The Pro-Competitive Effects of Trade Agreements

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Abstract

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1 Introduction

How do tariff changes impact the structure of markets and competition among firms? Over the last thirty years, preferential trade agreements have proliferated among low, middle, and high-income countries. The same period saw many lower-income countries accede to the World Trade Organisation. Finally, high income countries have extended and removed preferential tariff programmes to and from lower-income and least developed countries. In this paper, we examine how tariff changes under different trading arrangements impact price-cost markups of exporting firms in eleven low and middle-income countries.[1]

Our starting point is the observation that foreign exporters can simultaneously be big fish among exporters from their own country and small fry in the foreign markets they reach. For many low and middle income countries, only a few firms actively export a product. Data on the universe of exporting firms from eleven countries underscore the pronounced concentration of product-level trade (see table 1). Conditional on a positive trade volume, the median number of firms from an origin country exporting a product to a foreign trading partner is three. Further, new entrants often secure a significant share of an exported product's sales from their origin to a foreign destination; the median value is about one-third (see figure 1). While the *total* number of firms selling a product in any country is often large (see e.g., Bernard, Eaton, Jensen and Kortum (2003) and Helpman, Melitz and Yeaple (2004)), the limited number of competitors from the same origin could lead to non-trivial strategic interactions in price-setting among firms from that origin.

Does the small number of exporters from an origin in a destination's product market matter for markup responses to trade policy changes? We find in response to a 10% preferential tariff reduction, incumbent exporters from a preferred origin *reduce* their (tariff-exclusive) markups by 4.1%. This is an interesting and surprising result, especially when considering the classic literature on tariffs in imperfectly competitive markets. For example, Brander and Spencer (1984) showed that, under standard assumptions, a tariff cut on a foreign monopolist leads to an *increase* in a firm's market power and markup.[2] Similarly, in a multi-sector oligopolistic competition model like that of Atkeson and Burstein (2008), firms receiving a tariff cut would typically *increase* their (tariff-exclusive) markups to maximize profit.

We introduce a novel model to account for these new empirical facts, building upon Atkeson and Burstein (2008)'s seminal work on international pricing. Specifically, we extend

[1] The eleven countries are: Albania (2004-2012); Bulgaria (2001-2006); Burkina Faso (2005-2012); China (2000-2006); Egypt (2005-2013); Malawi (2006-2012); Mexico (2000-2012); Peru (2000-2013); Senegal (2000-2012); Uruguay (2001-2012); and Yemen (2008-2012).

[2] More generally, Brander and Spencer (1984) derive the demand conditions under which this holds for Cournot oligopoly with symmetric firms and no entry or exit.

Table 1: The number of entrants and incumbents exporting to granular markets: 3600 products, 11 origins, 165 destinations, and 12 years

	Mean	25th Percentile	Median	75th Percentile	Product-Origin-Destination-Year Markets
Number of Firms	11.97	1.00	3.00	7.00	1,303,733
– (a) Incumbents	4.35	0.00	1.00	2.00	1,303,733
– (b) Entrants	7.62	1.00	2.00	5.00	1,303,733

Notes: This table presents statistics on the number of exporting firms in a market defined at the product-origin-destination-year level using an unbalanced panel of the universe of firms exporting from 11 origins to 165 destinations for approximately 3600 intertemporally-consistent HS06 products over 12 years. The first row presents distribution moments for the number of active firms at the product-origin-destination-year level for the 1.3 million product-origin-destination-year markets in our final estimation sample. The next two rows break down the active firms in year t in an product-origin-destination-year market into (a) "incumbents", i.e., those firms that sell in an origin-destination-product market in both t and $t-1$, and (b) "entrants", i.e., those firms that did not sell in an product-origin-destination market in period $t-1$ but do so in period t. We provide more information on how these measures are constructed in online appendix OA1.5.

their two-country model into a multi-country framework and introduce a three-tiered CES preference structure: (1) the top tier captures a relatively low substitutability of different products in consumer welfare, (2) the middle tier captures a higher degree of substitutability across different national varieties of a product, and (3) the lowest tier captures an even higher degree of substitutability across firms within a country making the same national variety. This preference structure admits the possibility that firms can be small fry in foreign markets but still wield pricing power if they are big fish among all the firms from their own origin country that reach that foreign market. In this environment, a firm's markup depends on its elasticity of demand in the foreign market, which, in turn, is determined by two different market share measures and three elasticities of substitution.[3] A preferential tariff cut *increases* an origin's market share in a destination, which tends to increase the origin's pricing power, but it also *induces entry* of new exporters, reducing the pricing power of incumbent exporters. Whether the elasticity of demand facing an individual incumbent exporter rises or falls depends on the market structure in the destination and how the firm's relative market power evolves in response to the entry of new exporters.

Our model highlights the importance of two market share reallocation effects under a tariff cut: (a) the "across-origin" effect reflects how the increase in market access for the origin country as a whole could raise origin firms' market power, and hence, markups; and (b) the "within-origin" reallocation effect captures how lower tariffs encourage entry from a

[3]This framework nests the demand elasticities in Atkeson and Burstein (2008) and Melitz (2003) as special cases.

preferred origin, leading to a reduction in incumbent exporters' share of exports from their own country and, consequently, lower markups. Depending on the magnitude of these two reallocation effects, exporters either raise (anti-competitive) or lower (pro-competitive) their markups. Within-origin market share reallocation is typically ignored in studies assuming a Pareto distribution of firms because the quantitative impact of entrants and exiters on market structure is too small to influence incumbent firms' markups. However, in our model, where the number of incumbent firms and entrants is small and discrete, a trade policy change has a big effect on the extensive margin. This, in turn, causes substantial within-origin reallocation for all incumbent firms.

We show that within-origin market share reallocation can even dominate the impact on markups of conventional Vinerian "across-origin" trade diversion when goods produced by firms from the same origin are more substitutable with each other than with those produced by firms from *other* origins. Intuitively, when the elasticity of substitution among varieties from the same country is higher than that among varieties from *other* countries, exporting firms face the fiercest competition from their own national peers. As a result, for example, the markup of a Chinese firm will be heavily influenced by the prices charged by other Chinese firm(s) selling the same product in that destination, but less so by the prices of its numerous competitors from other countries. Under this setting, the entry of just one firm in response to a preferential tariff cut is sufficient to generate a markup reduction among incumbent exporting firm(s).[4]

Empirically, we investigate exporters' markup responses to trade policy changes for eleven low and middle income economies by integrating their annual customs records with information on 25 preferential trade agreements and data on bilateral import tariffs for 165 destinations. The unique structure of this multi-origin panel allows us to identify changes in markups and market shares by exploiting variation in firms' product-level export unit values (i.e., prices) and export sales across destinations and over time.

The empirical evidence produces strong support for our multi-country framework with nested CES preferences. First, our model predicts that the origin's market share in a destination *rises* while each individual firm's within-origin market share *falls* in response to a preferential tariff cut. Indeed, we estimate that a 10% preferential tariff liberalization leads to a 37% increase in an origin country's market share in the liberalizing destination and a

[4] An important empirical implication of our model is that the conventional import market share measure defined at the destination level (calculated as the trade value of the firm divided by the total trade value of all firms from all origins) is no longer a sufficient statistic for understanding markup adjustments. Due to the different effects of the within- vs. across-origin market share changes on markups, a firm can reduce its markup while its import market share in the destination market increases. This happens when firms respond more to their within-origin market share changes (e.g., due to a higher within-origin elasticity of substitution).

29% *reduction* in a firm's share of its origin's trade with the destination. Second, our model predicts a strong entry effect after a bilateral tariff reduction. Empirically, we find a 10% reduction in bilateral tariffs induces entry from the preferred origin and increases exporter participation by 22%.Viewed through the lens of our model, the empirical evidence indicates the within-origin market share reallocation effect dominates the across-origin reallocation effect, leading to an average 4.1% decrease in exporting firms' (pre-tariff) markups.

Literature. Our results contribute to a large literature that investigates the relationship between trade policy changes and markups (e.g., Brander and Krugman (1983), Brander and Spencer (1984), Helpman and Krugman (1985), Eaton and Grossman (1986), Markusen and Venables (1988), Epifani and Gancia (2011), Edmond, Midrigan and Xu (2015), Feenstra and Weinstein (2017), Feenstra (2018), Impullitti and Licandro (2018), and Arkolakis, Costinot, Donaldson and Rodríguez-Clare (2018)). A well-known theoretical result from Brander and Spencer (1984) showed that the price charged by a foreign monopolist rises in response to a tariff cut if, and only if, the elasticity of demand is decreasing in quantity along the demand curve; i.e., when Marshall's Second Law of Demand holds. A direct implication is that in a demand system where Marshall's Second Law of Demand fails to hold, a monopolistic firm may reduce its markup in response to a tariff cut, as we observed in the data. Recent work has examined markup adjustment to tariff changes under more general demand conditions. For example, Mrázová and Neary (2017) characterize for a general demand system the conditions under which the markup of a monopolistic firm falls with a tariff cut. The approach we take is different. We work with a standard CES demand function and show the empirical facts can be rationalized through the complex strategic interactions among firms.[5] Relative to existing multisector oligopolistic competition models (e.g., Atkeson and Burstein (2008), Edmond, Midrigan and Xu (2015)), we highlight the importance of firm entry and the related within-origin reallocation channel. We show foreign markups can *fall* with a reduction in tariffs in a nested CES framework whenever there is sufficiently strong substitution between foreign varieties and entry into the industry.[6]

[5]As we discuss in Section 3.3, in a concentrated market, a firm will account for and react to its competitors' price changes in response to a trade policy shock. Therefore, considering the properties of the demand function from the perspective of a single firm is no longer sufficient to capture the full equilibrium responses in a concentrated market, no matter how general this demand function is.

[6]Earlier work has emphasized the important role of free entry in models of imperfect competition. Markusen and Venables (1988) map out assumptions about market segmentation and free entry to show changes in assumptions about free entry nullify or flip predictions arising from changes in trade policy. More recently, Zhelobodko, Kokovin, Parenti and Thisse (2012) propose a model of monopolistic competition with additive preferences and show markup adjustment of firms depends on whether the relative love for variety increases with individual consumption. De Blas and Russ (2015) show that limiting the number of firms in a Bernard, Eaton, Jensen and Kortum (2003) model help to match number of stylized facts from the empirical literature on markups, pass-through, and trade openness.

Our results are also related to a growing empirical literature that has investigated how prices and markups of foreign and domestic firms adjust to trade liberalizations.[7] Consistent with our model's predictions, Amiti, Dai, Feenstra and Romalis (2020) highlight the quantitatively important role that new entry into the US by Chinese exporters over 2000-2006 had in reducing US manufacturing industry prices. Jaravel and Sager (2023) document that estimated declines in US CPI inflation arising from Chinese import penetration are consistent with trade models featuring strategic interactions in price-setting. Complementary to these studies, our empirical analysis exploits firm-level data from multiple origins and highlights the pro-competitive markup adjustments of exporters as well as the different responses of within- and across-origin market shares in response to trade policy changes.

The rest of the paper is organized as follows. Section 2 presents our data and highlights two key data features. Section 3 introduces our new model. Sections 4 and 5 discuss our estimation strategy and present our key empirical results. Section 6 concludes.

2 Firm-level export data

We bring together information on firms' product-level export values and quantities for eleven origins, 25 preferential trade agreements, and bilateral tariffs for 165 destinations to estimate the effect of trade policy on firms' exporting behaviour and markups. We use administrative data on the universe of Harmonized System 6-digit product exports by firms for eleven developing and emerging economies, obtained from three different sources. Data for Albania, Bulgaria, Burkina Faso, Malawi, Mexico, Peru, Senegal, Uruguay and Yemen are taken from the World Bank Exporter Dynamics Database,[8] data for Egypt from the Economic Research Forum Exports Dataset and data for China from the Chinese Customs Database. Our final estimation dataset contains 15,712,501 observations at the firm-product-origin-destination-year level and spans the years 2000-2013. While data for different countries are available for different years, 93% of observations in our final dataset are from 2000-2006. We provide more information about the dataset in Appendix A.

[7] For example, recent work by De Loecker, Goldberg, Khandelwal and Pavcnik (2016) and Edmond, Midrigan and Xu (2015) has found that trade liberalizations reduce the prices charged by domestic firms. Several papers (Bown and Crowley (2006), Amiti, Redding and Weinstein (2019), and Fajgelbaum, Goldberg, Kennedy and Khandelwal (2020)) examine foreign unit value responses to trade policy changes, but their product-level datasets do not allow for an analysis of markups. A recent study by Kikkawa, Mei and Santamarina (2019) uses survey data on Mexican firms to examine the impact of NAFTA on markups domestically and for exported products.

[8] The data employed in this paper are transaction-level customs data for the period 2000-2013. The data was collected by the Trade and Integration Unit of the World Bank Research Department, as part of their efforts to build the Exporter Dynamics Database described in Bortoluzzi, Fernandes and Pierola (2015). The sources for the data for each country are detailed at http://econ.worldbank.org/exporter-dynamics-database.

2.1 Entrants and incumbents in granular product markets

With this unique dataset, we highlight two key features of firm distributions at the granular product-origin-destination-year level. First, the number of firms competing at this granular level is limited – most markets have four or fewer incumbent firms selling the same HS6 product from an origin to a destination. Second, the extensive margin (at this granular level) plays a quantitatively important role in shaping market structure – new entrants comprise, on average, over one-third of an origin's exported sales of a product to a destination.

Table 2: The distribution of entrant and incumbent exporters across granular markets

Incumbents	**Entrants**						
	0	1	2	3	4	5+	Total
0		15.85	6.49	2.92	1.48	2.36	29.10
1	14.71	5.54	3.17	1.90	1.19	2.70	29.21
2	4.94	1.80	1.38	1.03	0.78	2.49	12.42
3	2.18	0.65	0.62	0.55	0.47	2.10	6.57
4	1.23	0.26	0.29	0.30	0.28	1.74	4.11
5+	4.82	0.25	0.35	0.42	0.47	12.29	18.59
Total	27.89	24.34	12.30	7.13	4.67	23.67	100.00

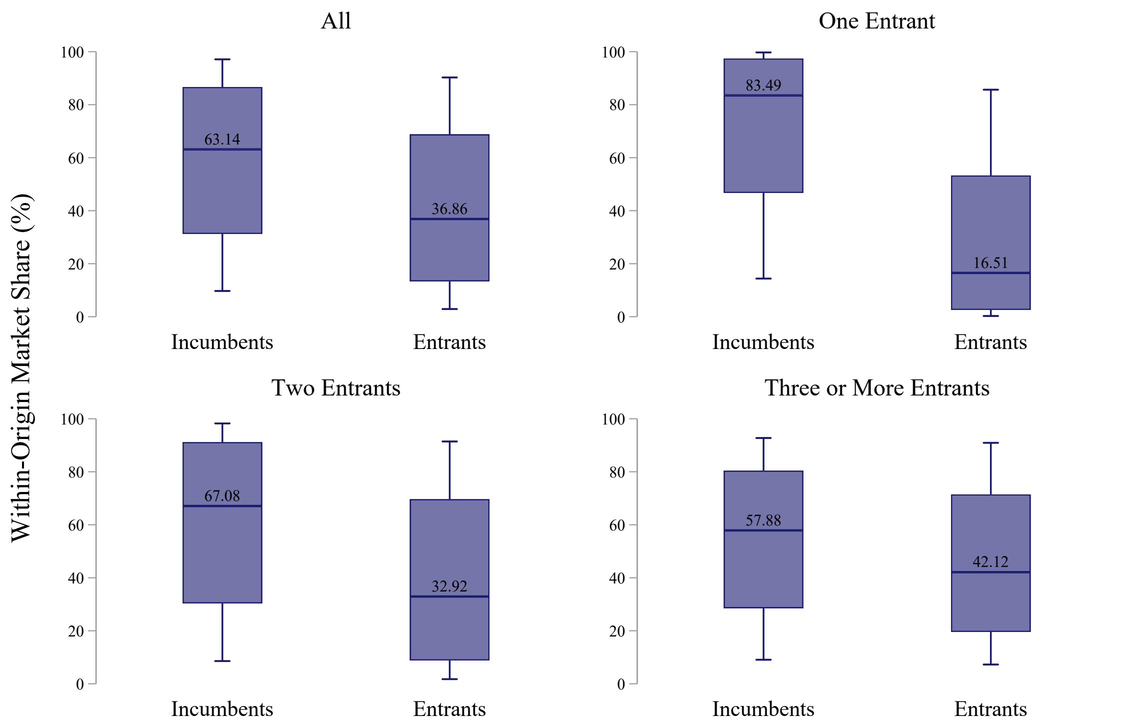
Notes: This table shows the share of markets, defined by a product-origin-destination-and-year, with different numbers of entering and incumbent exporters, conditional on the presence of at least one entrant or incumbent. Entrants are defined as firms from an origin o that sell to destination d product i at time t but did not do so at time $t-1$. Incumbents are defined as firms from an origin o that sell to destination d product i at time t and time $t-1$.

