibrated model.

At the 2016 tariffs, which average 1.62 percent, the tariff savings from under-declaring are small and MNEs price close to the arm's-length principle: in our model with local and global firms, imports valued at arm's-length prices exceed declared imports by only 0.6 percent, and by 1.6 percent for related-party imports. Higher tariffs raise the savings from under-declaring, and global firms respond accordingly by lowering the upstream markup on their intra-firm shipments. Under the 2018–2019 tariffs, the differential price response of global firms to the tariffs, weighted across firms using import values, is -1.16, and thus a 10 percent increase in the tariff lowers the declared value of related-party imports by about 11.6 percent relative to their arm's-length value. This response is larger than the unweighted response of -0.375 targeted in the calibration, because more productive MNEs, which account for most related-party trade, under-declare more.

Since the 2018–2019 tariff increases were concentrated on imports from China, in this tariff scenario transfer pricing is stronger with respect to China. The arm's-length value of related-party imports from China exceeds their declared value by 23 percent, compared with 5 percent at baseline. These tariffs add a tail of shipments priced well below the arm's-length markup. The optimal tariff, by contrast, applies to all trading partners and shifts the entire distribution of upstream markups down.[38] In the model with local and global firms, the optimal tariff of 8.7 percent exceeds the 2018–2019 tariffs for every trading partner except China, so under-declaration of U.S. import values overall is larger under the optimal tariff than under the 2018–2019 tariffs.

Finally, we turn to government revenue. Under-declaration lowers the tariff revenue collected on intra-firm imports. For example, under the optimal tariff, which applies the same rate to all imports, the 3.9 percent gap between the arm's-length value and the declared value of imports means that tariff revenue would be 3.9 percent higher if imports were declared at arm's-length values. Part of this lost revenue is recovered through transfer-pricing penalties on the transactions in which multinationals are caught under-declaring. We report this penalty revenue in Table 6, relative to total government revenue. This penalty income is sizable relative to the tariff revenue lost: in the optimal tariff scenario, the government collects penalty income equal to 1.7 percent of tariff revenue while losing 3.9 percent to transfer pricing, a recovery rate of more than 40 percent. The reason for this high recovery rate is that while multinationals under-declare until the marginal tariff saving equals the marginal expected penalty, the penalty is quadratic. As a result, penalties recover close

[38] Appendix D plots the distribution of upstream markups for the shipments that reach the U.S. market under the 2018–2019 U.S. tariffs and the optimal tariff.

to half of the revenue lost. The rest stays with MNEs as higher profits. Since part of these profits accrue to foreign owners, this shortfall is partly a loss for the U.S., which helps explain why transfer pricing lowers the welfare gains from the optimal tariff and increases the losses from the 2018–2019 tariffs.

6 Conclusion

Multinationals account for most of U.S. trade, and they can respond to a tariff in ways that firms that only export cannot: they can move production for the U.S. market to locations that do not face the tariff, and they can under-declare the value of the intra-firm shipments that still cross the border. This paper asks how these responses change optimal trade policy.

We show that, for the United States, these responses lower the optimal tariff. Part of this effect arises because multinationals make trade more elastic than a trade-only model would imply, since they can more easily substitute across locations than local firms can across varieties. Additionally, a higher tariff raises the profits that foreign affiliates earn in the United States, which accrue to foreigners. Without export taxes, the planner can reduce these profits only by lowering the import tariff. Transfer pricing adds to this force: MNEs under-declare more as the tariff rises, so a higher tariff also raises the revenue lost to foreign-owned MNEs, which pushes towards even lower tariffs. While domestic multinationals reallocate production abroad when faced with higher tariffs, which widens the trade deficit and pushes towards higher tariffs, this force is quantitatively small. In our calibrated model, the optimal U.S. tariff is 8.7 percent, well below the 17.4 percent implied by the terms-of-trade motive alone.

The presence of multinationals also change the welfare assessment of trade policy. In our model, the 2018–2019 U.S. tariffs reduce welfare, whereas models without MNEs tend to predict modest gains. The losses arise because the tariff increases are concentrated on China, and MNEs relocate production for the U.S. market to locations that do not face them. A planner who ignores MNEs and sets the tariff implied by the terms-of-trade motive alone achieves less than half of the gains from the optimal tariff. 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

Agustín Gutiérrez, Sebastian Heise, Nicolo Rizzotti, and Felix Tintelnot

Online Appendix (Not for Publication)

A Additional Empirical Results

A.1 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:

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

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.1, 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.1: 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.2, 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.2: 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.2 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.3 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.3 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.4 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.5 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.3: 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.4: 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.5: 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.4 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.7. 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 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

$$\Delta \ln m_{igt} = \eta_{gt} + \eta_{it} + \eta_{is(g)} + \sigma \Delta \ln(1+\tau_{igt}) + \rho \Delta \ln(1+\tau_{igt}) \cdot \text{RP Share}^{CN}_{n(g)} + \varepsilon_{igt}, \tag{A.2}$$

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.[1]

We first run the regression excluding the related-party term and report the results in column 1 of Table A.6. 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 imported. This elasticity is slightly lower than in Fajgelbaum et al. (2020) due to the different time period used, as described in Appendix A.1.

The second column runs our baseline specification (A.2). 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.

[1] 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.

Table A.6: 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.

A.5 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.

A.6 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.10 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.

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.

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.

The bottom two rows of Table A.10 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.

A.7 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

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.

Table A.10: 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.

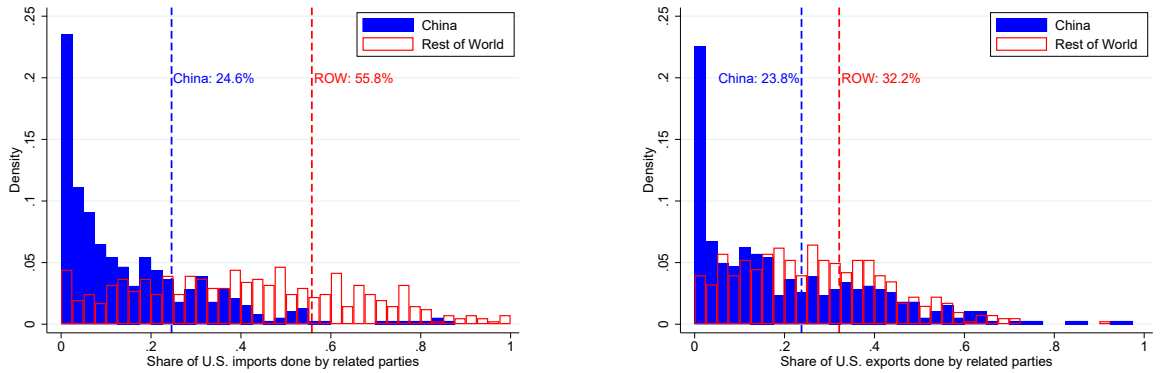
each 6-digit NAICS industry in 2017, available from the Census Bureau.[2]

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

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

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

$$ShareRP_{ij} = \beta_1 \mathbb{I}_{ij}(i = \text{China}) + \gamma_j + \epsilon_{ij} \tag{A.3}$$

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).

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

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

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:

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

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 an 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:

$$p^d_{i,lm} = t_{lm} x_{lm} p^u_{i,lm}, \qquad p^u_{i,lm} = \mu \frac{\tau_{lm} \gamma_{i,l}}{A_{i,l}} w_l. \tag{B.6}$$

Country m's price indexes in turn satisfy:

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

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;

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

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:

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

The share $\lambda_{i,lm}$ represents the expenditure share on goods originated in i that are produced in l and imported by m with $x_{lm}p^u_{i,lm}$ 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:

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

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:

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

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 $(\sigma/(\sigma-1))c_{i,lm}(\omega)$. Double marginalization in this environment is therefore a consequence of the arm's length principle itself. Because the internal transfer is a transaction within the firm, the multinational would prefer to price it at marginal cost and let the distributor's markup be the only one consumers pay. The customs authority, however, expects to

observe the markup that a local firm with the same cost would charge, and penalizes internal prices that fall below it. With tariffs low there is little tariff saving to weigh against the penalty, so the multinational marks up its internal sales to avoid it. Since consumer prices are then a markup over this internal price, 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 goods trade in the manufacturing, agriculture, and utilities sectors 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. Table C.1 provides summary statistics for each of the eight along these dimensions. 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.

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 $k \in \mathcal{K}$.

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
Europe	1.57	1.32	3.861	24.912	87.487	57.718
Canada	0.12	0.10	-8.063	68.232	57.234	31.625
Mexico	0.21	0.10	-2.854	71.866	70.642	43.662
United States	1.00	1.00	-9.252	32.333	75.335	49.429
South America	0.57	0.25	-1.854	22.772	79.724	31.757
Asia excluding China	2.83	1.35	4.852	27.443	92.365	46.037
China	2.53	2.19	4.650	15.585	91.915	24.670
Rest of World	1.88	0.98	-11.354	29.430	87.109	32.158

Source: OECD AMNE Database, 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. 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. NX/Exp and Trade/Exp denote net exports and total trade (exports plus imports) divided by total expenditure.

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 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 $\mu \frac{\tau^k_{im}\gamma^k_{i,l}}{A^k_i z(\omega)} w_l$. For a local firm, there is only one location-specific variety, the one produced in the hearquarters country. Hence:

$$P^k_{i,m}(\omega) = p^{k,d}_{i,im}(\omega) = t_{im}\mu \frac{\tau^k_{im}}{A^k_i z(\omega)} w_i.$$

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, $X^k_{i,im}(\omega)$:

$$X^k_{i,im}(\omega) = \frac{1}{t^k_{im}} \left(t^k_{im}\mu \frac{\tau^k_{im}}{A^k_i z(\omega)} w_i \right)^{1-\sigma} \left(P^k_m\right)^{\sigma-1} e^k E_m. \tag{C.2}$$

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:

$$\Delta \log X^k_{i,im}(\omega) = -\sigma \Delta \log t^k_{im} + \xi^L_{it} + \xi^{k,L}_{mt} + u^{k,L}_{it}(\omega), \tag{C.3}$$

for a variety ω produced by a continuing local firm. In equation (C.3), the country-time fixed effect $\xi^L_{it} \equiv (1-\sigma)\Delta \log w_{it}$ capture changes in wages in the production location, the sector-time fixed effects $\xi^{k,L}_{mt} \equiv (\sigma-1)\log P^k_{mt} + \log e^k_t + \log E_{mt}$ controls for changes in the price index and aggregate expenditure in country m, and the error term $u^{k,L}_{it}(\omega) \equiv (\sigma-1)\Delta \log(A^k_{it} z(\omega))$ reflect productivity shocks which are assumed to be uncorrelated with tariff changes.[5] 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:

$$X^k_{i,lm}(\omega) = \frac{1}{t^k_{lm}} \left(t^k_{lm}\mu\tau^k_{im}\gamma^k_{i,l}w_l\right)^{1-\varepsilon} \left(A^k_i z(\omega)\right)^{\sigma-1} \left(\bar{P}^k_{i,m}\right)^{\varepsilon-\sigma} \left(P^k_m\right)^{\sigma-1} e^k E_m, \tag{C.4}$$