Table 2 tabulates the share of granular markets, defined by product-origin-destination-and-year, by numbers of entrants and incumbents. Our approach is to break down all firms in a granular market in year t into two groups: (1) "incumbents" who also exported to this granular market in $t-1$ and (2) "entrants" who did not export to this granular market in $t-1$.[9] The last *column* shows that more than 80% of markets have four or fewer incumbent firms, with nearly 30% of markets having only one incumbent firm. The last *row* shows that new firm entry is frequent – more than 70% of markets have at least one new entrant. Focusing on the more detailed breakdowns, we see that the market structure

[9]These statistics are based on product-origin-destination markets that feature in our baseline estimation sample, but exclude the first year of our sample, as we cannot distinguish between entrants and incumbents in that year.

at this granular level is volatile.[10] For example, the second row of table 2 highlights that nearly one third of markets with one incumbent firm have more entrants than incumbents [(3.17+1.90+1.19+2.70)/29.21 = 30.7%].

Figure 1: Cumulative market shares of incumbents vs. entrants in granular markets (conditional on the presence of at least one incumbent and one entrant)



Notes: Each panel presents the distribution of the cumulative market share of incumbents (left-hand box and whisker plot) and entrants (right-hand box and whisker plot) in granular markets defined by product-origin-destination-year, conditional on the specified number of incumbents and entrants. All panels are based on markets with at least one entrant and one incumbent. The number of incumbents is as stated: the upper left panel contains all markets with at least one and no maximum number of entrants; the top right, bottom left and bottom right panels focus on markets with exactly one, exactly two and three or more entrants. Entrants are defined as firms from an origin o that sell to destination d product i at time t but did not do so at time $t-1$. Incumbents are defined as firms from an origin o that sell to destination d product i at time t which already served the same market at time $t-1$. The bars in the box plots indicates the 10^{th}, 25^{th}, 50^{th}, 75^{th} and 90^{th} percentile of the distribution, respectively. The reported number in each box is the median.

Figure 1 shows the quantitative importance of new entrants in granular product-origin-destination-year markets which have at least one incumbent and one entrant. We compute total firm sales for every product-origin-destination-year and then calculate the share of sales due to incumbents and entrants. The top-left panel shows the median cumulative market share of all entrants in a granular market with at least one entrant and one incumbent is

[10] This is in line with previous evidence about the frequency with which firms enter, exit and switch between different destination markets (see e.g., Han (2022); Corsetti, Crowley, Han and Song (2023)).

36.86%. The next three panels refine the granular market share of entrants by the number of entrants, and show that the median cumulative market share of all entrants in a granular market increases with the number of entrants.[11] Notably, even when there is only one entrant, the market share of the new entrant in a granular market is non-trivial with a median of 16.51%.

In summary, for our sample of eleven countries, product-destination markets tend to be highly concentrated among an origin's exporters. This has two implications. First, exporting firms' price-setting could be strategic with respect to other firms from the same origin. Second, new entrants could play a non-trivial role in influencing the prices and markups of incumbent firms. In what follows, we build a theoretical model to incorporate these new data features and characterize how exporters interact with the small number of firms from their own origin while competing with the much larger number of competitors from other origins.

3 Conceptual framework

In this section, we present a multi-country framework to study how firms compete and adjust their markups in response to trade liberalizations. We follow Atkeson and Burstein (2008) and Edmond, Midrigan and Xu (2015) and consider a nested CES demand structure with a finite number of producers in each industry.

The world consists of a set of countries denoted by $\mathcal{H}$ and trade among countries is indexed by origin $o \in \mathcal{H}$ and destination $d \in \mathcal{H}$.[12] In each country, there is a continuum of unit mass of industries, indexed by i, selling tradable goods.[13] Final consumption Y_{dt} and the price of the final consumption good P_{dt} in each country d in period t are aggregated over industries i:

$$Y_{dt} = \left(\int_i y_{idt}^{\frac{\eta-1}{\eta}} di \right)^{\frac{\eta}{\eta-1}}, \quad P_{dt} = \left(\int_i p_{idt}^{1-\eta} di \right)^{\frac{1}{1-\eta}} \tag{1}$$

where $\eta > 1$ is the elasticity of substitution across industries. Industry-level output y_{idt} and the industry-level price index p_{idt} are obtained by aggregating products across different origins:

$$y_{idt} = \left(\sum_{o \in \mathcal{H}} y_{iodt}^{\frac{\rho-1}{\rho}} \right)^{\frac{\rho}{\rho-1}}, \quad p_{idt} = \left(\sum_{o \in \mathcal{H}} p_{iodt}^{1-\rho} \right)^{\frac{1}{1-\rho}} \tag{2}$$

[11] The panels for "One Entrant", "Two Entrants" and "Three or More Entrants" in Figure 1 are constructed from the data in columns "1", "2" and "3, 4, 5+" of table 2, respectively, after excluding the data in the first row which indicates there is no incumbent firm in the market.

[12] Throughout our paper, we use calligraphy math symbols to indicate a set of elements.

[13] In our empirical analysis, an "industry" is an HS6 product. We use the words "industry" and "product" interchangeably throughout the paper.

where $\rho \geq \eta$ is the elasticity of substitution across products from different origins. Within each industry-origin-destination triplet, there is a finite number of firms, each producing a differentiated variety. The industry-origin-destination level output y_{iodt} and price p_{iodt} are obtained by aggregating across firms from the same origin:

$$y_{iodt} = \left(\sum_{f \in \mathcal{F}_{iodt}} (\alpha_{fiodt})^{1/\sigma} y_{fiodt}^{\frac{\sigma-1}{\sigma}} \right)^{\frac{\sigma}{\sigma-1}}, \quad p_{iodt} = \left(\sum_{f \in \mathcal{F}_{iodt}} (\alpha_{fiodt}) p_{fiodt}^{1-\sigma} \right)^{\frac{1}{1-\sigma}} \tag{3}$$

where $\sigma \geq \rho$ is the elasticity of substitution across varieties from the same origin, α_{fiodt} is a demand/preference shifter and $\mathcal{F}_{iodt}$ represents the set of active firms that sell product i from origin o to destination d at time t.[14]

Production. Labor is inelastically supplied and immobile across countries, and wages are identical across sectors in a given country. The production function is linear in labour L and productivity Ω, i.e., $Y \equiv \Omega L$. The marginal cost of the firm is thus $mc_{fiot} = W_{ot}/\Omega_{fiot}$, where W_{ot} is the nominal wage of the origin country o at time t and Ω_{fiot} is the productivity of firm f in industry i from country o at time t.

Price and export decisions. Firms compete by simultaneously choosing whether to enter a market, indicated by $\phi_{fiodt} \in \{0, 1\}$, and their optimal price p_{fiodt} if they enter.[15] Since the production technology implies constant marginal costs, firms make their pricing and entry decisions separately for each destination market. The profit maximization problem of firm f in industry i from origin o selling in destination d is given by:

$$\pi_{fiodt} = \max_{p_{fiodt}, \phi_{fiodt}} \left[y_{fiodt} \left(\frac{p_{fiodt}}{\tau_{iodt}} - mc_{fiot} \right) - W_{ot}\zeta_x \right] \phi_{fiodt}$$

subject to

$$y_{fiodt} = \alpha_{fiodt} \left(\frac{p_{fiodt}}{p_{iodt}} \right)^{-\sigma} \left(\frac{p_{iodt}}{p_{idt}} \right)^{-\rho} \left(\frac{p_{idt}}{P_{dt}} \right)^{-\eta} Y_{dt} \tag{4}$$

where τ_{iodt} is the bilateral trade cost including tariffs[16] and ζ_x is a constant per-period export

[14] We indicate a variable's level of aggregation in our model by its subscript. The most disaggregated variables have five dimensions, f, i, o, d and t, which stand for firm, industry, origin, destination, and time, respectively.

[15] The analysis throughout the paper relies on the assumption of Bertrand competition. The demand elasticity under the assumption that firms compete on quantity is derived in Online Appendix OA3.2 .

[16] Throughout the paper we emphasize *bilateral tariffs* which destination d sets on imports from origin o at the level of a product i. Under World Trade Organization (WTO) rules, a destination country that is a WTO member should charge the same tariff on imports from all origin countries that are WTO members. In practice, WTO members that belong to preferential trade agreements and WTO members that offer preferential tariff treatment to imports from low income economies can deviate from this general rule by setting a lower bilateral tariff on imports from a preferred origin. Thus, we use the term "preferential tariff"

cost in terms of labor units. The firm will enter a market if the potential operating profit $y_{fiodt}(p_{fiodt}/\tau_{iodt} - mc_{fiot})$ is larger than the fixed per-period exporting cost $W_{ot}\zeta_x$.[17] We follow Atkeson and Burstein (2008) and Gaubert and Itskhoki (2021) and assume that firms enter sequentially, in reverse order of marginal costs.[18] This framework allows us to calibrate the fixed cost of entry to ensure that each market that is open to trade is served by a plethora of domestic and international firms, but that only a handful of firms from the same country of origin enter each disaggregated product market in a destination.

Upon entry, the optimal price p_{fiodt} is equal to the endogenous (destination-specific) markup μ_{fiodt} multiplied by the tariff-inclusive marginal cost mc_{fiodt}:

$$p_{fiodt} = \mu_{fiodt} mc_{fiodt}, \quad \mu_{fiodt} \equiv \frac{\varepsilon_{fiodt}}{\varepsilon_{fiodt} - 1}, \quad mc_{fiodt} \equiv mc_{fiot}\tau_{iodt} \tag{5}$$

where ε_{fiodt} is the price elasticity of demand.

In what follows, we discuss the key implications of our extensions for the firm's optimal markup μ_{fiodt} under different assumptions about competition.

3.1 Market structure, competition, and markups

The way in which firms compete depends on the structure of a market, which is characterized by two sets of statistics: (1) the market share distributions of firms and (2) the substitutability of varieties within an origin, across origins and across industries.

The general functional form of the demand elasticity under the triple-nested demand structure described by expressions (1) - (3) can be derived as follows:[19]

$$\varepsilon_{fiodt} = \sigma - ms_{fiodt}[\sigma - \rho + (\rho - \eta)ms_{iodt}] \tag{6}$$

where the first market share ms_{fiodt} captures the importance of the firm among all exporters from the origin and the second market share ms_{iodt} captures the importance of the origin country in the destination market:

$$\underbrace{ms_{fiodt} = \frac{p_{fiodt}y_{fiodt}}{\sum_{f' \in \mathcal{F}_{iodt}} p_{f'iodt}y_{f'iodt}}}_{\text{firm's within-origin market share}}, \qquad \underbrace{ms_{iodt} = \frac{p_{iodt}y_{iodt}}{\sum_{o' \in \mathcal{H}} p_{io'dt}y_{io'dt}}}_{\text{origin's market share in the destination}} \tag{7}$$

to describe bilateral tariffs associated with either of these WTO exceptions.

[17]The production and pricing decisions for a firm selling in its own domestic (origin) market are similarly defined with a smaller fixed cost of operating in the domestic market, $\zeta_h < \zeta_x$, and bilateral trade costs normalised to one ($\tau_{ioot} = 1$).

[18]This selects the equilibrium in which the most efficient firms operate (among multiple potential equilibria).

[19]See online appendix OA3.1 for the complete derivation.

In what follows, we show that equation (6) is a generalization, which nests many important models in the literature.

Monopolistic competition. First, there are two important cases where our model converges to a Melitz (2003) model: (a) when the number of firms from the same origin is large enough, e.g., $|\mathcal{F}_{iodt}| \to \infty$, and/or (b) when the degree of substitutability is the same for all products, i.e., $\sigma = \rho = \eta$.

In either case, firms compete under monopolistic competition and charge constant markups:

$$\mu_{fiodt} = \frac{\varepsilon_{fiodt}}{\varepsilon_{fiodt} - 1} \quad \text{with} \quad \varepsilon_{fiodt} = \sigma. \tag{8}$$

A key implication of this market structure is that the optimal markup is the same across big (more productive) and small (less productive) firms. In this case, firms will fully pass through any change in tariffs or other trade costs to the consumer price. Both (a) and (b) are strong theoretical assumptions which generate predictions that are not supported in the data. This has led many researchers to turn their attention to models featuring variable markups (Bernard, Eaton, Jensen and Kortum (2003), Melitz and Ottaviano (2008), Atkeson and Burstein (2008), Edmond, Midrigan and Xu (2015), Amiti, Itskhoki and Konings (2019)) with the class of models introduced by Atkeson and Burstein (2008) proving especially useful for studying pricing under oligopolistic competition at the industry level.

Oligopolistic competition at the industry level. Second, our model converges to that of Atkeson and Burstein (2008) if the number of firms operating in an industry is finite and the substitutability of products from different origins is the same, i.e., $\sigma = \rho$.

Under this market structure, the firm will internalize the impact of its competitors' prices at the industry level and the demand elasticity in equation (6) can be simplified to

$$\varepsilon_{fiodt} = \rho - \omega_{fiodt}(\rho - \eta) \tag{9}$$

where $\omega_{fiodt} = ms_{iodt} ms_{fiodt}$ is the firm's market share in the destination, capturing the importance of the firm in industry i to destination d at time t. A crucial implication of equation (9) is that a tariff reduction that increases the market shares of firms from the preferred origin in the destination leads to an increase in their markups.

Oligopolistic competition among firms from the same origin. If the number of firms from an origin selling a specific product to a particular destination is finite and small but the number of competitors from other origins is large, the firm may view other firms from the same origin as its key competitors and endogenize its impact on the origin-specific industry price index in the destination p_{iodt} but not on the overall industry price index in the destination p_{idt}. As $ms_{iodt} \to 0$, the demand elasticity converges to:

$$\varepsilon_{fiodt} \to \sigma - ms_{fiodt}(\sigma - \rho) \tag{10}$$

A key feature of equation (10) is that firms will only adjust their markups according to the level of competition from their peers from the same origin. Contrary to the prediction from the Atkeson and Burstein (2008) model, a tariff reduction will lead to a drop in the average markup of continuing firms from the origin. This is due to an important difference between oligopolistic and monopolistic competition: under oligopolistic competition with a small number of firms, the marginal entrant can substantially reduce the market shares of incumbent exporters, resulting in economically meaningful changes in the demand elasticity facing each incumbent exporter. Since the tariff reduction makes firms from the origin more competitive, some small firms will find it optimal to export and therefore enter the market, which reduces the average market share ms_{fiodt} of incumbent firms. The drop in market share in turn increases the demand elasticity, which leads to a reduction in the average markup. While intuitive, our model is, to the best of our knowledge, the first to formally characterize this oligopolistic competition at the level of an origin. Next, we show how to build on this intuition and construct a more general model where firms can compete oligopolistically both within and across origins within an industry.

3.2 Markup adjustment and market share reallocation effects

In this subsection, we examine the more general case of oligopolistic competition among origin firms and other foreign and domestic firms within a national industry. When there are a small number of competitors in a destination from the same origin *and* a small number of competitors from other origins, *and* the degree of substitutability for varieties produced within the same origin is different from that for varieties produced in different origins (i.e., $\sigma \neq \rho$), an origin firm will endogenize its impact on both the origin-industry price index p_{iodt} and the industry price index p_{idt} so that its demand elasticity takes the general form characterized in equation (6).

In this more general case, a preferential tariff reduction will lead to two competing channels: (1) a drop in the average market share of firms exporting product i from origin o to destination d (i.e., ms_{fiodt} goes down) and (2) a rise in the market share for sales of product i by origin o in destination d (i.e., ms_{iodt} goes up). As shown in equation (6), a drop in ms_{fiodt} increases the demand elasticity, whereas an increase in ms_{iodt} reduces the demand elasticity. So, the overall effect on the demand elasticity and, consequently, the markup can go in either direction in response to a tariff reduction. Whether the elasticity of demand rises or falls will depend on the initial market structure, which in turn governs the relative importance of the two channels.

Our starting point is to decompose changes in markups into two channels: (1) a within-origin reallocation effect which captures the adjustments of markups due to changes in the within-origin market shares, $\widehat{ms}_{fiodt}$, and (2) an across-origin reallocation effect that captures the markup adjustments due to changes in the across-origin market share, $\widehat{ms}_{iodt}$.