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

$$\bar{P}^k_{i,m} \equiv \left[\sum_{l=1}^{N} \left(t^k_{lm}\mu\tau^k_{lm}\gamma^k_{i,l}w_l\right)^{1-\varepsilon} \right]^{\frac{1}{1-\varepsilon}}.$$

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:

$$\Delta \log X^k_{i,lm}(\omega) = -\varepsilon \Delta \log t^k_{lm} + \xi^G_{lt} + \xi^{k,G}_{imt} + u^{k,G}_{it}(\omega), \tag{C.5}$$

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

Table C.2: Simulation-Based Validation

	Baseline elasticities $\sigma = 5.19,\ \varepsilon = 7.96$			Conservative elasticities $\sigma = 2.65,\ \varepsilon = 4.07$		
	Local firms	Global firms		Local firms	Global firms	
Δ log gross tariff	−5.193	−7.964	−7.964	−2.651	−4.072	−4.072
	(0.019)	(0.009)	(0.009)	(0.007)	(0.004)	(0.004)
Country-Time FE	Y	Y	Y	Y	Y	Y
Sector-Time FE	Y		Y	Y		Y
HQ-Sector-Time FE		Y			Y	

Notes: Coefficients on the change in the log gross tariff from regressions on simulated firm-level data, with robust standard errors in parentheses.

for a variety ω produced by a continuing global firm. In equation (C.5), the country-time fixed effect $\xi^G_{lt} \equiv (1-\varepsilon)\Delta \log w_{lt}$ capture changes in wages in the production location, the sector-time fixed effects $\xi^{k,G}_{mt} \equiv (\sigma-1)\log P^k_{mt} + \log e^k_t + \log E_{mt}$ controls for changes in the price index and aggregate expenditure in country m, the headquarter-sector-time fixed effect $\xi^{k,G}_{mt} \equiv (\varepsilon-\sigma)\log \bar{P}^k_{i,mt}$ controls for the price index of bundled final good for variety ω, and the error term $u^{k,G}_{it}(\omega) \equiv (\sigma-1)\Delta\log(A^k_{it}z(\omega))$ reflect productivity shocks which are assumed to be uncorrelated with tariff changes.[6] 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 $\xi^{k,G}_{it}$ 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.

We validate the recovery of the gravity elasticities by estimating equations (C.3) and (C.5) on simulated firm-level data. We use the multi-sector extension of the model, the calibrated parameters of our baseline model, and no transfer pricing. We generate 199 counterfactual tariff vectors by drawing the gross import tariff applied by the US to each foreign region and sector from a uniform distribution on $[1, 1.2]$, independently across production countries and sectors, and solve for the equilibrium under each draw. For each headquarter country and sector, we sample 100 firms from the productivity distribution, keep their status (local or global) fixed at its baseline value, and compute the change in each firm's pre-tariff imports from each of its production locations relative to the baseline.

We add idiosyncratic productivity shocks. In each draw, every sampled firm receives a shock to its overall productivity and a shock to its productivity at each production location, drawn independently from a normal distribution with mean zero and standard deviation 0.1. These shocks play the role of the error terms $u^{k,L}_{it}(\omega)$ and $u^{k,G}_{it}(\omega)$ in equations (C.3) and (C.5). Since they are idiosyncratic and average out across the continuum

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

of firms, they leave wages and price indices unchanged.

Table C.2 reports the coefficient on the tariff change from these regressions, run separately for local and global firms, for our baseline elasticities and for the more conservative ones. For global firms, we report the regression with the headquarter-sector-time fixed effect, as in equation (C.5), and without it, as in the empirical specification (2). In all cases, the coefficient on the tariff change recovers σ for local firms and ε for global firms, and omitting the headquarter-sector-time fixed effect leaves the estimate for global firms unchanged.

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 2 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 of a firm headquartered in country i sells to the distribution subsidiary located in country m. Multinational firms conduct all of their trade intra-firm. We construct their arm's length price as $\mu c_{i,lm}(z)$, the price the production subsidiary would set if it adhered to the arm's length principle, which is also the price a local firm with the same marginal cost would charge. Unit costs are $c_{i,lm}(z) = \tau_{lm}\gamma_{i,l}w_l/(A_{i,l}z)$. The ratio between the internal and the arm's length price then follows from equation (16) and 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 $\tilde{z}_i$ denote the productivity threshold above which firms headquartered in country i select into global firms, and $\bar{z}_{i,lm}$ the productivity above which the production subsidiary engages in the maximum transfer pricing possible, $\mu^u_{i,lm}(z) = 1$:

$$\bar{z}_{i,lm}(t_{lm}) \equiv \frac{\gamma_{i,l}\tau_{lm}w_l}{A_{i,l}}(\mu-1)\left(\frac{\delta\kappa}{t_{lm}-1}\right)^{\frac{1}{\alpha-1}}. \tag{C.7}$$

The threshold $\bar{z}_{i,lm}$ is decreasing in the tariff: higher tariffs raise the return to shifting profits to the distributor, so more firms max out on transfer pricing.[7] Since $\bar{z}_{i,lm}$ is the productivity at which the interior markup equals one, the markup depends on productivity only through $z/\bar{z}_{i,lm}$:

$$\mu^u_{i,lm}(z; t_{lm}) = \max\left\{\mu - (\mu-1)\frac{z}{\bar{z}_{i,lm}(t_{lm})}, 1\right\}. \tag{C.8}$$