Proposition 1. *The markup adjustment under our proposed triple-nested CES framework is, up to a first order approximation, given by*

$$\widehat{\mu}_{fiodt} = \underbrace{A(\sigma, \rho, \eta, ms_{fiodt}, ms_{iodt}) \cdot \widehat{ms}_{fiodt}}_{\text{Within-origin reallocation effect}} + \underbrace{B(\sigma, \rho, \eta, ms_{fiodt}, ms_{iodt}) \cdot \widehat{ms}_{iodt}}_{\text{Across-origin reallocation effect}} \tag{11}$$

where the $\widehat{\ }$ *notation represents percentage changes of the variable from one period to the next, i.e.,* $\widehat{x}_t = ln(x_{t+1}/x_t)$*, and*

$$A(.) \equiv \frac{\sigma - \varepsilon_{fiodt}}{\varepsilon_{fiodt}(\varepsilon_{fiodt} - 1)}, \quad B(.) \equiv \frac{(\rho - \eta) ms_{fiodt} ms_{iodt}}{\varepsilon_{fiodt}(\varepsilon_{fiodt} - 1)}.$$

Regardless of the initial market share distributions (i.e., the values of ms_{fiodt} *and* ms_{iodt} $\forall f, i, o, d$ *at* t*) and the elasticity of substitution across industries* η*, we have*

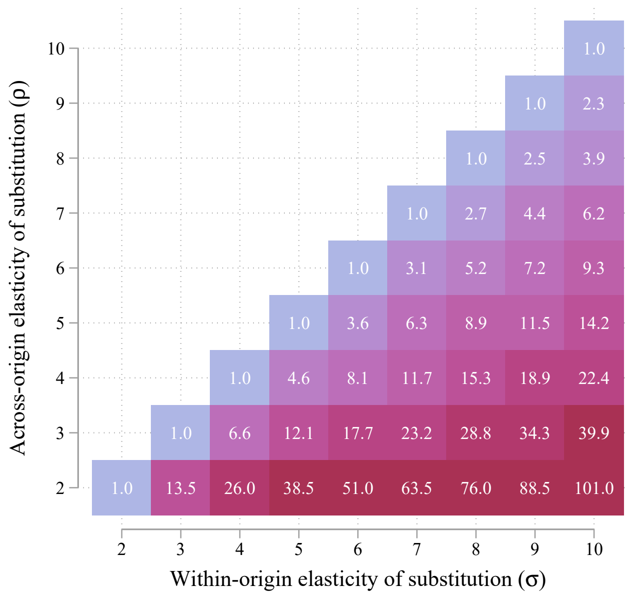
$$\begin{aligned} A(.) = B(.) \quad iff \quad \sigma = \rho \\ A(.) > B(.) \quad iff \quad \sigma > \rho \end{aligned} \tag{12}$$

See appendix B.1 for the proof. The key insight of Proposition 1 is that, while $A(.)$ and $B(.)$ are functions of two market shares (ms_{fiodt}, ms_{iodt}) and all three elasticities (σ, ρ, η), the relative importance of the two market share changes only depends on two elasticities: the within-origin elasticity of substitution σ and the across-origin elasticity of substitution ρ.[20]

When $\sigma = \rho$, we return to the Atkeson and Burstein (2008) case, where changes in the firm's within-origin market share $\widehat{ms}_{fiodt}$ have exactly the same effect as changes in the origin's market share in the destination $\widehat{ms}_{iodt}$. In this case, the direction of the markup adjustment depends only on the sum of the two market share changes, i.e., $\widehat{ms}_{fiodt} + \widehat{ms}_{iodt} = \widehat{\omega}_{fiodt}$. This implies that a firm's markup always moves in the same direction as its market share in the destination. Therefore, if a bilateral tariff cut raises the firm's market share in the destination market, it will increase its markup.

[20]Note that this is a general result that holds regardless of which set of underlying shocks drive the two market share changes.

Figure 2: Relative importance of two market share changes on the markup adjustment



Note: The numbers in the coloured cells give the ratio of the two reallocation effects (i.e., $A(.)/B(.)$) for an example firm with $ms_{fiodt} = 0.5, ms_{iodt} = 0.1$, and $\eta = 1.2$.

Our framework allows for a more flexible relationship between the two market shares and markups. When $\sigma > \rho$, and a product is therefore more substitutable across firms within an origin than across firms from different origins, the effect of changing the firm's within-origin market share $\widehat{ms}_{fiodt}$ is larger than that of changing the origin's market share in the destination market $\widehat{ms}_{iodt}$. Therefore, the markup adjustment can be positive even if the sum of the two market share changes is zero or negative (i.e., $\widehat{ms}_{fiodt} + \widehat{ms}_{iodt} = \widehat{\omega}_{fiodt} \leq 0$). Intuitively, this is because when $\sigma > \rho$, firms face fiercer competition from peers from their own origin than they do from firms from *other* origins.

Figure 2 presents a visualization of the ratio of the two functions $(A(.)/B(.))$ under different values of within- and across-origin elasticities while fixing the firm's within-origin market share ms_{fiodt} at 50%, the origin's market share in the destination ms_{iodt} at 10% and the elasticity of substitution across products η at 1.2. Specifically the numbers in the cells give information on the extent to which the origin's market share in the destination $\widehat{ms}_{iodt}$ would need to drop in order to offset the effect of a 1% increase in the firm's within-origin market share $\widehat{ms}_{fiodt}$ on markups. The diagonal elements of 1.0 indicate that the origin's market share in the destination $\widehat{ms}_{iodt}$ would need to drop by 1% to offset the effect of a 1% increase in the firm's within-origin market share $\widehat{ms}_{fiodt}$ in the Atkeson and Burstein (2008) case. Focusing on the off-diagonal elements, we can see clearly that the ratio increases dramatically as the distance between the two elasticities becomes larger. At an extreme, when $\rho = 2$ and $\sigma = 10$, the origin's market share in the destination $\widehat{ms}_{iodt}$ would need to drop by more than 100% to offset the effect of a 1% increase in the firm's within-origin market share $\widehat{ms}_{fiodt}$.[21]

3.3 The role of strategic interaction under firm entry

In this subsection, we analyse the role of strategic interaction and firm entry on markup adjustments under a preferential tariff change. The key question we want to address is whether the entry and exit of relatively small firms would lead to economically meaningful changes in market structure and the markup adjustments of incumbent firms from the preferred origin.

We approach the question by solving for the endogenous market share changes (i.e., $\widehat{ms}_{fiodt}$ and $\widehat{ms}_{iodt}$) in Proposition 1. Following Amiti, Itskhoki and Konings (2019), we decompose any price adjustment into (tariff-inclusive) marginal cost changes and markup adjustments:

$$\widehat{p}_{fiodt} = \widehat{mc}_{fiodt} + \widehat{\mu}_{fiodt} \tag{13}$$

where the optimal markup responds to (i) the firm's own price changes $\widehat{p}_{fiodt}$, (ii) other firms' price changes from the same origin $\widehat{p}_{kiodt}$ $\forall k \neq f \in \mathcal{F}_{iodt}$, (iii) other firms' price changes from the different origins $\widehat{p}_{f'io'dt}$ $\forall f', o' \in \mathcal{F}_{idt} \backslash \mathcal{F}_{iodt}$ and (iv) the new entrants $\widehat{E}_{fiodt}$:

$$\begin{aligned} \widehat{\mu}_{fiodt} = {} & \frac{\partial \mu_{fiodt}}{\partial p_{fiodt}} \frac{p_{fiodt}}{\mu_{fiodt}} \widehat{p}_{fiodt} + \sum_{k \neq f \in \mathcal{F}_{iodt}} \frac{\partial \mu_{fiodt}}{\partial p_{kiodt}} \frac{p_{kiodt}}{\mu_{fiodt}} \widehat{p}_{kiodt} \\ & + \sum_{f', o' \in \mathcal{F}_{idt} \backslash \mathcal{F}_{iodt}} \frac{\partial \mu_{fiodt}}{\partial p_{f'io'dt}} \frac{p_{f'io'dt}}{\mu_{fiodt}} \widehat{p}_{f'io'dt} + \widehat{E}_{fiodt} \end{aligned} \tag{14}$$

Different from Amiti, Itskhoki and Konings (2019), our triple nested demand structure implies different responses to price changes by firms from one's own versus other origins, which means we need to keep track of (ii) and (iii) separately. More importantly, our decomposition accounts for the effect of new entrants $\widehat{E}_{fiodt}$ on incumbent firms' markups.[22] Since all variables on the right hand side of equation (14) are endogenous, equations (13) and (14) represent a fixed point problem, which we solve in appendix B.2.

Proposition 2. *Under a 1% preferential tariff reduction (i.e., $\widehat{\tau}_{iodt} = -1\%$), the markup adjustment (as a percentage) of firms from the preferred origin is, up to a first order approx-*

[21] See online appendix OA3.1.1 for further discussion of the two reallocation effects and how these two effects vary with the firm's initial within-origin market share and the origin's initial market share in the destination.

[22] We use $\widehat{E}_{fiodt}$ to denote the direct entry effect on an incumbent firm's optimal markup for now and give more details about the exact form of $\widehat{E}_{fiodt}$ in appendix B.2.4.

imation, given by

$$\widehat{\mu}_{fiodt} \approx \Upsilon_{fiodt} - (1 - \Upsilon_{fiodt})\, \Phi_{iodt} \widetilde{ms}_{jiodt} \tag{15}$$

where $0 \leq \Upsilon_{fiodt} < 1$ *is the markup adjustment in the absence of entry;* $-(1 - \Upsilon_{fiodt})\, \Phi_{iodt}$ *captures the entry effect;* $\widetilde{ms}_{jiodt}$ *is the sum of the within-origin market shares of new entrants from origin* o *in product-market* id *due to the preferential tariff reduction; and*

$$\Phi_{fiodt} = \varphi_{iodt} \left(\sum_{f \in \mathcal{F}_{iodt}} \frac{ms_{fiodt}}{\varepsilon^2_{fiodt} + \sigma^2 - (\varepsilon_{fiodt} + 1)\sigma} \right) / \left(\sum_{f \in \mathcal{F}_{iodt}} \frac{ms_{fiodt}\varepsilon_{fiodt}(\varepsilon_{fiodt} - 1)}{\varepsilon^2_{fiodt} + \sigma^2 - (\varepsilon_{fiodt} + 1)\sigma} \right) \times 100,$$

$$\varphi_{iodt} \equiv (\sigma - \rho) + (\rho - \eta) ms_{iodt}[1 - (\rho - 1)/(\sigma - 1)(1 - ms_{iodt})].$$

We give the exact expression of Υ_{fiodt} in appendix B.2. There are two key takeaways from Proposition 2. First, we see from equation (15) that, in the absence of entry (i.e., when $\widetilde{ms}_{jiodt} = 0$), the markup adjustment is in general positive (i.e., $\Upsilon_{fiodt} > 0$) under a preferential tariff reduction, implying an incomplete pass through into import prices. Second, the direction of the entry effect is proportional to the within-origin market share taken by the new entrants $\widetilde{ms}_{jiodt}$ and depends on the sign of Φ_{iodt}. When $\sigma > \rho$, $\Phi_{iodt} > 0$ and new entrants from the preferred origin reduce incumbent firms' optimal markups. Define the breakeven market share as

$$\overline{\widetilde{ms}}_{jiodt} \equiv \frac{\Upsilon_{fiodt}}{(1 - \Upsilon_{fiodt})\, \Phi_{iodt}}. \tag{16}$$

Provided that $\sigma > \rho$, the markup adjustment of an incumbent exporter is negative under a preferential tariff cut if the market share of new entrants is sufficiently large, i.e., $\widetilde{ms}_{jiodt} > \overline{\widetilde{ms}}_{jiodt}$. Unfortunately, the exact values of Υ_{fiodt} and Φ_{iodt} depend on the entire market share distribution of all firms in the industry (i.e., firms from the preferred origin and those from all other origins) and there is no simple analytical expression for $\overline{\widetilde{ms}}_{jiodt}$.[23] However, an *ex ante* symmetric case – in which countries have the same ms_{iodt} and within each origin firms have the same ms_{fiodt} before the tariff shock hits – provides useful insights.

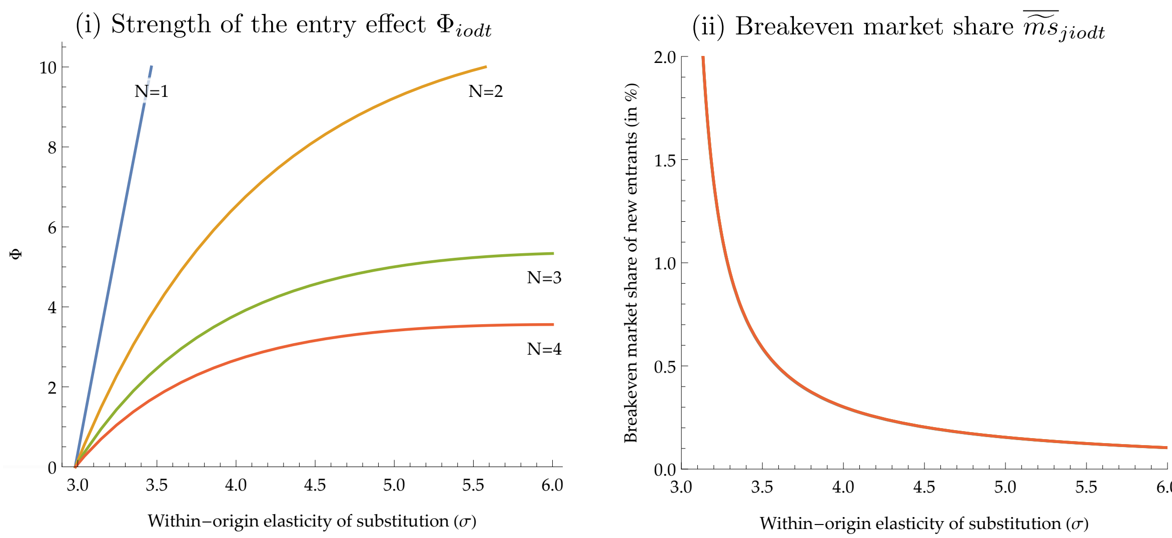
Figure 3 illustrates the strength of the entry effect Φ_{iodt} and the breakeven market share $\overline{\widetilde{ms}}_{jiodt}$ in such a symmetric setting. We can see from panel (i) of figure 3 that the strength of the entry effect Φ_{iodt} is increasing in σ.[24] In the Atkeson-Burstein special case when $\sigma = \rho$, Φ_{iodt} is exactly zero. The entry effect is stronger if there are fewer incumbent firms in the market before the tariff shock hits. Panel (ii) of figure 3 shows that the breakeven market share is decreasing in σ (when $\sigma > \rho$). For example, when σ is close to $\rho = 3$, $\overline{\widetilde{ms}}_{jiodt} > 1\%$, suggesting that a 10% tariff reduction would need to entice entrants that account for more

[23] In appendix B.2, we give the full expressions of Υ_{fiodt} and Φ_{iodt}, which can be calculated numerically for a given market share distribution.

[24] In general, Φ_{iodt} is a non-monotonic function of σ; it is increasing in σ when σ is close to ρ.

than 10% of the within-origin market share to lead incumbent firms from the preferred origin to reduce their markups. However, the breakeven market share drops quickly as σ increases; $\widetilde{\overline{ms}}_{jiodt} < 0.2\%$ when $\sigma > 5$, which suggests that new entrants which account for more than 2% of the within-origin market share would be sufficient for a 10% tariff reduction to encourage incumbent firms from the preferred origin to reduce their markups. Finally, unlike Φ_{iodt}, the breakeven market share $\widetilde{\overline{ms}}_{jiodt}$ is insensitive to the initial market share distribution of the preferred origin. This is because more concentrated industries with a high Φ_{iodt} also tend to have a higher Υ_{fiodt}. Lemma 1 gives a formal characterization of our discussion around panel (ii).

Figure 3: The entry effect in an *ex ante* symmetric setting



Notes: These two figures illustrate the entry effect on markups under a preferential tariff cut in an *ex ante* symmetric setting with $ms_{iodt} = 0.1$, $\rho = 3$ and $\eta = 1.2$. The left figure plots the Φ_{iodt} function for different values of σ and the number of incumbent firms in the market before the tariff hits N with $ms_{fiodt} = 1/N$. The right hand side figure plots the breakeven market share of new entrants $\widetilde{\overline{ms}}_{jiodt}$ above which the markup adjustment of the incumbent firm will be negative for different values of σ. The value of $\widetilde{\overline{ms}}_{jiodt}$ is insensitive to N.

Lemma 1. *In the symmetric case where incumbent firms have identical market shares* ex ante, *the breakeven market share of the new entrants*

$$\widetilde{\overline{ms}}_{jiodt} \approx \frac{ms_{iodt}(\rho-1)(\rho-\eta)(\sigma-1)}{100\left\{(\sigma-\rho)(\sigma-1) + ms_{iodt}(\rho-\eta)[ms_{iodt}(\rho-1)+\sigma-\rho]\right\}}$$

is independent of the initial within-origin market concentration (i.e., $ms_{fiodt} = 1/N_{iodt}$) and strictly decreasing in σ when $\sigma > \rho$.

Remarks. We conclude our discussion on the entry effect by clarifying the limitation and the applicability of our Proposition 2 results. First, in deriving Proposition 2, we only considered the partial equilibrium effects of the preferential tariff reduction. In a general equilibrium framework, the wages of the countries which sign the preferential trade agreement may also change, which could have additional impacts on firms' prices through the cost channel.[25] Second, we have directly accounted for the entry effect of firms from the preferred origin, and have assumed that the entry and exit decisions of firms from other origins have small impacts on the markups of firms from the preferred origin.[26] In general, the increased competitive pressure due to price reductions and entry of firms from the preferred origin may lead some firms from other origins to exit the market and thus partly offset the effect of entry from the preferred origin.[27] In this vein, our Proposition 2 is best viewed as a partial equilibrium approximation in the case where the origin country's market share ms_{iodt} is small and thus has limited impact on the entry and exit decisions of firms in other countries.

The role of strategic interactions in the absence of entry. On top of the entry effect, oligopolistic competition implies strategic interactions in pricing, which means that the properties of the demand function (or the demand elasticity) facing a single firm no longer provide sufficient information to understand the price pass through of a common cost shock, like a preferential tariff change, that affects a group of firms.

A classical result on the markup adjustment under a tariff change is given by Brander and Spencer (1984), which states that, for a monopoly exporter, the optimal markup declines in response to a preferential tariff cut if and only if the demand elasticity is decreasing in quantity along the demand curve.[28] Intuitively, the tariff cut increases the quantity sold by the exporter for a given price; the firm will want to reduces its markup if and only if the

[25] In empirical specifications, general equilibrium effects (e.g., changes in the wages) are controlled for via time-varying fixed effects.

[26] Specifically, this assumption is only needed when we approximate the entry effect in subsection B.2.4. Our expression (B-24) in appendix B.2.3 remains a general decomposition that incorporates all the entry effects.

[27] One particular concern with this assumption is that increased competitive pressure from new entrants of preferred origin may lead small domestic firms to exit, partially offsetting the entry effect we document here. We acknowledge this is a valid concern. However, we argue that the exit impact of domestic firms on incumbent foreign exporters should be quantitatively small for three reasons. First, unlike new entrants from the preferred origin who enter the market due to the *direct* effect of a cost reduction (resulting from the tariff cut), the exit decisions of domestic firms arise from the *indirect* effects of competition, which are generally an order of magnitude smaller than the direct effect. Second, domestic firms face no trade costs and have smaller entry costs compared to foreign firms. As a result, domestic firms around the operating cutoff are much smaller than the foreign firms around the exporting cutoff, and therefore the exits of these tiny domestic firms will have a much smaller impact on market structure. Third, the exit of domestic firms will affect all foreign exporters from the preferred origin equally, and thus will not have any first-order impact on within-origin market shares. For these reasons, the exit of small domestic firms following a PTA will only have a limited impact on the markups of incumbent foreign exporters.

[28] Also see chapter 8 of Feenstra (2015) for more detailed discussion.

rise in demand leads to an increase in its demand elasticity.[29] Mrázová and Neary (2017) characterize a more general condition of this result and relate it to the curvature of the demand curve. We note that, while the theoretical results in this strand of the literature are rich and allow for flexible demand functions, they do not directly account for a firm's strategic markup adjustments to its competitor's prices. In the context of our price decomposition, this would be equivalent to restricting the markup responses in equation (14) to:

$$\widehat{\mu}_{fiodt} = \frac{\partial \mu_{fiodt}}{\partial p_{fiodt}} \frac{p_{fiodt}}{\mu_{fiodt}} \widehat{p}_{fiodt} \tag{17}$$

Lemma 2. *The (tariff-exclusive) markup of a firm which does not endogenize its competitors' price changes in its markup decision (i.e., a firm for which the assumption embodied in equation (17) holds) decreases in response to a preferential tariff cut if and only if the following* equivalent *statements hold*

(i) the demand elasticity is decreasing in the firm's (tariff-inclusive) price

(ii) the demand elasticity is increasing in the quantity the firm sells

(iii) Marshall's "Second Law of Demand" is violated

(iv) the demand function is "superconvex".

A key feature of our oligopolistic competition framework is that firms care about and react to their competitors' prices changes. Therefore, firms pass through common and idiosyncratic shocks quite differently. Under a common cost shock, the fact that the firm's competitors are also hit by the same shock increases the pass through due to strategic complementarity in pricing. Intuitively, under a preferential tariff cut, holding all of its competitors' prices fixed, a firm would want to increase its markups to maximize its profit. However, at the same time, the firm realises that its competitors' from the same origin hit by the same shock would also want to reduce their prices, which increases the competitive pressure facing the firm. Accounting for its competitors' price reductions, the firm would want to increases its markup by a smaller extent compared to the scenario in which all of its competitors' prices are held fixed.[30] Lemma 3 formalizes this discussion.

[29] Since this requires the demand elasticity to *increase* (rather than decrease) in quantity, it is also referred to as a violation of Marshall's Second Law of Demand.

[30] Amiti, Itskhoki and Konings (2019) also note that firms pass-through common and idiosyncratic shocks differently in a Atkeson and Burstein (2008) model: a common cost shock has a limited impact on the structure of a market (i.e., the market share distribution) and thus leads to complete (100%) pass through of the shock with no markup adjustments, while an idiosyncratic cost shock leads to significant changes in market shares and therefore large markup adjustments. Unlike Amiti, Itskhoki and Konings (2019), we

Lemma 3. *In the absence of entry and exit, firms which strategically respond to their competitors' price changes following a preferential tariff change $\widehat{\tau}_{iodt}$ adjust their markups differently than firms which do not:*

$$\widehat{\mu}_{fiodt} \approx \begin{cases} -\Upsilon_{fiodt}\widehat{\tau}_{iodt} & \textit{with strategic response} \\ -\Gamma_{fiodt}/(\Gamma_{fiodt}+\varepsilon_{fiodt}-1)\widehat{\tau}_{iodt} & \textit{without strategic response (under eq. (17))} \end{cases}$$

where $\Gamma_{fiodt} \equiv \frac{\partial \varepsilon_{fiodt}}{\partial p_{fiodt}} \frac{p_{fiodt}}{\varepsilon_{fiodt}}$ is the super elasticity that captures how a firm's demand elasticity changes with its price. In the ex ante symmetric case, $\Upsilon_{fiodt} < \Gamma_{fiodt}/(\Gamma_{fiodt}+\varepsilon_{fiodt}-1)$ when $ms_{fiodt} \neq 1$ and $\sigma > \rho$.[31]

To summarize, our framework envisions a world in which there may only be a small number of firms which export a highly disaggregated product from any given origin to any given destination. This departure from existing trade models is motivated by the distribution of the number of firms across product-origin-destination markets we observe in our empirical dataset, where we find a median of three firms across all of our product-origin-destination-year markets (see table 1).[32] Our framework incorporates the discrete and granular nature of our empirical firm distribution and emphasizes that the entry or exit of a single firm can have a substantial impact on the within-origin market structure. This has important implications for the markup repercussions of trade shocks, especially when firms react to both changes in costs and changes in their competitors' prices. In particular, our theoretical framework highlights the possibility that an incumbent firm's markup may drop in response to a preferential tariff cut. This happens when the entry effect is strong and the within-origin reallocation effect is large. In addition, for a given change in the within-origin market share, the markup adjustment is more likely to be negative the larger the distance between the within- and across-origin elasticities of substitution, $\sigma - \rho$. In the next section, we estimate the markup responses to preferential tariff changes and test these theoretical relationships.

consider a bilateral tariff shock, which is a shock common to all firms from the preferred origin which does not simultaneously affect the costs of any other firms in the market. In this case, pass through will be higher than in response to an idiosyncratic cost shock but still incomplete (less than 100%).

[31] While in general $\Upsilon_{fiodt} < \Gamma_{fiodt}/(\Gamma_{fiodt}+\varepsilon_{fiodt}-1)$, it is difficult to prove this relationship analytically. This is because the exact expression of Υ_{fiodt} depends on the distribution of market shares of all firms in the industry and cannot be easily compared to $\Gamma_{fiodt}/(\Gamma_{fiodt}+\varepsilon_{fiodt}-1)$. We thus turn to consider the case where firms have identical market shares *ex ante*.

[32] In a trade model with a continuous measure of heterogeneous firms (e.g., Melitz (2003)), entry and exit of marginal firms would have a negligible direct impact on existing exporters' market shares.

4 Empirical strategy

To examine the predictions of our model, we exploit the fact that our dataset encompasses both multiple countries of origin and multiple destinations to analyse exporting firms behaviour in response to preferential trade policy changes. In particular, we want to investigate firms' markup responses, whether a preferential trade policy change can simultaneously increase an origin's market share in a destination and reduce the within-origin market shares of firms from that origin, and whether this differential response could be due to additional firm entry. Our main variables of interest are, therefore, (i) the firm's markup μ_{fiodt}, (ii) the firm's market share in the product market of a destination $\omega_{fiodt} = p_{fiodt} y_{fiodt} / \left(\sum_{f,o} p_{fiodt} y_{fiodt} \right)$, (iii) the firm's within-origin market share ms_{fiodt}, (iv) the origins' market share in a destination-product market ms_{iodt}, and (v) the number of firms from an origin selling a given product to a destination N_{iodt}.

We rely on two insights, together with the multi-origin and multi-destination nature of our panel dataset, to identify the elasticities of these five variables to changes in trade policy despite the fact that we observe neither firms' marginal costs nor overall sales, which include sales by domestic firms, in any given product market of a destination.[33] First, firms' marginal costs of production for a given product are the same regardless of where the firm sells that product. This means we can leverage the presence of multiple destination markets in our dataset to difference out the marginal cost component, as well as any global markup component that is common to all destinations, of firms' prices, allowing us to study adjustments in the destination-specific component of markups. Second, the overall size of a product market in a country is the same for all firms regardless of where a firm is based. This means we can leverage the presence of multiple countries of origin in our dataset to control for market size. This allows us to analyse the response of market shares, rather than export values, to trade policy changes.

Specifically, we identify the elasticities of markups and market shares to trade policy

[33] While it may be possible to obtain data on domestic firms' sales in some cases (as in Amiti, Itskhoki and Konings (2019)), gathering detailed product-level domestic sales data for all 165 destination countries in our estimation sample is generally infeasible.

changes via the following specification:[34]

$$\ln(\text{Outcome}_{fiodt}) = \beta_1 \cdot \text{PTA}_{odt} + \beta_2 \cdot \text{Tariff}_{iodt} + \delta_{fiot} + \delta_{idt} + \delta_{od} + \zeta_{fiodt}, \tag{18}$$

and use PPML to estimate an aggregated version of this specification for the number of firms in a product-origin-destination-year market N_{iodt}:[35]

$$N_{iodt} = \beta_1 \cdot \text{PTA}_{odt} + \beta_2 \cdot \text{Tariff}_{iodt} + \delta_{iot} + \delta_{idt} + \delta_{od} + \zeta_{iodt}, \tag{19}$$

where δ_{fiot}, δ_{iot}, δ_{idt} and δ_{od} are firm-product-origin-year, product-origin-year, product-destination-year and origin-destination fixed effects, respectively, and ζ_{fiodt} and ζ_{iodt} are residual terms.[36] The two right-hand-side variables describe the trade policy regime firms from an origin face in the destination. The first, PTA_{odt}, is an indicator variable equal to one if the origin and the destination have an active trade agreement in year t. The second, Tariff_{iodt}, denotes the natural logarithm of one plus the ad-valorem tariff on imports of product i from origin o charged by destination d.

Specification (18) allows us to identify firms' (destination-specific) markup adjustments in response to preferential trade policy changes. This is because the (tariff-exclusive) border price $\ln(p^b_{fiodt})$, which is directly observable in our dataset, can be decomposed into a destination-specific markup component, a component that captures the mean markup across all active destinations $\ln(\mu_{fiot})$, and the firm's product-level marginal cost $\ln(\text{mc}_{fiot})$:

$$\ln(p^b_{fiodt}) = \underbrace{\ln(\mu_{fiodt}) - \ln(\mu_{fiot})}_{\text{destination-specific markup}} + \underbrace{\ln(\mu_{fiot}) + \ln(mc_{fiot})}_{\text{absorbed by } fiot \text{ fixed effects}}. \tag{20}$$

[34]We estimate the effect of tariffs and trade agreements on the origin's market share in the destination at the same level of aggregation and over the same sample as the other three variables, despite the fact that this market share does not vary across firms, to ensure that the estimated elasticities for the three market shares add up in the expected way. This essentially amounts to comparing an origin's market share across different destinations within a firm rather than within an origin as is common in the literature and corresponds to a weighting scheme that puts more emphasis on markets with more firms (see Online Appendix OA2.1 for more details).

[35]For this variable, we create a dataset at the product-origin-destination-year level which includes zeros in years when no firms are observed exporting a product that the origin exports to the destination in at least one year.

[36]All continuous outcome variables enter our estimating equations in natural logarithms. We estimate these specifications with panel OLS rather than PPML regressions, as creating a full panel of zero trade flows at the firm-product-origin-destination-year level for eleven countries would result in a dataset of more than 100 million observations, rendering estimation in a reasonable time period infeasible. This means that we only use observations with positive trade flows. However, it is important to note that our fixed effects should absorb most of the variation in trade costs that prevents firms from entering a market, and thus account for the selection process that gives rise to positive trade flows, as noted in Baier, Bergstrand and Feng (2014) and Corsetti, Crowley, Han and Song (2023).

Once we account for our firm-product-origin-year fixed effects, conventional in the pricing-to-market literature (see, e.g., Knetter (1989), Knetter (1993), and more recently Fitzgerald and Haller (2014), and Fitzgerald, Haller and Yedid-Levi (2023)), only the first component remains.[37]

To identify changes in market shares, we rely on the fact that our sample includes multiple countries of origin and include product-destination-year fixed effects in specification (18).[38] This allows us to obtain market share elasticities with respect to trade policy changes because we can decompose the log of a firm's trade value in a destination-product market, $\ln(p_{fiodt}y_{fiodt})$, which is directly measurable in our dataset, into the firm's market share in a destination and an unobserved market size term that is absorbed by these fixed effects, $\ln\left(\sum_{f,o} p_{fiodt}y_{fiodt}\right)$:

$$\ln(p_{fiodt}y_{fiodt}) = \ln(\omega_{fiodt}) + \underbrace{\ln\left(\sum_{f,o} p_{fiodt}y_{fiodt}\right)}_{\text{absorbed by } \delta_{idt} \text{ fixed effects}} . \tag{21}$$

The same approach also allows us to identify the effect of trade policy changes on countries' market shares, as we can decompose the total trade value from an origin to a destination-product market, $\ln(p_{iodt}y_{iodt})$, as:

$$\ln(p_{iodt}y_{iodt}) = \ln(ms_{iodt}) + \underbrace{\ln\left(\sum_{o} p_{iodt}y_{iodt}\right)}_{\text{absorbed by } \delta_{idt} \text{ fixed effects}} . \tag{22}$$

where market size $\ln\left(\sum_o p_{iodt}y_{iodt}\right) = \ln\left(\sum_{f,o} p_{fiodt}y_{fiodt}\right)$ is, once again, absorbed by our product-destination-year fixed effects.

We include the full set of fixed effects (i.e., $\delta_{fiot}, \delta_{idt}$, and δ_{od}) in all of our regressions, as shown in (18). The inclusion of product-destination-year fixed effects in the markup specification helps control for changes in demand in the destination-product market that are common for all origins. The inclusion of firm-product-origin-year fixed effects in the

[37]Note that these fixed effects also control for any endogenous changes in marginal costs that might result from a preferential trade policy change, regardless of returns to scale in production. For example, even if a trade agreement increases the overall production of a firm and thereby reduces its marginal costs, this change should be reflected in the firms' prices in all of its destination markets and thus will be controlled for by our firm-product-origin-year fixed effects.

[38]This approach would not be feasible if we only had access to firm-level data from a single country of origin, since product-destination-year fixed effects would absorb all the available variation in trade policy, which varies at the origin-product-destination-year level. Our multi-origin dataset therefore provides a unique opportunity to identify market share elasticities with respect to trade policy changes.

market share specifications helps control for unobserved production or cost shocks in our origin countries. Finally, we include origin-destination fixed effects to absorb any variation due to the distance between two countries as well as their geography, history, and culture.[39]

We close this section by highlighting that our identification comes from preferential changes in trade policy. This is because trade policy changes that apply equally to all origins (e.g., an MFN tariff change) or destinations (e.g., a country joins the WTO) will be absorbed by the rich set of fixed effects included in our empirical specification. Only preferential tariff and trade policy changes will survive these fixed effects and, therefore, drive our identification.

5 Empirical results

We find that exporting firms respond to the tariff liberalizations associated with preferential trade agreements by lowering their markups. The richness of our multi-origin panel allows us to trace out not only changes in markups, but also the role of the two different market share measures that influence the elasticity of demand facing a firm under our triple-nested preference structure. We show that preferential tariff liberalizations stimulate entry from an origin to such a degree that the market power of individual firms from that origin declines in the destination, even as the total market share of the origin in the destination rises. This is an exciting result which highlights the importance of examining precisely how oligopolistic competition evolves under a trade liberalization.

We present our main results, estimates of elasticities to bilateral tariffs and PTA participation, in table 3. The first column contains the elasticity of a firm's market share in a destination, at the level of an HS6 product, to the tariff it faces.[40] A 10% reduction in tariffs is associated with an 8% increase in a firm's market share in the destination. For a firm with an initial market share of 50%, this means that a 10% tariff cut, for example from 10% to 9%, will increase the firm's market share to 54%. This shows that the bilateral tariff cut

[39] Origin-destination fixed effects also absorb pricing variation associated with time-invariant features such as quality Bastos and Silva (2010) or, for instance, the Alchian-Allen effect Hummels and Skiba (2004). Additionally, origin-destination fixed effects help address potential endogeneity problems of PTAs. For example, the existence of a PTA could be intertwined with the level of bilateral trade flows – the larger the trade flows between two countries, the greater the benefits from and therefore the incentive to sign a PTA. This means that there is potential for reverse causality, and it might be large trade flows that cause PTAs, rather than PTAs that cause large trade flows. While this is unlikely to be a problem at the firm level, it could be an issue at the country-pair level. Accounting for unobserved heterogeneity at this level should therefore resolve most of these concerns (See Baier and Bergstrand (2007)).