Firm-level responses to factual tariff changes. Fact 2 estimates the differential price response among continuing MNE exporters. Consistent with that empirical exercise, we consider partial equilibrium changes in which $\tilde{z}_i$ and unit costs $c_{i,lm}(z)$ are held fixed. For given baseline and new US import tariffs $\{t^0_{lm}, t^1_{lm}\}_{l\neq m}$, the change in related-party relative to arm's length prices for a firm with productivity z is

$$\log\frac{p^{u,1}_{i,lm}(z)}{\mu c_{i,lm}(z)} - \log\frac{p^{u,0}_{i,lm}(z)}{\mu c_{i,lm}(z)} = \log\frac{p^{u,1}_{i,lm}(z)}{p^{u,0}_{i,lm}(z)} = \log\frac{\mu^{u,1}_{i,lm}(z)}{\mu^{u,0}_{i,lm}(z)},$$

[7] For $t_{lm} = 1$ there are no tariff savings and every global firm sets $\mu^u_{i,lm} = \mu$; we adopt the convention $\bar{z}_{i,lm}(1) = \infty$, under which the expressions below apply unchanged. We restrict attention to $t_{lm} \geq 1$.

where the superscript denotes baseline tariffs (0) and new tariffs (1), $\mu^{u,r}_{i,lm}(z) \equiv \mu^{u}_{i,lm}(z; t^r_{lm})$, and $\bar{z}^r_{i,lm} \equiv \bar{z}_{i,lm}(t^r_{lm})$ for $r \in \{0,1\}$.

Since $\bar{z}_{i,lm}$ depends on the bilateral tariff, let

$$z^{\min}_{i,lm} \equiv \min\{\bar{z}^0_{i,lm}, \bar{z}^1_{i,lm}\}, \qquad z^{\max}_{i,lm} \equiv \max\{\bar{z}^0_{i,lm}, \bar{z}^1_{i,lm}\}.$$

We need to consider three cases: (i) firms with $z \geq z^{\max}_{i,lm}$, which max out on transfer pricing under both tariffs; (ii) firms with $z \in [z^{\min}_{i,lm}, z^{\max}_{i,lm})$, which max out on transfer pricing under the higher of the two tariffs but not under the lower one; and (iii) firms with $z \in [\tilde{z}_i, z^{\min}_{i,lm})$, which are interior under both tariffs. Firms with productivity below $\tilde{z}_i$ are local firms in equilibrium and are therefore not part of the Fact 2 sample. Using equation (C.8),

$$\Delta \log \mu^{u}_{i,lm}(z) \equiv \log \frac{\mu^{u,1}_{i,lm}(z)}{\mu^{u,0}_{i,lm}(z)} = \begin{cases} 0 & \text{if } z \geq z^{\max}_{i,lm} \\ -\operatorname{sgn}\left(t^1_{lm} - t^0_{lm}\right) \log\left(\mu - (\mu-1)\dfrac{z}{z^{\max}_{i,lm}}\right) & \text{if } z \in \left[z^{\min}_{i,lm}, z^{\max}_{i,lm}\right) \\ \log\left(\dfrac{\mu - (\mu-1)\, z/\bar{z}^1_{i,lm}}{\mu - (\mu-1)\, z/\bar{z}^0_{i,lm}}\right) & \text{if } z \in \left[\tilde{z}_i, z^{\min}_{i,lm}\right) \end{cases} \tag{C.9}$$

In case (ii), the firm is at the corner under the higher tariff and interior under the lower one, whose threshold is $z^{\max}_{i,lm}$. For a tariff increase, the response is $-\log \mu^{u,0}_{i,lm}(z)$; for a tariff cut, it is $\log \mu^{u,1}_{i,lm}(z)$.

Aggregation across firms and routes. The differential price response estimated in Fact 2 pools continuing MNEs that export to the US. Therefore, the model counterpart aggregates equation (C.9) across all global firms with headquarters in country i, producing in country $l \neq m$, and selling to country $m =$ US. For a given (i, l, m) triple, we have:

$$\Delta \log \mathcal{P}_{i,lm} = \int_{\tilde{z}_i}^{\infty} \Delta \log \mu^{u}_{i,lm}(z) \, \frac{d\Phi(z)}{1 - \Phi(\tilde{z}_i)}, \tag{C.10}$$

where the response is zero for $z \geq z^{\max}_{i,lm}$.[8] Splitting the integral according to the cases in equation (C.9),

$$\begin{aligned} \Delta \log \mathcal{P}_{i,lm} = {} & \frac{1}{1 - \Phi(\tilde{z}_i)} \int_{\tilde{z}_i}^{\max\{\tilde{z}_i, z^{\min}_{i,lm}\}} \log\left(\frac{\mu - (\mu-1)\, z/\bar{z}^1_{i,lm}}{\mu - (\mu-1)\, z/\bar{z}^0_{i,lm}}\right) d\Phi(z) \\ & - \frac{\operatorname{sgn}\left(t^1_{lm} - t^0_{lm}\right)}{1 - \Phi(\tilde{z}_i)} \int_{\max\{\tilde{z}_i, z^{\min}_{i,lm}\}}^{\max\{\tilde{z}_i, z^{\max}_{i,lm}\}} \log\left(\mu - (\mu-1)\frac{z}{z^{\max}_{i,lm}}\right) d\Phi(z). \end{aligned} \tag{C.11}$$

Equation (C.11) is equivalent to equation (C.10), but it is the form we use in the computation. The integrand in equation (C.10) has kinks at $\bar{z}^0_{i,lm}$ and $\bar{z}^1_{i,lm}$, where firms switch between interior and corner markups. Splitting the integral at these points leaves a smooth integrand on each interval, which numerical quadrature evaluates accurately. Taking the maximum with $\tilde{z}_i$ in the limits restricts both integrals to global firms.

[8] If $z^{\min}_{i,lm} \leq \tilde{z}_i$, case (iii) is empty: every global firm is at the corner under the higher tariff. For a tariff increase the response is then $-\log \mu^{u,0}_{i,lm}(z)$, which does not depend on t^1_{lm}, so further increases in the tariff leave the response unchanged. If in addition $z^{\max}_{i,lm} \leq \tilde{z}_i$, every global firm is at the corner under both tariffs and $\Delta \log \mathcal{P}_{i,lm} = 0$.

Mapping to the Fact 2 coefficient. The coefficient on the interaction term in equation (3) is identified only from the difference between the related-party and arm's length price changes within each exporter-country-product-month, and it equals the slope of a regression of that difference on the tariff change without a constant. Its model counterpart is the analogous regression of $\Delta \log \mu^u_{i,lm}(z)$ on $\Delta \log t_{lm}$ across global firms. Because all firms on a route face the same tariff change, this regression can be written at the route level, with each route weighted by its number of global firms, $M_i[1 - \Phi(\tilde{z}_i)]$, where M_i is the mass of potential firms headquartered in i. Since the Fact 2 regression is unweighted, each exporter counts equally regardless of its size, so we weight firms by their number. The model counterpart to Fact 2 is then given by:

$$\beta_{\text{model}} = \frac{\sum_i \sum_{l \neq m} M_i \big[1 - \Phi(\tilde{z}_i)\big] \Delta \log t_{lm} \, \Delta \log \mathcal{P}_{i,lm}}{\sum_i \sum_{l \neq m} M_i \big[1 - \Phi(\tilde{z}_i)\big] \big(\Delta \log t_{lm}\big)^2}, \tag{C.12}$$

where $\Delta \log t_{lm} = \log t^1_{lm} - \log t^0_{lm}$.

D Additional Quantitative Results

D.1 Additional Parameters and Model Fit in the Baseline Calibration

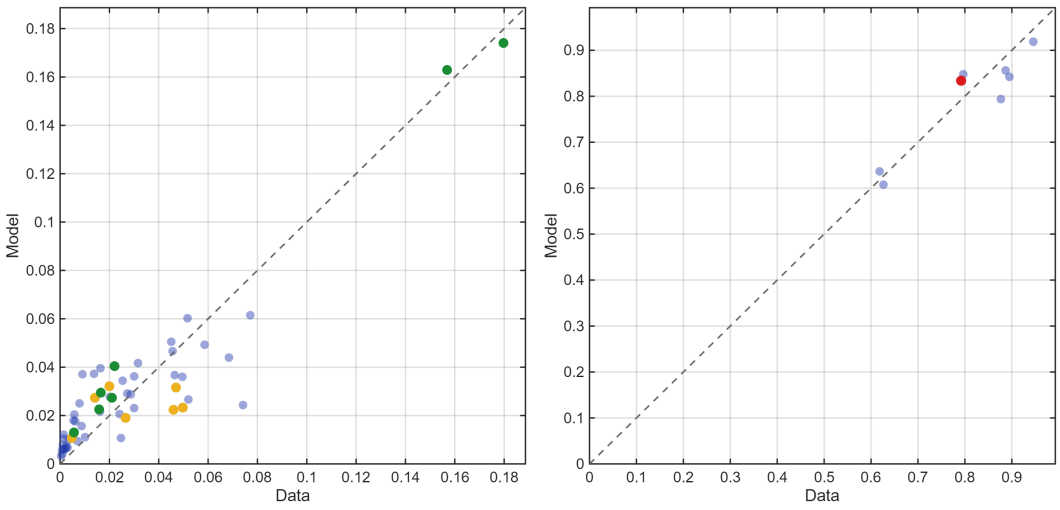
Here we report the additional parameters calibrated for the different model variants under the baseline calibration, $\varepsilon = 7.96$ and $\sigma = 5.19$. Table D.1 reports the estimated origin and production-location productivities and the fixed cost of becoming a global firm. Figures D.1, D.2, and D.3 plot the bilateral trade shares, bilateral output shares, and MNE domestic output shares in the data against their model counterparts, together with the 45-degree line.

Table D.1: Additional Calibrated Parameters, $\varepsilon = 7.96, \sigma = 5.19$

	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	1.263	1.366	1.251	1.364
Canada	1.280	1.269	1.299	1.275
Mexico	1.129	1.206	1.154	1.211
United States	1.016	1.114	1.033	1.117
S. America	0.959	1.022	0.985	1.027
Asia excluding China	1.022	1.073	1.010	1.073
China	1.020	0.998	1.004	0.998
Rest of the World	1.000	1.000	1.000	1.000
Estimated Production-Location Productivity, A_l^{loc}				
Europe	1.359	1.194	1.377	1.197
Canada	1.447	3.122	1.448	3.095
Mexico	1.055	1.360	1.026	1.348
United States	2.317	2.036	2.281	2.029
S. America	0.988	0.924	0.966	0.919
Asia excluding China	0.845	0.787	0.856	0.787
China	1.717	1.748	1.754	1.747
Rest of the World	1.000	1.000	1.000	1.000
Estimated Fixed Cost				
Common f		0.317		0.317