[40] As discussed in section 4, regressing the log value of a firm's product- and destination-specific exports on a product-destination-year fixed effect implies that the parameter estimate on the tariff captures the elasticity of a firm's market share to the tariff (see equation (22)).

Table 3: Elasticities of market shares, markups, and counts of firms to tariffs and trade agreements

	Firm's mkt share in the dest. $\ln(\omega_{fiodt})$ (1)	Markups $\ln(\mu_{fiodt})$ (2)	Firm's within origin mkt share $\ln(ms_{fiodt})$ (3)	Origin's mkt share $\ln(ms_{iodt})$ (4)	No. of firms (PPML) (5)
Tariff_{iodt}	-0.78***	0.41***	2.88***	-3.67***	-2.45***
	(0.244)	(0.073)	(0.322)	(0.429)	(0.184)
PTA_{odt}	0.02	-0.02**	0.06**	-0.04	-0.06***
	(0.021)	(0.008)	(0.027)	(0.031)	(0.011)
R^2	0.65	0.90	0.79	0.88	-
Observations	15,712,501	15,712,501	15,712,501	15,712,501	1,563,040
Fixed Effects					
Firm-product-origin-year	✓	✓	✓	✓	
Product-origin-year					✓
Product-destination-year	✓	✓	✓	✓	✓
Origin-destination	✓	✓	✓	✓	✓

Notes: The dependent variable is the firm's log (tariff-inclusive) export value in column (1), the firm's log (tariff-exclusive) unit value in column (2), the log of the firm's share of its country's trade with the destination in column (3), the log of the country's (tariff-inclusive) export value to the destination market in column (4) and the number of firms in column (5). Tariff_{iodt} and PTA_{odt} capture the trade policy firms from the origin face in the destination. Standard errors, reported in parentheses, are clustered at the product-destination level, and we denote statistical significance with *** p<0.01, ** p<0.05, and * p<0.1. Estimates are based on an integrated dataset of firms' exports from eleven countries built from the World Bank Exporter Dynamics Database, China's Customs Authority, and Egypt's Customs Authority, as well as tariff data from the WTO and Feenstra and Romalis (2014), and the World Bank Deep Trade Agreements Database.

increases the market power of firms from the preferred origin at the expense of firms exporting from other origins as well as domestic firms. Recall that in the Atkeson and Burstein (2008) model of oligopolistic competition, which emphasizes competition among all firms within a product market, the effect of tariffs on firms' market shares would be a sufficient statistic for the direction of the change in markups in response to a change in trade policy. Notably, a tariff cut would imply an increase in the firm's market share in the destination, a decline in the demand elasticity it faces, and a rise in the firm's markup. This is not what we find empirically. Turning to markups, column (2) identifies how the component of the markup that is specific to a destination, the residual component of the markup that varies across destination markets, changes when a country joins a PTA.[41] Signing a PTA reduces markups by 2%. More interestingly, we find that a 10% reduction in the tariff on a product is associated with a 4% *decline* in firms' markups. This finding, which shows that markups fall while market shares rise, directly contradicts the prediction of most standard models of oligopoly.[42]

Our theoretical model highlights the importance of decomposing the firm's market share in the destination into two parts, the origin country's share of the destination market (ms_{iodt}) and the firm's share of its country's trade with the destination (ms_{fiodt}). In a world with oligopolistic competition that is shaped by the substitutability of varieties both across origins within an industry and across firms within an origin, markups depend on changes in both of these market shares. We see the negative sign on the elasticity of firms' overall market share in the destination to tariffs (column 1) can be decomposed into a positive sign on the elasticity of the firm's share of its country's trade with the destination (column 3) and a negative sign on the elasticity of the origin's share of the destination market (column 4). Using a traditional definition of import market share, that of the origin in the destination (see column 4), we find a country's import market share rises 37% when it is the beneficiary of a 10% preferential tariff cut. As first described by Viner (1950), when one country enjoys a tariff cut in a destination that is not offered to competing origins, the country's market share in that destination rises.

But building on this with firm-level data, our analysis shows more subtle forces are at play. Turning to a firm's trade share in a destination among all firms from its own origin, we find that a 10% reduction in the bilateral tariff is associated with a substantial *decline*

[41]The inclusion of firm-product-origin-time fixed effects controls for time-varying marginal costs at the level of the product within a firm as well as time-variation in the global or common markup that the firm charges in all foreign destinations (see section 4).

[42]As discussed in Helpman and Krugman (1985), the results in trade models of oligopoly are extremely sensitive to precise market structures. That said, most standard quantity competition models yield a positive correlation between market shares and markups.

in the average market share of an exporting firm of 29% (see column (3)). Importantly, market participation by exporting firms increases as the bilateral tariff falls (column (5)). A 10% cut in the tariff imposed by a destination leads to a 22% increase in the number of exporters from the affected origin. The strong extensive margin response from the origin affects both market shares that our theoretical model suggests influence the impact of a trade liberalization on markups, an origin's share of trade in a destination and a firm's share of trade among compatriot firms from its origin, and moves them in opposite directions.

Interpreted through the lens of our model, this suggests that a tariff liberalization leads to an across-origin reallocation effect that puts upward pressure on markups and a within-origin reallocation effect that puts downward pressure on markups. As discussed in section 3, the net effect on markups will depend on which of these two effects dominates.[43] The finding that markups decline with tariff cuts implies that the within-origin reallocation effect dominates the across-origin reallocation effect, and that the elasticity of demand facing a firm therefore falls, in our sample. This is consistent with the idea that consumers' preferences across varieties lead firms in our dataset to view firms from their own origin as more relevant competitors in the destination market than firms from other origins and to react more strongly to additional entrants from their own origin than to the fall in their trade costs in setting prices.

Table 3 also shows that preferential trade agreements have small effects on some of our outcomes of interest beyond the tariff reductions they embody. PTAs signed by low and middle income countries typically involve much larger tariff cuts than those among high income countries, suggesting that most of the benefit of a preferential trade agreement for low and middle income countries comes from tariff changes rather than provisions that simplify cross-border trade or remove non-tariff barriers.[44] It is therefore not surprising that the direct effect of the PTA dummy in our dataset is limited. Finally, we present various robustness checks for our baseline results in online appendices OA2.3 and OA2.4.

5.1 Trade policy and product differentiation

To investigate whether firms' and markup responses vary systematically with the degree of substitutability of a product, as predicted by our theoretical framework and documented in prior work (Corsetti, Crowley, Han and Song (2023)), we use the CCHS commodity

[43] Recall from figure 2 that, when σ is larger than ρ, changes in the within-origin market share can have a much bigger impact on a firm's markup adjustment than changes in the across-origin market share, resulting a positive markup adjustment.

[44] We thank Jeff Bergstrand for sharing this insight.

classification system to split our sample into highly and less differentiated products.[45] Our framework predicts that firms which sell highly differentiated goods, and therefore operate in markets in which there is considerable scope to exploit market power, should adjust markups more than firms which sell less differentiated products that are highly substitutable.

We explore this idea in table 4, which reports exporters' responses to changes in trade policy by degree of product differentiation. The top panel presents results for the subsample of highly differentiated goods and the bottom panel presents results for the subsample of goods which are less differentiated, including commodities and simple manufactured goods like processed foods. We begin by discussing the elasticities of the firm's within-origin market share and the origin's market share to the tariff reported in columns (3) and (4). We consistently find a positive sign on the elasticity of the firm's within-origin market share and a negative one on the origin's market share for both highly and less differentiated goods: for a 10% bilateral tariff cut, the firm's within-origin market share drops by 37.2% for highly differentiated goods and by 15.5% for less differentiated goods, while the origin's market share increases by 51.0% and 16.6%, respectively. Recall from Proposition 1 that a drop in the within-origin market share ms_{fiodt} reduces the firm's optimal markup, while an increase in the origin's market share ms_{iodt} increases the firm's optimal markup. If the two market share changes had an equal influence on the firm's markup decisions (as in the Atkeson-Burstein case), we would have found a positive markup adjustment (a negative coefficient on our tariff variable) for highly differentiated goods and a markup adjustment close to zero for less differentiated goods.

Empirically, we find a significant markup reduction of 8.8% (a positive coefficient on our tariff variable) for highly differentiated goods and no markup adjustment for low differentiation goods. In the context of our model, the differential markup responses of these two types of goods can result from differences in the underlying degree of substitutability within and across countries. As shown in figure 2, the importance of the within-origin market share change increases as $\sigma - \rho$ increases. Additionally, as demonstrated in Lemma 1 and figure 3, the significance of the entry effect also increases with $\sigma - \rho$. Based on our theoretical findings, our estimates suggest that highly differentiated products may have more scope for special-

[45] Most studies adopt the industry classifications set forth by Rauch (1999), according to which a product is differentiated if it does not trade on organized exchanges and/or its price is not regularly published in industry sales catalogues. While this system is quite powerful in identifying commodities, a drawback is that the vast majority of manufactured goods end up being classified as differentiated. The CCHS classification refines the class of differentiated goods in Rauch into two categories – highly and less differentiated. Corsetti, Crowley, Han and Song (2023) calculate that in the Chinese Customs Database 2000-2014, 79.8 percent of observations are classified by Rauch as differentiated. Of these, only 48.6 percent are categorized as highly differentiated under the CCHS Chinese-linguistics-based classification system. See online appendix OA1.3 for further details.

Table 4: Highly vs. less differentiated goods

	Firm's mkt share in the dest. $\ln(\omega_{fiodt})$ (1)	Markups $\ln(\mu_{fiodt})$ (2)	Firm's within origin mkt share $\ln(ms_{fiodt})$ (3)	Origin's mkt share $\ln(ms_{iodt})$ (4)	No. of firms (PPML) (5)
Highly Differentiated Goods					
Tariff_{iodt}	-1.38***	0.88***	3.73***	-5.11***	-3.13***
	(0.389)	(0.106)	(0.429)	(0.666)	(0.224)
PTA_{odt}	-0.00	-0.02	0.28***	-0.28***	-0.20***
	(0.041)	(0.014)	(0.046)	(0.059)	(0.018)
R^2	0.62	0.93	0.75	0.88	-
Observations	5,759,013	5,759,013	5,759,013	5,759,013	491,177
Less Differentiated Goods					
Tariff_{iodt}	-0.09	0.06	1.56***	-1.66***	-1.57***
	(0.287)	(0.077)	(0.386)	(0.469)	(0.209)
PTA_{odt}	0.08***	-0.03***	-0.03	0.11***	0.02
	(0.027)	(0.010)	(0.029)	(0.032)	(0.011)
R^2	0.70	0.90	0.77	0.86	-
Observations	7,720,109	7,720,109	7,720,109	7,720,109	1,010,891
Fixed Effects					
Firm-product-origin-year	✓	✓	✓	✓	
Product-origin-year					✓
Product-destination-year	✓	✓	✓	✓	✓
Origin-destination	✓	✓	✓	✓	✓

Notes: The dependent variable is the firm's log (tariff-inclusive) export value in column (1), the firm's log (tariff-exclusive) unit value in column (2), the log of the firm's share of its country's trade with the destination in column (3), the log of the country's (tariff-inclusive) export value to the destination market in column (4) and the number of firms in column (5). Products are separated into highly differentiated and less differentiated goods based on the CCHS classification system. Standard errors, reported in parentheses, are clustered at the product-destination level, and we denote statistical significance with *** p<0.01, ** p<0.05, and * p<0.1. Estimates are based on an integrated dataset of firms' exports from eleven countries built from the World Bank Exporter Dynamics Database, China's Customs Authority, and Egypt's Customs Authority, as well as tariff data from the WTO and Feenstra and Romalis (2014), and the World Bank Deep Trade Agreements Database.

isation, allowing for a larger difference in $\sigma - \rho$ than low-differentiation products. Indeed, many of the products we classify as low-differentiation are commodities and raw materials, which are highly standardized and openly traded on the world exchange market. Although these products have high σ and ρ, the difference between the two elasticities ($\sigma - \rho$) may be small due to a common international standard. On the other hand, highly differentiated consumer goods often have a low ρ, but firms from the same origin may produce similar products, which implies a high σ and a larger difference in $\sigma - \rho$.

5.2 Pro-competitive trade agreements and global value chains

In this section, we introduce a new dimension to refine our breakdown of the product space and explore the role of PTA participation in global value chains. We do this by using the Broad Economic Categories classification (Rev. 4) to distinguish between intermediate inputs and final consumption goods. Firms which produce and sell final consumption goods often engage in activities such as marketing or branding that aim to differentiate their product relative to their competitors in the marketplace. This suggests that markets for final consumption goods might be oligopolistic and that firms which operate in these markets hold some amount of market power. As a result, we would expect changes in barriers to entry to have large impacts on market shares and markups. In contrast, intermediate goods include products such as commodities that may be more substitutable across varieties.

Table 5 presents results for consumption goods, and table 6 for intermediate inputs. They each contain three panels: the top panel considers all consumption or intermediate goods, the middle panel hones in on highly differentiated goods and the bottom panel reports results for less differentiated goods. Comparing the top panels of the two tables, we see that a 10% tariff reduction decreases markups for consumption goods by 6%, but has no effect on the markups of intermediate inputs. We also see that the three different market shares, and particularly firms' share of their origin's trade, as well as the number of firms in the market, respond more strongly for consumption goods. Turning to the middle two panels, the effects on consumption goods, but not on intermediates, appear to be almost entirely driven by highly differentiated consumption goods, for which a 10% tariff reduction leads to a 10% decrease in markups. The effect of a tariff liberalization on market shares and market participation is also particularly pronounced for this set of products. Finally, the bottom two panels show that tariff liberalizations have little effect on less differentiated consumption goods.

The overall pattern is consistent with the idea that the markets for consumption goods are oligopolistic, and have a larger within-origin elasticity of substitution σ relative to their

Table 5: Trade policy elasticities and global value chains: Consumption goods

	Firm's mkt share in the dest. $\ln(\omega_{fiodt})$ (1)	Markups $\ln(\mu_{fiodt})$ (2)	Firm's within origin mkt share $\ln(ms_{fiodt})$ (3)	Origin's mkt share $\ln(ms_{iodt})$ (4)	No. of firms (PPML) (5)
Consumption Goods					
Tariff_{iodt}	-0.88***	0.65***	4.38***	-5.26***	-3.40***
	(0.337)	(0.091)	(0.385)	(0.606)	(0.239)
PTA_{odt}	0.11***	-0.02*	0.32***	-0.20***	-0.19***
	(0.038)	(0.011)	(0.041)	(0.053)	(0.017)
R^2	0.65	0.92	0.75	0.89	-
Observations	6,831,914	6,831,914	6,831,914	6,831,914	559,901
Highly Differentiated Consumption Goods					
Tariff_{iodt}	-1.14**	1.02***	5.07***	-6.21***	-3.48***
	(0.480)	(0.129)	(0.532)	(0.849)	(0.245)
PTA_{odt}	0.05	-0.03*	0.48***	-0.44***	-0.31***
	(0.052)	(0.015)	(0.062)	(0.081)	(0.024)
R^2	0.60	0.92	0.74	0.90	-
Observations	4,045,879	4,045,879	4,045,879	4,045,879	270,291
Less Differentiated Consumption Goods					
Tariff_{iodt}	-0.48	0.11	1.45***	-1.93***	-1.69***
	(0.496)	(0.122)	(0.466)	(0.742)	(0.360)
PTA_{odt}	0.20***	-0.02	0.13***	0.07	-0.02
	(0.051)	(0.015)	(0.049)	(0.056)	(0.021)
R^2	0.70	0.92	0.78	0.89	-
Observations	2,628,913	2,628,913	2,628,913	2,628,913	281,324
Fixed Effects					
Firm-product-origin-year	✓	✓	✓	✓	
Product-origin-year					✓
Product-destination-year	✓	✓	✓	✓	✓
Origin-destination	✓	✓	✓	✓	✓

Notes: The dependent variable is the firm's log (tariff-inclusive) export value in column (1), the firm's log (tariff-exclusive) unit value in column (2), the log of the firm's share of its country's trade with the destination in column (3), the log of the country's (tariff-inclusive) export value to the destination market in column (4) and the number of firms in column (5). Products are separated into different groups based on the CCHS and BEC (Revision 4) classification systems. Standard errors, reported in parentheses, are clustered at the product-destination level, and we denote statistical significance with *** p<0.01, ** p<0.05, and * p<0.1. Estimates are based on an integrated dataset of firms' exports from eleven countries built from the World Bank Exporter Dynamics Database, China's Customs Authority, and Egypt's Customs Authority, as well as tariff data from the WTO and Feenstra and Romalis (2014), and the World Bank Deep Trade Agreements Database.

Table 6: Trade policy elasticities and global value chains: Intermediate inputs

	Firm's mkt share in the dest. $\ln(\omega_{fiodt})$ (1)	Markups $\ln(\mu_{fiodt})$ (2)	Firm's within origin mkt share $\ln(ms_{fiodt})$ (3)	Origin's mkt share $\ln(ms_{iodt})$ (4)	No. of firms (PPML) (5)
Intermediate Inputs					
Tariff_{iodt}	0.01	0.09	1.78***	-1.78***	-1.52***
	(0.368)	(0.107)	(0.630)	(0.613)	(0.261)
PTA_{odt}	-0.02	-0.02*	-0.13***	0.12***	0.03***
	(0.028)	(0.013)	(0.035)	(0.036)	(0.011)
R^2	0.69	0.90	0.77	0.86	-
Observations	5,706,413	5,706,413	5,706,413	5,706,413	777,559
Highly Differentiated Intermediate Inputs					
Tariff_{iodt}	-0.26	0.19	-1.81	1.55	-0.32
	(1.301)	(0.390)	(1.337)	(1.442)	(0.584)
PTA_{odt}	0.07	-0.01	-0.08	0.15*	0.05*
	(0.080)	(0.044)	(0.081)	(0.088)	(0.024)
R^2	0.64	0.91	0.75	0.87	-
Observations	687,156	687,156	687,156	687,156	85,493
Less Differentiated Intermediate Inputs					
Tariff_{iodt}	-0.23	0.11	2.01***	-2.23***	-1.59***
	(0.365)	(0.108)	(0.686)	(0.677)	(0.289)
PTA_{odt}	-0.01	-0.03**	-0.11***	0.10***	0.02*
	(0.030)	(0.014)	(0.036)	(0.039)	(0.013)
R^2	0.70	0.90	0.77	0.85	-
Observations	4,630,735	4,630,735	4,630,735	4,630,735	667,741
Fixed Effects					
Firm-product-origin-year	✓	✓	✓	✓	
Product-origin-year					✓
Product-destination-year	✓	✓	✓	✓	✓
Origin-destination	✓	✓	✓	✓	✓

Notes: The dependent variable is the firm's log (tariff-inclusive) export value in column (1), the firm's log (tariff-exclusive) unit value in column (2), the log of the firm's share of its country's trade with the destination in column (3), the log of the country's (tariff-inclusive) export value to the destination market in column (4) and the number of firms in column (5). Products are separated into different groups based on the CCHS and BEC (Revision 4) classification systems. Standard errors, reported in parentheses, are clustered at the product-destination level, and we denote statistical significance with *** p<0.01, ** p<0.05, and * p<0.1. Estimates are based on an integrated dataset of firms' exports from eleven countries built from the World Bank Exporter Dynamics Database, China's Customs Authority, and Egypt's Customs Authority, as well as tariff data from the WTO and Feenstra and Romalis (2014), and the World Bank Deep Trade Agreements Database.

across-origin elasticity of substitution ρ. As a result, firms which sell consumption goods, and particularly highly differentiated consumption goods, seem to respond strongly to additional entry due to trade liberalizations by lowering their markups.

5.3 Trade policy and destination income levels

The previous two subsections have partitioned the product space. In this subsection, we take an alternative approach and split our sample based on income-levels in the destination to isolate markets with different scopes for market power. Rich countries have more power to enforce idiosyncratic national policies such as health or safety regulations that create an international segmentation of markets. They also have larger and more diverse markets, and a larger proportion of their imports are highly differentiated.[46] We would therefore expect trade policy to have larger effects on markups in high-income countries. To investigate this idea, we split the destinations in our sample into three groups, high-, middle- and low-income countries, based on their per-capita income levels in 1999 and repeat our analysis for each of these three subsamples.

Table 7 presents our estimates. The results show that the tariff elasticities of firms' market shares and markups are largest in high income destinations. A 10% tariff reduction leads to a 16% increase in firms' market shares in high income destinations, but has little effect on market shares in middle or low income destinations. At the same time, it decreases markups by 8% in high income destinations, by 2% in middle income destinations, and has no effect on markups in low income destinations. Our findings are consistent with the view that countries with large markets in which firms from many different countries compete can support consumption of many different varieties of a product, and that oligopolistic competition between firms which produce varieties distinct to their origin is more plausible in this setting. In this scenario, the within-origin elasticity of substitution σ is larger relative to the across-origin elasticity of substitution ρ and the within-origin reallocation effect is therefore more likely to dominate in destinations with higher incomes.

[46]See online appendix table OA1-2 for details.

Table 7: Trade policy elasticities by destination country income level

	Firm's mkt share in the dest. $\ln(\omega_{fiodt})$ (1)	Markups $\ln(\mu_{fiodt})$ (2)	Firm's within origin mkt share $\ln(ms_{fiodt})$ (3)	Origin's mkt share $\ln(ms_{iodt})$ (4)	No. of firms (PPML) (5)
High Income Countries					
Tariff_{iodt}	-1.63**	0.84***	2.46***	-4.10***	-1.98***
	(0.649)	(0.143)	(0.597)	(0.880)	(0.252)
PTA_{odt}	0.14***	-0.06***	0.05	0.08	0.13***
	(0.053)	(0.016)	(0.056)	(0.059)	(0.017)
R^2	0.65	0.90	0.78	0.91	-
Observations	8,160,945	8,160,945	8,160,945	8,160,945	662,440
Middle Income Countries					
Tariff_{iodt}	-0.25	0.20***	2.95***	-3.20***	-2.10***
	(0.203)	(0.077)	(0.416)	(0.483)	(0.188)
PTA_{odt}	-0.02	-0.02	0.03	-0.05	-0.07***
	(0.023)	(0.011)	(0.034)	(0.037)	(0.010)
R^2	0.74	0.91	0.82	0.87	-
Observations	4,277,859	4,277,859	4,277,859	4,277,859	736,673
Low Income Countries					
Tariff_{iodt}	0.39	0.03	0.92	-0.53	-1.16***
	(0.845)	(0.427)	(0.870)	(1.090)	(0.361)
PTA_{odt}	-0.42**	0.01	0.16	-0.58**	-0.36***
	(0.168)	(0.084)	(0.167)	(0.229)	(0.046)
R^2	0.76	0.93	0.85	0.93	-
Observations	865,706	865,706	865,706	865,706	85,605
Fixed Effects					
Firm-product-origin-year	✓	✓	✓	✓	
Product-origin-year					✓
Product-destination-year	✓	✓	✓	✓	✓
Origin-destination	✓	✓	✓	✓	✓

Notes: The dependent variable is the firm's log (tariff-inclusive) export value in column (1), the firm's log (tariff-exclusive) unit value in column (2), the log of the firm's share of its country's trade with the destination in column (3), the log of the country's (tariff-inclusive) export value to the destination market in column (4) and the number of firms in column (5). Countries are separated into high income, middle income and low income destinations according to World Bank lending groups in 1999. Standard errors, reported in parentheses, are clustered at the product-destination level, and we denote statistical significance with *** p<0.01, ** p<0.05, and * p<0.1. Estimates are based on an integrated dataset of firms' exports from eleven countries built from the World Bank Exporter Dynamics Database, China's Customs Authority, and Egypt's Customs Authority, as well as tariff data from the WTO and Feenstra and Romalis (2014), and the World Bank Deep Trade Agreements Database.

6 Conclusion

Understanding the welfare implications of trade agreements has long been a central focus of the international economics literature. The role of competition and markup adjustments, and the question of whether the pro-competitive gains from trade are elusive, is at the core of recent debates.[47] Despite several theoretical contributions, empirical evidence on how foreign exporters compete and adjust their markups to trade policy changes in a multi-country world remains scarce.

In this paper, we exploit product exports by firms from eleven emerging economies and investigate how tariffs and preferential trade agreements affect the ways in which firms compete and the markups they charge. We find, surprisingly, that in response to a bilateral tariff cut, foreign exporters lower their markups while their market share in the destination increases – an observation that contradicts the predictions of standard oligopolistic competition models.

We show this puzzling empirical finding can be rationalized theoretically in a more general multi-country framework that allows for a different degree of oligopolistic competition within and across origins. Our theoretical model suggests *two* market share reallocation effects matter for firms' markup adjustments after a bilateral tariff cut: (1) a "within-origin" reallocation effect that reduces the firms' optimal markups and (2) an "across-origin" reallocation effect that increases the firms' optimal markups. We find, empirically, that tariff reductions induce entry by firms from preferred origin countries, leading to economically important "within-origin" reallocation of market shares. This new entry reduces the pricing-power of incumbent exporters from the same origin, resulting in markup reductions. These pro-competitive markup reductions by exporting firms add a new element to the welfare gains of tariff liberalisation.

[47] See Bagwell and Staiger (2016) for a comprehensive review of the theoretical literature on the welfare consequences of trade agreements and Ossa (2016) for a summary of the literature on quantitative modelling of trade agreements. While early contributions investigated the efficiency properties of trade agreements under perfect competition (Bagwell and Staiger (1999)), more recent studies have examined welfare impacts under more complex market structures featuring price formation under bilateral bargaining (Antràs and Staiger (2012)) or in an environment with variable markups (Bagwell and Lee (2020)). See Edmond, Midrigan and Xu (2015) and Arkolakis, Costinot, Donaldson and Rodríguez-Clare (2018) for recent debates on the pro-competitive gains of trade.

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A Data Appendix

A.1 Firm-level trade

Apart from the Chinese Customs Database, which contains monthly data for HS8 products, the raw datasets provide information on non-zero annual firm level export values and volumes to individual foreign destinations by HS6 product. Export values are provided in US dollars and reported on a FOB basis for all countries except Senegal, which reports CIF figures. Export volumes represent net weight in kilograms, with the exception of China and Egypt, which use a variety of measures, as well as Mexico, which does not specify the measures used between 2000 and 2009. To ensure that our data are comparable across our eleven origin countries, we aggregate the monthly Chinese data to the annual level. For all eleven countries, we drop observations for which we cannot determine the destination country, observations which report a product code that is not part of any HS revision during our sample period and observations with missing or negative reported trade values.[48] As our dataset spans multiple revisions of the HS classification system, we further convert the raw HS6 codes to consolidated HS codes which are stable over time (see online appendix OA1.2 for more details). The final estimation dataset contains 3646 intertemporally-consistent consolidated HS products. To create theory-consistent market share measures, we construct tariff-inclusive exports sales values by applying the relevant preferential or MFN tariff to the free-on-board export values observed in the data. Similar to other studies using administrative data, we use trade unit values as a proxy for prices.[49]

A.2 Trade policy

We source data on trade agreements from the World Bank Deep Trade Agreements (WB DTA) Database and data on preferential and most favoured nation (MFN) tariffs from the WTO Integrated Database (WTO IDB). To capture the phase-in of trade agreements, we supplement the data sourced from the WTO IDB with information contained in the tariff data compiled by Feenstra and Romalis (2014).

The WB DTA contains detailed information on the contents of trade agreements, their members and the years they were adopted as well as, where applicable, discarded, for 257 agreements which entered into force between 1958 and 2015. The eleven countries in our sample are involved in 83 of these trade agreements, 25 of which entered into force during our

[48] Additionally, we drop exports from China to Hong Kong, which likely acts as an entrepot during this period.

[49] To address any issues that might arise if different quantity measures were reported in different datasets, we include firm-product-origin-time fixed effects in our markup regressions (see section 4).

Table A-1: Firm-level trade data: countries and years

Country	Years	Firms	Observations	... with PTA	... with Tariff	... with Δ PTA	... with Δ Tariff
Albania	2004 - 2012	1,006	9,023	1,086	9,023	84	765
Bulgaria	2001 - 2006	8,922	288,945	34,672	288,945	5,398	27,297
Burkina Faso	2005 - 2007	190	1,923	785	1,923	0	71
	2008 - 2012	258	2,004	799	2,004	0	69
China	2000 - 2006	152,726	13,495,561	698,043	13,495,561	155,082	1,190,735
Egypt	2005 - 2013	7,471	246,445	193,402	246,445	402	23,108
Malawi	2006 - 2008	156	1,298	561	1,298	0	30
	2009 - 2012	265	2,751	1,124	2,751	0	151
Mexico	2000 - 2007	17,402	655,228	297,011	655,228	1,562	83,730
	2008 - 2009	9,168	202,762	86,018	202,762	0	7,779
	2010 - 2011	9,580	234,688	99,253	234,688	0	9,279
	2012	7,777	132,754	93,368	132,754	0	0
Peru	2000 - 2013	7,850	349,238	117,564	349,238	13,915	38,955
Senegal	2000 - 2012	840	25,183	13,982	25,183	0	2,559
Uruguay	2001 - 2012	1,586	60,142	17,995	60,142	263	8,376
Yemen	2008 - 2012	335	4,556	2,230	4,556	0	325

Notes: The datasets for Burkina Faso, Malawi and Mexico feature multiple distinct panels as a result of changes to the system of firm identifiers. The columns "...with PTA", "...with Tariff", "...with Δ PTA" and "...with Δ Tariff" report the number of observations for which our binary PTA_{odt} variable takes a positive value, our Tariff_{iodt} variable takes non-missing values, and there is a change in our PTA_{odt} and Tariff_{iodt} variables relative to the closest available previous period, respectively. For PTA_{odt}, this amounts to the number of observations for which there is an active PTA between the origin and the destination, and for which a new PTA enters into force in a given year. For Tariff_{iodt}, this refers to the number of observations for which data on bilateral tariffs is available, and for which there is a change in the level of bilateral tariffs firms face.

sample period. We use information on these agreements to construct an indicator variable that records whether there is an active trade agreement between an origin and a destination in our sample in any given year.

The WTO IDB contains HS6-product-level data on preferential and applied MFN ad-valorem tariffs for the years 2000-2013 for 138 and 165 destination countries, respectively.[50] We aggregate the raw data to consolidated HS codes by taking a simple average across HS6 codes. To address missing values, we follow Feenstra and Romalis (2014). For applied MFN tariffs, we replace missing values with the closest preceding value, on the basis that updated tariff schedules are more likely to be available after significant changes. In cases where there is no preceding value, we use the closest subsequent value. For preferential tariffs, we extract information about the phase-in of trade agreements from the dataset compiled by Feenstra and Romalis (2014), and then use this data to impute missing values (see online appendix OA1.1 for details). We then set our bilateral tariff variable equal to the lowest reported preferential tariff a destination offers to exporters from a given origin, when it is available, and use data on the MFN tariff applied by the destination, when it is not.

B Model Appendix

B.1 Proof of Proposition 1

Proof. Based on equations (5) and (6), we have that:

$$\widehat{\mu}_{fiodt} = -\frac{1}{\varepsilon_{fiodt} - 1}\widehat{\varepsilon}_{fiodt} \tag{B-1}$$

$$\widehat{\varepsilon}_{fiodt} = -\frac{\sigma - \varepsilon_{fiodt}}{\varepsilon_{fiodt}}\widehat{ms}_{fiodt} - \frac{(\rho-\eta)ms_{fiodt}ms_{iodt}}{\varepsilon_{fiodt}}\widehat{ms}_{iodt} \tag{B-2}$$

Substituting equation (B-2) into equation (B-1), we get

$$A(.) \equiv \frac{\sigma - \varepsilon_{fiodt}}{\varepsilon_{fiodt}(\varepsilon_{fiodt} - 1)}; \quad B(.) \equiv \frac{(\rho-\eta)ms_{fiodt}ms_{iodt}}{\varepsilon_{fiodt}(\varepsilon_{fiodt} - 1)} \tag{B-3}$$

Since $\varepsilon_{fiodt}(\varepsilon_{fiodt} - 1)$ is strictly larger than 0, the sign of $A(.) - B(.)$ depends on the sign of

$$\sigma - \varepsilon_{fiodt} - (\rho - \eta)ms_{fiodt}ms_{iodt} = (\sigma - \rho)ms_{fiodt} \tag{B-4}$$

[50] The eleven national customs databases report exports to a total of 251 foreign destinations. Omitting observations for the smaller destinations for which no tariff data is available reduces the size of the initial dataset from 26,069,241 to 24,963,950. Removing singleton observations which are absorbed by fixed effects in our baseline specification further reduces the size of our final estimation dataset to 15,712,501.