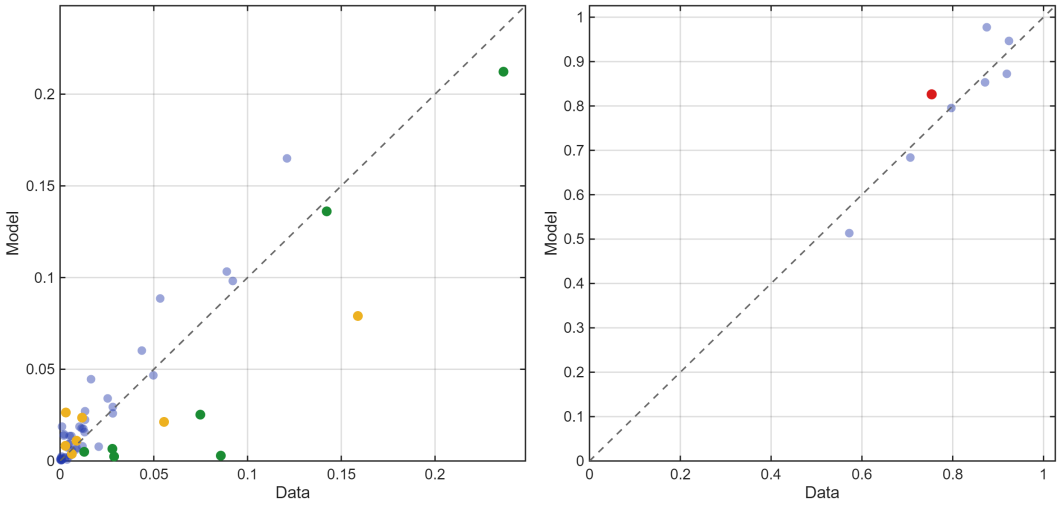
Notes: This table reports the remaining parameters from the baseline calibration ($\varepsilon = 7.96$, $\sigma = 5.19$) corresponding to Table 4. The productivity shifters A_i^{orig} and A_l^{loc} are normalized relative to the Rest of the World. The fixed cost f applies only to specifications with local and global firms.

Figure D.1: Bilateral Trade Shares: Model versus Data



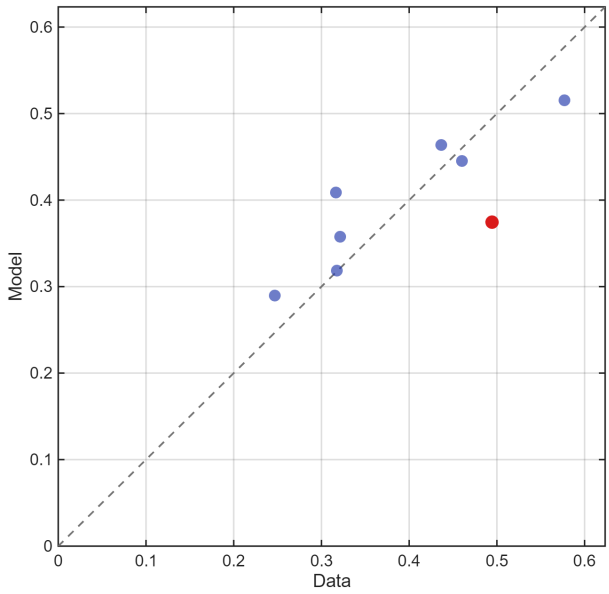
Notes: Each dot corresponds to a bilateral trade share in the data (x-axis) and in the model (y-axis). The left panel shows off-diagonal elements and the right panel diagonal elements; both panels are in levels. The dashed line is the 45-degree line. In the left panel, yellow dots correspond to trade 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: Bilateral Output Shares: Model versus Data



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 the data and in the model. The left panel shows off-diagonal elements and the right panel diagonal elements; both panels are in levels. The dashed line is the 45-degree line. In the left panel, yellow dots correspond to output shares where the U.S. are the headquarter-origin country, while green dots correspond to output shares where the U.S. are the host country. In the right panel, the red dot is the U.S. own output share.

Figure D.3: MNE Domestic Output Shares: Model versus Data

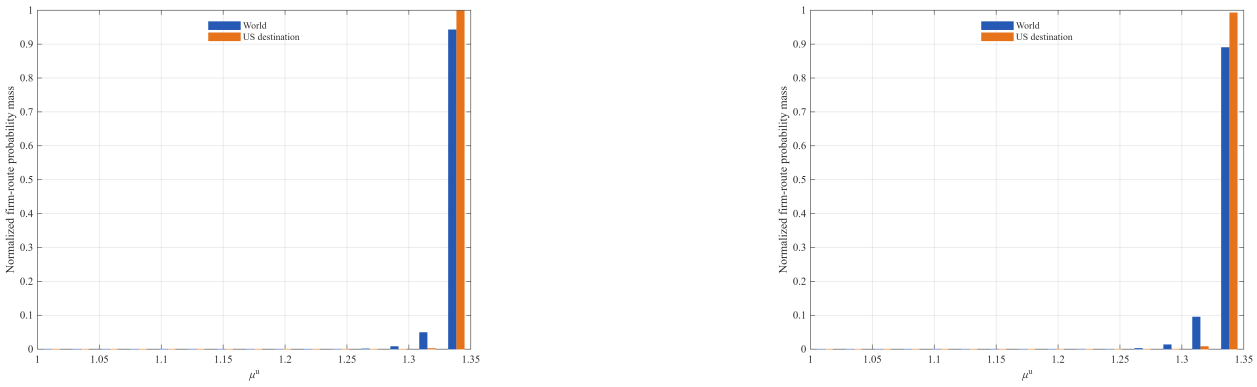


Notes: Each dot corresponds to an MNE domestic output share (i.e., the share of output produced in country l by firms headquartered in l that is accounted for by MNEs), in the data and in the model. Shares are in levels. The dashed line is the 45-degree line. The red dot is the U.S. MNE domestic output share.

D.2 Distribution of Upstream Markups under Different Tariff Policies

Here we report the distribution of the upstream markups that global firms set on their intra-firm shipments, which we discuss in Section 5.4. Figures D.4, D.5, and D.6 show these distributions under the 2016 U.S. tariffs, the 2018–2019 U.S. tariffs, and the optimal uniform tariff, across all routes and across routes whose destination is the United States.

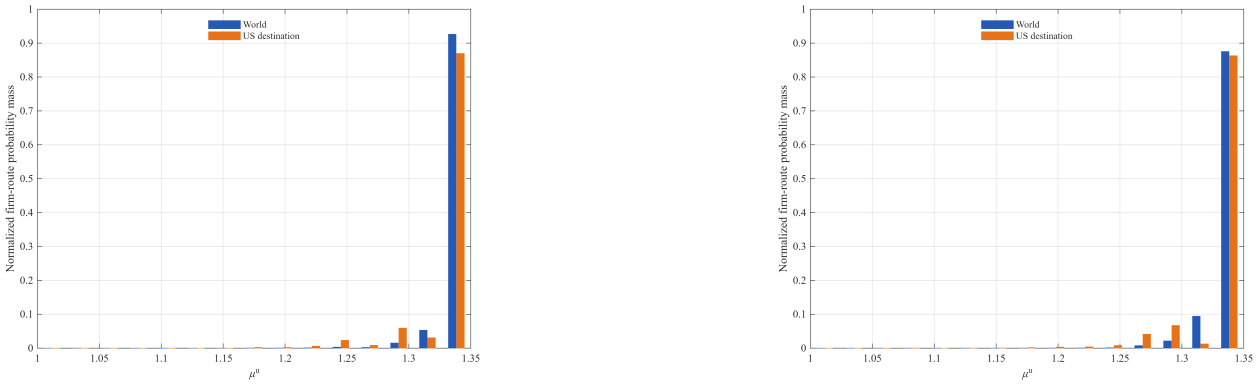
Figure D.4: Distribution of Upstream Markups under the 2016 U.S. Tariffs



(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 plots the distribution of the upstream markup $\mu^u_{i,lm}$ across global firms and headquarter i–production location l–destination m routes under the 2016 U.S. tariffs, weighting each firm-route by its mass. Markups are grouped into 15 bins below the full markup $\mu = 1.35$. Blue bars show the distribution across all routes and orange bars the distribution across routes whose destination is the United States; each sums to one.

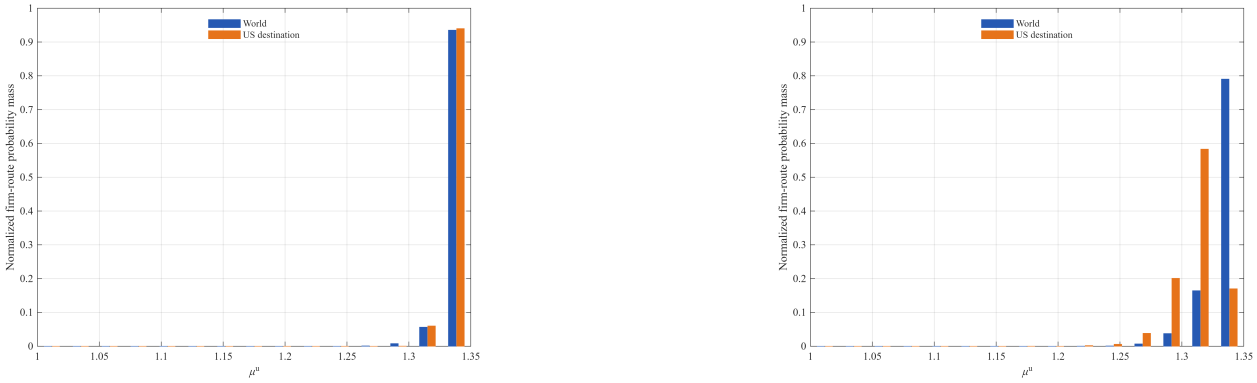
Figure D.5: Distribution of Upstream Markups under the 2018–2019 U.S. Tariffs



(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 plots the distribution of the upstream markup $\mu^u_{i,lm}$ across global firms and headquarter i–production location l–destination m routes under the 2018–2019 U.S. tariffs, weighting each firm-route by its mass. Markups are grouped into 15 bins below the full markup $\mu = 1.35$. Blue bars show the distribution across all routes and orange bars the distribution across routes whose destination is the United States; each sums to one.

Figure D.6: Distribution of Upstream Markups under the Optimal Tariff



(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 plots the distribution of the upstream markup $\mu^u_{i,lm}$ across global firms and headquarter i–production location l–destination m routes under the optimal uniform tariff, weighting each firm-route by its mass. Markups are grouped into 15 bins below the full markup $\mu = 1.35$. Blue bars show the distribution across all routes and orange bars the distribution across routes whose destination is the United States; each sums to one.