Given that $ms_{fiodt} > 0$, $A(.) - B(.) > 0$ iff $\sigma > \rho$ and $A(.) - B(.) = 0$ iff $\sigma = \rho$. $\square$

B.2 Proof of Proposition 2

B.2.1 Preliminaries: key elasticities

We start by deriving how a firm's demand elasticity changes with the firm's own price:

$$\begin{aligned}\frac{\partial \varepsilon_{fiodt}}{\partial p_{fiodt}} &= -\left[\sigma - \rho + (\rho - \eta) ms_{iodt}\right] \frac{\partial ms_{fiodt}}{\partial p_{fiodt}} - ms_{fiodt}(\rho - \eta)\frac{\partial ms_{iodt}}{\partial p_{fiodt}} \\ &= -\left[\sigma - \rho + (\rho - \eta) ms_{iodt}\right] ms_{fiodt}(1 - ms_{fiodt})(1-\sigma)/p_{fiodt} \\ &\quad - ms_{fiodt}(\rho - \eta)(1-\rho)(1 - ms_{iodt}) ms_{fiodt} ms_{iodt}/p_{fiodt} \end{aligned} \tag{B-5}$$

With equation (B-5), the super-elasticity Γ_{fiodt} can be expressed as

$$\Gamma_{fiodt} \equiv \frac{\partial \varepsilon_{fiodt}}{\partial p_{fiodt}} \frac{p_{fiodt}}{\varepsilon_{fiodt}} = \frac{ms_{fiodt}}{\varepsilon_{fiodt}} \begin{Bmatrix} (\sigma - 1)(1 - ms_{fiodt})[\sigma - \rho + ms_{iodt}(\rho - \eta)] \\ +(\rho - 1)(\rho - \eta)(1 - ms_{iodt}) ms_{fiodt} ms_{iodt} \end{Bmatrix} \tag{B-6}$$

We now give more details on our derivations of $\frac{\partial ms_{fiodt}}{\partial p_{fiodt}}$ and $\frac{\partial ms_{iodt}}{\partial p_{fiodt}}$, to highlight an approach that we will use repeatedly in what follows. Using the definition of the market shares and price indices, we note

$$ms_{fiodt} = \frac{\alpha_{fiodt}(p_{fiodt})^{1-\sigma}}{(p_{iodt})^{1-\sigma}}, \quad ms_{iodt} = \frac{(p_{iodt})^{1-\rho}}{(p_{idt})^{1-\rho}} \tag{B-7}$$

With the expression in equation (B-7), we can get the partial derivates of the market shares by taking partial derivatives for each of the prices, i.e., p_{fiodt}, p_{iodt} and p_{odt}:

$$\begin{aligned}\frac{\partial ms_{fiodt}}{\partial p_{fiodt}} &= -\frac{\alpha_{fiodt}(p_{fiodt})^{1-\sigma}}{(p_{iodt})^{2-2\sigma}} \frac{\partial (p_{iodt})^{1-\sigma}}{\partial p_{fiodt}} + (1-\sigma)\frac{\alpha_{fiodt}(p_{fiodt})^{-\sigma}}{(p_{iodt})^{1-\sigma}} \\ &= \frac{(p_{fiodt})^{-\sigma}}{(p_{iodt})^{1-\sigma}}\left[-\frac{\alpha_{fiodt}(p_{fiodt})^{1-\sigma}}{(p_{iodt})^{1-\sigma}}(1-\sigma) + (1-\sigma)\right] \\ &= (1-\sigma) ms_{fiodt}(1 - ms_{fiodt})/p_{fiodt} \end{aligned} \tag{B-8}$$

$$\begin{aligned}\frac{\partial ms_{iodt}}{\partial p_{fiodt}} &= \frac{\partial[(p_{iodt})^{1-\rho}(p_{idt})^{\rho-1}]}{\partial p_{fiodt}} = (p_{idt})^{\rho-1}\frac{\partial (p_{iodt})^{1-\rho}}{\partial p_{fiodt}} + (p_{iodt})^{1-\rho}\frac{\partial (p_{idt})^{\rho-1}}{\partial p_{fiodt}} \\ &= (p_{idt})^{\rho-1}\frac{\partial (p_{iodt})^{1-\rho}}{\partial p_{fiodt}}(1 - ms_{iodt}) = (1-\rho)(1 - ms_{iodt})\alpha_{fiodt}(p_{fiodt})^{-\sigma}(p_{iodt})^{\sigma-\rho}(p_{idt})^{\rho-1} \\ &= (1-\rho)(1 - ms_{iodt}) ms_{fiodt} ms_{iodt}/p_{fiodt} \end{aligned} \tag{B-9}$$

Elasticities with respect to other firms' price changes. A key feature of oligopolistic competition is that a firm will endogenize the price changes of its competitors in making its markup decisions. Before we proceed to the price decomposition, it is useful to derive how a firm's demand elasticity varies due to price changes of firms from the same origin $\frac{\partial \varepsilon_{fiodt}}{\partial p_{kiodt}}$ $\forall k \neq f \in \mathcal{F}_{iodt}$ and different origins $\frac{\partial \varepsilon_{fiodt}}{\partial p_{f'io'dt}}$ $\forall f', o' \in \mathcal{F}_{idt} \backslash \mathcal{F}_{iodt}$:

$$\begin{aligned}\frac{\partial \varepsilon_{fiodt}}{\partial p_{kiodt}} = & -[\sigma - \rho + (\rho - \eta) ms_{iodt}] \frac{\partial ms_{fiodt}}{\partial p_{kiodt}} - ms_{fiodt}(\rho - \eta) \frac{\partial ms_{iodt}}{\partial p_{kiodt}} \\ = & -[\sigma - \rho + (\rho - \eta) ms_{iodt}](\sigma - 1) ms_{fiodt} ms_{kiodt} / p_{kiodt} \\ & - ms_{fiodt}(\rho - \eta)(1 - \rho)(1 - ms_{iodt}) ms_{kiodt} ms_{iodt} / p_{kiodt}\end{aligned}$$

$$\frac{\partial \varepsilon_{fiodt}}{\partial p_{f'io'dt}} = -ms_{fiodt}(\rho - \eta) \frac{\partial ms_{iodt}}{\partial p_{f'io'dt}} = ms_{fiodt}(\rho - \eta)(1 - \rho) ms_{iodt} ms_{f'io'dt} ms_{io'dt} / p_{f'io'dt}$$

where $\frac{\partial ms_{iodt}}{\partial p_{f'io'dt}}$ is derived as follows:

$$\begin{aligned}\frac{\partial ms_{iodt}}{\partial p_{f'io'dt}} &= \frac{\partial[(p_{iodt})^{1-\rho}(p_{idt})^{\rho-1}]}{\partial p_{f'io'dt}} = (p_{iodt})^{1-\rho} \frac{\partial (p_{idt})^{\rho-1}}{\partial p_{f'io'dt}} \\ &= (\rho - 1) ms_{iodt} \alpha_{f'io'dt} (p_{f'io'dt})^{-\sigma} (p_{iodt})^{\sigma-\rho} (p_{idt})^{\rho-1} \\ &= (\rho - 1) ms_{iodt} ms_{f'io'dt} ms_{io'dt} / p_{f'io'dt}\end{aligned}$$

Note that, as a standard property of static oligopolistic competition models, the price elasticities sum to zero:

$$\frac{\partial \varepsilon_{fiodt}}{\partial p_{fiodt}} \frac{p_{fiodt}}{\varepsilon_{fiodt}} + \sum_{k \neq f \in \mathcal{F}_{iodt}} \frac{\partial \varepsilon_{fiodt}}{\partial p_{kiodt}} \frac{p_{kiodt}}{\varepsilon_{fiodt}} + \sum_{f', o' \in \mathcal{F}_{idt} \backslash \mathcal{F}_{iodt}} \frac{\partial \varepsilon_{fiodt}}{\partial p_{f'io'dt}} \frac{p_{f'io'dt}}{\varepsilon_{fiodt}} = 0 \tag{B-10}$$

B.2.2 A total price decomposition

Following Amiti, Itskhoki and Konings (2019), we decompose the price adjustment into (tariff-inclusive) marginal cost changes and markup adjustments:

$$\widehat{p}_{fiodt} = \widehat{mc}_{fiodt} + \widehat{\mu}_{fiodt} \tag{B-11}$$

where the optimal markup responds to (i) the firm's own price changes $\widehat{p}_{fiodt}$, (ii) other firms' price changes from the same origin $\widehat{p}_{kiodt}$, (iii) other firms' price changes from the different origins $\widehat{p}_{f'io'dt}$ and (iv) new entrants $\widehat{E}_{fiodt}$:

$$\widehat{\mu}_{fiodt} = \frac{\partial \mu_{fiodt}}{\partial p_{fiodt}} \frac{p_{fiodt}}{\mu_{fiodt}} \widehat{p}_{fiodt} + \sum_{k \neq f \in \mathcal{F}_{iodt}} \frac{\partial \mu_{fiodt}}{\partial p_{kiodt}} \frac{p_{kiodt}}{\mu_{fiodt}} \widehat{p}_{kiodt} + \sum_{f',o' \in \mathcal{F}_{idt} \setminus \mathcal{F}_{iodt}} \frac{\partial \mu_{fiodt}}{\partial p_{f'io'dt}} \frac{p_{f'io'dt}}{\mu_{fiodt}} \widehat{p}_{f'io'dt} + \widehat{E}_{fiodt}$$

In contrast to Amiti, Itskhoki and Konings (2019), our triple nested demand structure implies different responses to price changes by firms from the same and firms from different origins, which means we need to keep track of (ii) and (iii) separately. In addition, our decomposition accounts for the effect of new entrants on incumbent firms' markups. We use $\widehat{E}_{fiodt}$ to denote the direct entry effect on an incumbent firm's optimal markup for now and give more details about the exact form of $\widehat{E}_{fiodt}$ in subsection B.2.4.

Let

$$\begin{aligned}
\mathbb{A}_{fiodt} &\equiv \frac{\partial \mu_{fiodt}}{\partial p_{fiodt}} \frac{p_{fiodt}}{\mu_{fiodt}} = -\frac{1}{\varepsilon_{fiodt} - 1} \Gamma_{fiodt}, \\
\mathbb{B}_{fiodt} &\equiv \sum_{k \neq f \in \mathcal{F}_{iodt}} \frac{\partial \mu_{fiodt}}{\partial p_{kiodt}} \frac{p_{kiodt}}{\mu_{fiodt}} = -\frac{1}{\varepsilon_{fiodt} - 1} \sum_{k \neq f \in \mathcal{F}_{iodt}} \frac{\partial \varepsilon_{fiodt}}{\partial p_{kiodt}} \frac{p_{kiodt}}{\varepsilon_{fiodt}}, \\
\mathbb{C}_{fiodt} &\equiv \sum_{f',o' \in \mathcal{F}_{idt} \setminus \mathcal{F}_{iodt}} \frac{\partial \mu_{fiodt}}{\partial p_{f'io'dt}} \frac{p_{f'io'dt}}{\mu_{fiodt}} = -\frac{ms_{fiodt}}{\varepsilon_{fiodt}(\varepsilon_{fiodt} - 1)} (\rho - \eta)(1 - \rho) ms_{iodt} (1 - ms_{iodt}).
\end{aligned}$$

From equation (B-10), we know $\mathbb{A}_{fiodt} + \mathbb{B}_{fiodt} + \mathbb{C}_{fiodt} = 0$. In addition, note the following relationship holds

$$\sum_{k \neq f \in \mathcal{F}_{iodt}} \frac{\partial \mu_{fiodt}}{\partial p_{kiodt}} \frac{p_{kiodt}}{\mu_{fiodt}} \widehat{p}_{kiodt} = \mathbb{B}_{fiodt} \sum_{k \neq f \in \mathcal{F}_{iodt}} \frac{ms_{kiodt}}{1 - ms_{fiodt}} \widehat{p}_{kiodt} \tag{B-12}$$

$$\sum_{f',o' \in \mathcal{F}_{idt} \setminus \mathcal{F}_{iodt}} \frac{\partial \mu_{fiodt}}{\partial p_{f'io'dt}} \frac{p_{f'io'dt}}{\mu_{fiodt}} \widehat{p}_{f'io'dt} = \mathbb{C}_{fiodt} \sum_{f',o' \in \mathcal{F}_{idt} \setminus \mathcal{F}_{iodt}} \frac{ms_{f'io'dt} ms_{io'dt}}{1 - ms_{iodt}} \widehat{p}_{f'io'dt} \tag{B-13}$$

Using equations (B-11)–(B-13) together with the definition of price indices that

$$\widehat{p}_{iodt} = \sum_{f \in \mathcal{F}_{iodt}} ms_{fiodt} \widehat{p}_{fiodt} \quad \text{and} \quad \widehat{p}_{idt} = \sum_{o \in \mathcal{H}} ms_{iodt} \widehat{p}_{iodt}, \tag{B-14}$$

we can solve for the optimal price change as

$$\begin{aligned}
\widehat{p}_{fiodt} = {} & (1 - ms_{fiodt})(1 - ms_{iodt})/\mathbb{D}_{fiodt}(\widehat{mc}_{fiodt} + \widehat{E}_{fiodt}) + \mathbb{B}_{fidot}/\mathbb{D}_{fiodt}(1 - ms_{iodt})\widehat{p}_{iodt} \\
& + \mathbb{C}_{fiodt}/\mathbb{D}_{fiodt}(1 - ms_{fiodt})(\widehat{p}_{idt} - ms_{iodt}\widehat{p}_{iodt})
\end{aligned} \tag{B-15}$$

where

$$
\begin{aligned}
\mathbb{D}_{fiodt} &\equiv (1-ms_{iodt})(1-ms_{fiodt})(1-\mathbb{A}_{fiodt}) + (1-ms_{iodt})ms_{fiodt}\mathbb{B}_{fiodt} \\
&= (1-ms_{iodt})(1-ms_{fiodt}-\mathbb{A}_{fiodt}-\mathbb{C}_{fiodt}ms_{fiodt}) \\
&= (1-ms_{iodt})[\mathbb{B}_{fiodt}+(1-ms_{fiodt})(1+\mathbb{C}_{fiodt})] \\
&= (1-ms_{iodt})(1-ms_{fiodt})\frac{\varepsilon_{fiodt}^2+\sigma^2-(\varepsilon_{fiodt}+1)\sigma}{\varepsilon_{fiodt}(\varepsilon_{fiodt}-1)}
\end{aligned}
$$

Note that we have written $\mathbb{D}_{fiodt}$ in different forms here, which will be convenient in simplifying expressions in the rest of this and the next subsections.

To proceed, we need to solve for $\widehat{p}_{iodt}$ and $\widehat{p}_{idt}$ in equation (B-15), which are endogenous functions of the cost shocks. We do so by iteratively applying the definition of the price indices in equation (B-14).

First, summing over price changes from the origin gives

$$
\begin{aligned}
\sum_{f\in\mathcal{F}_{iodt}} ms_{fiodt}\widehat{p}_{fiodt} = &\sum_{f\in\mathcal{F}_{iodt}} (1-ms_{fiodt})(1-ms_{iodt})ms_{fiodt}/\mathbb{D}_{fiodt}(\widehat{mc}_{fiodt}+\widehat{E}_{fiodt}) \\
&+ \sum_{f\in\mathcal{F}_{iodt}} ms_{fiodt}[\mathbb{B}_{fiodt}(1-ms_{iodt})-\mathbb{C}_{fiodt}ms_{iodt}(1-ms_{fiodt})]/\mathbb{D}_{fiodt}\widehat{p}_{iodt} \\
&+ \sum_{f\in\mathcal{F}_{iodt}} \mathbb{C}_{fiodt}(1-ms_{fiodt})ms_{fiodt}/\mathbb{D}_{fiodt}\widehat{p}_{idt}
\end{aligned}
$$

Rearrange and we get

$$
\begin{aligned}
\widehat{p}_{iodt} = &\frac{1}{\mathbb{X}_{iodt}+\mathbb{Y}_{iodt}}\sum_{f\in\mathcal{F}_{iodt}}(1-ms_{fiodt})(1-ms_{iodt})ms_{fiodt}/\mathbb{D}_{fiodt}(\widehat{mc}_{fiodt}+\widehat{E}_{fiodt}) \\
&+\frac{1}{\mathbb{X}_{iodt}+\mathbb{Y}_{iodt}}\sum_{f\in\mathcal{F}_{iodt}}\mathbb{C}_{fiodt}(1-ms_{fiodt})ms_{fiodt}/\mathbb{D}_{fiodt}\widehat{p}_{idt}
\end{aligned} \tag{B-16}
$$

where

$$
\mathbb{X}_{iodt} \equiv (1-ms_{iodt})\sum_{f\in\mathcal{F}_{iodt}}(1-ms_{fiodt})ms_{fiodt}/\mathbb{D}_{fiodt} = \sum_{f\in\mathcal{F}_{iodt}} ms_{fiodt}\frac{\varepsilon_{fiodt}(\varepsilon_{fiodt}-1)}{\varepsilon_{fiodt}^2+\sigma^2-(\varepsilon_{fiodt}+1)\sigma}
$$

$$
\mathbb{Y}_{iodt} \equiv \sum_{f\in\mathcal{F}_{iodt}}\mathbb{C}_{fiodt}(1-ms_{fiodt})ms_{fiodt}/\mathbb{D}_{fiodt} = \sum_{f\in\mathcal{F}_{iodt}} ms_{fiodt}\frac{(\rho-\eta)(\rho-1)ms_{fiodt}ms_{iodt}}{\varepsilon_{fiodt}^2+\sigma^2-(\varepsilon_{fiodt}+1)\sigma}
$$

Second, summing over equation (B-15) across origins gives

$$\widehat{p}_{idt} = \frac{1}{1-\mathbb{F}_{idt}} \sum_{o\in\mathcal{H}} \frac{ms_{iodt}}{\mathbb{X}_{iodt}+\mathbb{Y}_{iodt}} \sum_{f\in\mathcal{F}_{iodt}} (1-ms_{fiodt})(1-ms_{iodt})ms_{fiodt}/\mathbb{D}_{fiodt}(\widehat{mc}_{fiodt}+\widehat{E}_{fiodt}) \tag{B-17}$$

where

$$\mathbb{F}_{idt} \equiv \sum_{o\in\mathcal{H}} \frac{ms_{iodt}\mathbb{Y}_{iodt}}{\mathbb{X}_{iodt}+\mathbb{Y}_{iodt}}$$

It is straightforward to see that, for a common cost shock that affects all firms in the industry ($\widehat{mc}_{fiodt} = constant\ \forall f, o$), the pass through is 100% in the absence of firm entry and exit:

$$\frac{1}{1-\mathbb{F}_{idt}} \sum_{o\in\mathcal{H}} \frac{ms_{iodt}\mathbb{X}_{iodt}}{\mathbb{X}_{iodt}+\mathbb{Y}_{iodt}} = 1. \tag{B-18}$$

Finally, substituting expressions (B-17) and (B-16) into equation (B-15), we get the solution of the optimal price change in terms of exogenous shocks and the entry effect, which we characterize next.