D.3 Calibration with the More Conservative Elasticities

Here we repeat the calibration using the more conservative scaling factor of seven from Anderson and Yotov (2025), which implies $\varepsilon = 4.07$ and $\sigma = 2.65$. Table D.2 reports the estimated parameters and the fit of each model variant, and Table D.3 reports the remaining calibrated parameters. Matching the same trade and output shares with lower elasticities requires substantially larger frictions: in the Local & Global calibration with strategic transfer pricing, the average τ rises from 2.07 in the baseline to 6.30, and the average γ from 2.06 to 6.16. This is the sense in which the more conservative elasticities imply less plausible magnitudes of trade and MP frictions. Figure D.7 reproduces the decomposition of optimal import tariffs under this calibration.

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				
Scale parameter $\delta \times \kappa$			0.001	0.023
Trade costs, eq. (29)				
Constant	3.785	4.943	3.957	4.864
Distance	0.245	0.136	0.170	0.128
Common border	0.548	0.430	0.588	0.445
Common language	0.944	0.798	0.878	0.779
Average τ	6.703	6.665	6.183	6.520
MP frictions, eq. (30)				
Constant	3.202	2.470	1.570	2.850
Distance	0.550	0.351	1.562	0.334
Common border	0.433	0.324	0.328	0.300
Common language	0.810	0.887	1.499	0.821
Average γ	8.572	6.241	16.665	6.383
Panel B: Goodness of fit (RMSE)				
Targeted moments				
Bilateral trade shares	0.0134	0.0141	0.0143	0.0139
Bilateral output shares	0.0216	0.0212	0.0213	0.0213
Expenditure relative to US	0.0020	0.0284	0.0020	0.0282
MNE domestic output share	0.6128	0.0603	0.6128	0.0583
Differential price response	0.3750	0.3750	0.0137	0.0026
Penalties to tariff revenue	0.0200	0.0200	0.0586	0.0416

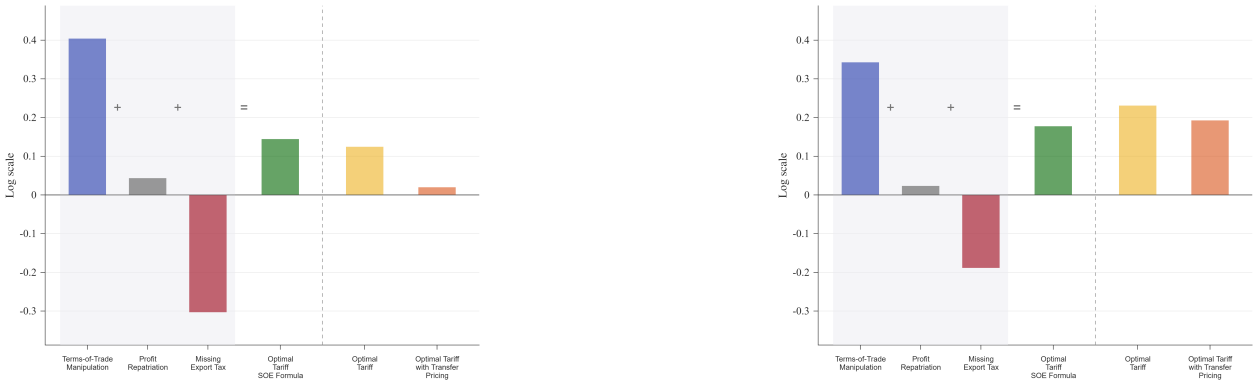
Notes: The four columns correspond to four model variants: whether strategic transfer pricing is allowed or shut down, and whether the firm population includes only global firms (*Global Firms*) or both local and global firms (*Local & Global Firms*). Panel A reports the parameters estimated. Trade costs and MP frictions follow the functional forms in equations (29) and (30). The curvature parameter α is fixed at 2; the scale parameter $\delta \times \kappa$ governs the transfer pricing technology and is estimated only in the two columns with strategic transfer pricing, where it targets two moments: the differential price response of -0.375 and the ratio of customs fines and penalties to tariff revenue of 0.2 percent. We multiply the second moment by 10, both in the estimation and in Panel B. Panel B reports the root mean squared error (RMSE) between model-generated and data moments.

Table D.3: Additional Calibrated Parameters, $\varepsilon = 4.07, \sigma = 2.65$

	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	1.841	2.215	2.904	2.261
Canada	1.883	1.801	1.412	1.805
Mexico	1.450	1.619	1.055	1.624
United States	1.093	1.321	0.816	1.311
S. America	1.013	1.089	0.711	1.104
Asia excluding China	1.016	1.180	1.744	1.206
China	1.018	0.989	1.549	1.006
Rest of the World	1.000	1.000	1.000	1.000
Estimated Production-Location Productivity, A_l^{loc}				
Europe	1.106	0.846	0.696	0.838
Canada	1.418	3.387	1.827	3.348
Mexico	1.028	1.364	1.364	1.344
United States	2.673	2.172	3.539	2.185
S. America	1.080	1.019	1.521	0.995
Asia excluding China	0.809	0.677	0.473	0.665
China	1.824	1.871	1.199	1.838
Rest of the World	1.000	1.000	1.000	1.000
Estimated Fixed Cost				
Common f		0.286		0.258

Notes: This table reports the remaining parameters from the calibration with the more conservative elasticities ($\varepsilon = 4.07$, $\sigma = 2.65$) corresponding to Table D.2. The productivity shifters A_i^{orig} and A_l^{loc} are normalized relative to the Rest of the World. The fixed cost f applies only to specifications with local and global firms.

Figure D.7: 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 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 $\log\left(\frac{\bar{\theta}_m E x_m}{\bar{\theta}_m E x_m - \bar{\vartheta}_m \Pi_m^{mne}}\right)$, 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.