B.2.3 Price responses to preferential tariffs

With the solutions discussed in the previous subsection, we characterize the price adjustment to a preferential tariff $\widehat{\tau}_{iodt}$. First of all, since a preferential tariff has no direct impact on the costs of firms from other origins, the change in the industry level price index can be calculated using equation (B-17) as

$$\widehat{p}_{idt} = \frac{1}{1-\mathbb{F}_{idt}} \frac{ms_{iodt}\mathbb{X}_{iodt}}{\mathbb{X}_{iodt}+\mathbb{Y}_{iodt}} \left(1+\frac{\mathbb{E}_{iodt}}{\mathbb{X}_{iodt}}\right) \widehat{\tau}_{iodt} \tag{B-19}$$

where

$$\mathbb{E}_{fiodt} \equiv (1-ms_{iodt})/\widehat{\tau}_{iodt} \sum_{f\in\mathcal{F}_{iodt}} (1-ms_{fiodt})ms_{fiodt}/\mathbb{D}_{fiodt}\widehat{E}_{fiodt} \tag{B-20}$$

Similarly, the change in the origin-specific price index can be calculated using equation (B-16) as

$$\begin{aligned}\widehat{p}_{iodt} &= \left[1+\frac{ms_{iodt}}{\sum_{o\in\mathcal{H}}\frac{ms_{iodt}\mathbb{X}_{iodt}}{\mathbb{X}_{iodt}+\mathbb{Y}_{iodt}}} \frac{\mathbb{Y}_{iodt}}{\mathbb{X}_{iodt}+\mathbb{Y}_{iodt}}\right]\left[1-\frac{\mathbb{Y}_{iodt}}{\mathbb{X}_{iodt}+\mathbb{Y}_{iodt}}\right]\left(1+\frac{\mathbb{E}_{iodt}}{\mathbb{X}_{iodt}}\right)\widehat{\tau}_{iodt} \\ &= (1-\mathbb{Z}_{iodt})\left(1+\frac{\mathbb{E}_{iodt}}{\mathbb{X}_{iodt}}\right)\widehat{\tau}_{iodt}\end{aligned} \tag{B-21}$$

where

$$\mathbb{Z}_{iodt} \equiv \frac{\mathbb{Y}_{iodt}}{\mathbb{X}_{iodt}+\mathbb{Y}_{iodt}}\left[1-\frac{1}{1-\mathbb{F}_{idt}}\frac{ms_{iodt}\mathbb{X}_{iodt}}{\mathbb{X}_{iodt}+\mathbb{Y}_{iodt}}\right] > 0 \tag{B-22}$$

is the average markup adjustment for firms from origin o selling in industry i in destination d in year t. $\mathbb{Z}_{iodt} > 0$ means the price pass through of a preferential tariff change is incomplete in the absence of entry effects (i.e., when $\mathbb{E}_{iodt} = 0$).

Next, with some rearrangement, we have that

$$\begin{aligned}
\widehat{p}_{fiodt} =& \ \{1-[1-(1-ms_{iodt})(1-ms_{fiodt}+\mathbb{C}_{fiodt})/\mathbb{D}_{fiodt}]\mathbb{Z}_{iodt}\}\left(1+\frac{\mathbb{E}_{iodt}}{\mathbb{X}_{iodt}}\right)\widehat{\tau}_{iodt} \\
& -\mathbb{C}_{fiodt}(1-ms_{fiodt})/\mathbb{D}_{fiodt}\left(1+\frac{\mathbb{X}_{iodt}}{\mathbb{Y}_{iodt}}\right)\mathbb{Z}_{iodt}\left(1+\frac{\mathbb{E}_{iodt}}{\mathbb{X}_{iodt}}\right)\widehat{\tau}_{iodt} \\
& +\left(\widehat{E}_{fiodt}/\widehat{\tau}_{iodt}-\frac{\mathbb{E}_{iodt}}{\mathbb{X}_{iodt}}\right)(1-ms_{iodt})(1-ms_{fiodt})/\mathbb{D}_{fiodt}\widehat{\tau}_{iodt} \\
=& \left[1-ms_{fiodt}(\sigma-\rho)\frac{(\sigma-1)+(\rho-\eta)ms_{iodt}}{\varepsilon_{fiodt}^2+\sigma^2-(\varepsilon_{fiodt}+1)\sigma}\mathbb{Z}_{iodt}\right]\left(1+\frac{\mathbb{E}_{iodt}}{\mathbb{X}_{iodt}}\right)\widehat{\tau}_{iodt} \\
& -\frac{(\rho-\eta)(\rho-1)ms_{fiodt}ms_{iodt}}{\varepsilon_{fiodt}^2+\sigma^2-(\varepsilon_{fiodt}+1)\sigma}\left(1+\frac{\mathbb{X}_{iodt}}{\mathbb{Y}_{iodt}}\right)\mathbb{Z}_{iodt}\left(1+\frac{\mathbb{E}_{iodt}}{\mathbb{X}_{iodt}}\right)\widehat{\tau}_{iodt} \\
& +\left(\widehat{E}_{fiodt}/\widehat{\tau}_{iodt}-\frac{\mathbb{E}_{iodt}}{\mathbb{X}_{iodt}}\right)\frac{\varepsilon_{fiodt}(\varepsilon_{fiodt}-1)}{\varepsilon_{fiodt}^2+\sigma^2-(\varepsilon_{fiodt}+1)\sigma}\widehat{\tau}_{iodt}
\end{aligned} \tag{B-23}$$

Finally, the markup adjustment is given by

$$\widehat{\mu}_{fiodt} = \widehat{p}_{fiodt}-\widehat{\tau}_{iodt} = -\Upsilon_{fiodt}\widehat{\tau}_{iodt}+\frac{\mathbb{E}_{iodt}}{\mathbb{X}_{iodt}}\left(1-\Upsilon_{fiodt}\right)\widehat{\tau}_{iodt}+\epsilon_{fiodt}\widehat{\tau}_{iodt} \tag{B-24}$$

where

$$\Upsilon_{fiodt} \equiv \left[ms_{fiodt}(\sigma-\rho)\frac{(\sigma-1)+(\rho-\eta)ms_{iodt}}{\varepsilon_{fiodt}^2+\sigma^2-(\varepsilon_{fiodt}+1)\sigma}+\frac{(\rho-\eta)(\rho-1)ms_{fiodt}ms_{iodt}}{\varepsilon_{fiodt}^2+\sigma^2-(\varepsilon_{fiodt}+1)\sigma}\left(1+\frac{\mathbb{X}_{iodt}}{\mathbb{Y}_{iodt}}\right)\right]\mathbb{Z}_{iodt} \tag{B-25}$$

$$\epsilon_{fiodt} \equiv \left(\widehat{E}_{fiodt}/\widehat{\tau}_{iodt}-\frac{\mathbb{E}_{iodt}}{\mathbb{X}_{iodt}}\right)\frac{\varepsilon_{fiodt}(\varepsilon_{fiodt}-1)}{\varepsilon_{fiodt}^2+\sigma^2-(\varepsilon_{fiodt}+1)\sigma} \tag{B-26}$$

B.2.4 Approximating the entry effect

In this subsection, we approximate the effect of new entrants on incumbent firms' optimal markups. With some abuse of notation, we use $\partial x_{fiodt}/\partial ms_{jiodt}$ to denote the partial effect of new entrant j on an incumbent firm's outcome variable x_{fiodt} (e.g., market shares, demand elasticity and markup) due to a one percent preferential tariff reduction (i.e., $\widehat{\tau}_{iodt} = -1\%$).

Our approximation relies on the following observation:

$$\frac{\partial ms_{fiodt}}{\partial ms_{jiodt}} = -\frac{\alpha_{fiodt}(p_{fiodt})^{1-\sigma}}{(p_{iodt})^{2-2\sigma}} \frac{\partial (p_{iodt})^{1-\sigma}}{\partial ms_{jiodt}} \approx -ms_{fiodt}ms_{jiodt} \tag{B-27}$$

which states that the market share reduction of an incumbent due to a new entrant is approximately the product of the market share of the incumbent firm and that of the new entrant, i.e., $ms_{fiodt}ms_{jiodt}$. For example, consider an industry with two incumbent firms of equal size (i.e., with 50% market share each). Now if the tariff reduction leads to a new entrant with 20% market share, the new market share distribution is {40%, 40%, 20%}, which means each firm has lost 10% = 50% × 20% market share. The implicit assumption imposed by equation (B-27) is that the new entrant will have a similar (proportional) impact on the incumbent firms' market shares. While equation (B-27) may not hold exactly in the case of heterogeneous incumbent firms (as some firms may be slightly more impacted by the new entrant than others), we think it is a reasonable first order approximation of the exact equilibrium.

Under the assumption that equation (B-27) is a good approximation, we can back out the direct impact of the new entrant on the (transformed) price index as given by equation (B-28) and use this relationship to calculate how the origin's market share changes in the destination as given by equation (B-29).

$$\frac{\partial (p_{iodt})^{1-\sigma}}{\partial ms_{jiodt}} \approx \alpha_{jiodt}(p_{jiodt})^{1-\sigma} \tag{B-28}$$

$$\begin{aligned}
\frac{\partial ms_{iodt}}{\partial ms_{jiodt}} &= (p_{idt})^{\rho-1} \frac{\partial (p_{iodt})^{1-\rho}}{\partial ms_{jiodt}} (1 - ms_{iodt}) \\
&= \frac{1-\rho}{1-\sigma} (p_{idt})^{\rho-1} (p_{iodt})^{\sigma-\rho} \frac{\partial (p_{iodt})^{1-\sigma}}{\partial ms_{jiodt}} (1 - ms_{iodt}) \\
&\approx \frac{1-\rho}{1-\sigma} ms_{jiodt} ms_{iodt} (1 - ms_{iodt})
\end{aligned} \tag{B-29}$$

With the expression in equations (B-27) and (B-29), the effect of new entrant j on incumbent firm f's demand elasticity can be calculated as

$$\begin{aligned}
\frac{\partial \varepsilon_{fiodt}}{\partial ms_{jiodt}} =& -[\sigma - \rho + (\rho - \eta) ms_{iodt}] \frac{\partial ms_{fiodt}}{\partial ms_{jiodt}} - ms_{fiodt}(\rho - \eta) \frac{\partial ms_{iodt}}{\partial ms_{jiodt}} \\
&\approx ms_{fiodt} ms_{jiodt} \varphi_{iodt}
\end{aligned} \tag{B-30}$$

where

$$\varphi_{iodt} \equiv (\sigma - \rho) + (\rho - \eta) ms_{iodt}[1 - (\rho - 1)/(\sigma - 1)(1 - ms_{iodt})].$$

Finally, the total effect of new entrants on incumbent firm f's optimal markup can be calculated as

$$\begin{aligned} \widehat{E}_{fiodt}|_{\widehat{\tau}=-0.01} &= \sum_j \frac{\partial \log(\mu_{fiodt})}{\partial ms_{jiodt}} = \frac{1}{\mu_{fiodt}} \frac{\partial \mu_{fiodt}}{\partial \varepsilon_{fiodt}} \sum_j \frac{\partial \varepsilon_{fiodt}}{\partial ms_{jiodt}} \\ &\approx -\frac{ms_{fiodt}\varphi_{iodt}}{\varepsilon_{fiodt}(\varepsilon_{fiodt} - 1)} \widetilde{ms}_{jiodt} \end{aligned} \tag{B-31}$$

where $\widetilde{ms}_{jiodt} \equiv \sum_j ms_{jiodt}$ is the sum of market shares of new entrants from origin o in product-market id due to the preferential tariff reduction.

It is worth noting that $\widehat{E}_{fiodt}|_{\widehat{\tau}=-0.01}$ only represents the *unsolved direct* effect of entry on an incumbent firm's markup. In equilibrium, the firm will also need to account for its competitors' reactions. To get the equilibrium markup adjustment due to entry, we follow the procedures in subsections B.2.2 and B.2.3. Substituting equation (B-31) into the definition of $\mathbb{E}_{iodt}$ in equation (B-20), we get

$$\mathbb{E}_{iodt}|_{\widehat{\tau}=-0.01} \approx 100 \times \varphi_{iodt} \widetilde{ms}_{jiodt} \sum_{f \in \mathcal{F}_{iodt}} \frac{ms_{fiodt}}{\varepsilon^2_{fiodt} + \sigma^2 - (\varepsilon_{fiodt} + 1)\sigma} \tag{B-32}$$

Plunging the expression of $\mathbb{E}_{iodt}|_{\widehat{\tau}=-0.01}$ into equation (B-24) gives the formula in Proposition 2 and completes our proof:

$$100 \times \widehat{\mu}_{fiodt}|_{\widehat{\tau}=-0.01} \approx \Upsilon_{fiodt} - (1 - \Upsilon_{fiodt})\, \Phi_{iodt} ms_{fiodt} + \epsilon_{fiodt} \qquad \square$$

where ϵ_{fiodt} is a residual term that captures the additional differential impact of entry for large relative to small firms and is close to zero if all firms are similar in size.

B.3 Proof of Lemma 1

Note that in the symmetric case, we have

$$\frac{\mathbb{E}_{iodt}}{\mathbb{X}_{iodt}} = \widehat{E}_{fiodt}/\widehat{\tau}_{iodt} \quad \text{and} \quad \Upsilon_{fiodt} = \mathbb{Z}_{iodt} = (1 - ms_{iodt}) \frac{\mathbb{X}_{iodt}}{\mathbb{X}_{iodt} + \mathbb{Y}_{iodt}}$$

where

$$\mathbb{X}_{iodt} = \frac{\varepsilon_{fiodt}(\varepsilon_{fiodt} - 1)}{\varepsilon^2_{fiodt} + \sigma^2 - (\varepsilon_{fiodt} + 1)\sigma} \quad \text{and} \quad \mathbb{Y}_{iodt} = \frac{(\rho - \eta)(\rho - 1) ms_{fiodt} ms_{iodt}}{\varepsilon^2_{fiodt} + \sigma^2 - (\varepsilon_{fiodt} + 1)\sigma} \tag{B-33}$$

It follows that $\epsilon_{fiodt} = 0$ and

$$\widetilde{\overline{ms}}_{jiodt} = \frac{\Upsilon_{fiodt}}{(1-\Upsilon_{fiodt})\Phi_{iodt}} = \frac{\mathbb{Y}_{iodt}}{\mathbb{X}_{iodt}\Phi_{iodt}} \frac{1-ms_{iodt}}{1+ms_{iodt}\frac{\mathbb{Y}_{iodt}}{\mathbb{X}_{iodt}}}$$
$$\approx \frac{\mathbb{Y}_{iodt}}{\mathbb{X}_{iodt}\Phi_{iodt}} = \frac{ms_{iodt}(\rho-1)(\rho-\eta)(\sigma-1)}{100\left\{(\sigma-\rho)(\sigma-1)+ms_{iodt}(\rho-\eta)[ms_{iodt}(\rho-1)+\sigma-\rho]\right\}}$$

where we have used the fact that $(1-ms_{iodt})/(1+ms_{iodt}\mathbb{Y}_{iodt}/\mathbb{X}_{iodt})$ is close to one when ms_{iodt} is small. It is straightforward to see that $\widetilde{\overline{ms}}_{jiodt}$ is strictly decreasing in σ when $\sigma > \rho$.
$\square$

B.4 Proof of Lemma 2

Using equations (13) and (14) and setting competitors' price changes and the entry effect to zero, we get

$$\frac{\partial \mu_{fiodt}}{\partial \tau_{iodt}} \frac{\tau_{iodt}}{\mu_{fiodt}} = -\frac{\Gamma_{fiodt}}{\Gamma_{fiodt}+\varepsilon_{fiodt}-1} \tag{B-34}$$

where Γ_{fiodt} is the elasticity of the demand elasticity with respect to price (also called the "super-elasticity") given by equation (B-6). Since the denominator $\Gamma_{fiodt}+\varepsilon_{fiodt}-1>0$, $\frac{\partial \mu_{fiodt}}{\partial \tau_{iodt}} \frac{\tau_{iodt}}{\mu_{fiodt}} > 0$ if and only if $\Gamma_{fiodt} < 0$, i.e., when the firm's demand elasticity is decreasing in its (tariff-inclusive) price. This completes our proof for part (i).

Parts (ii) and (iii) are equivalent statements. The elasticity of the demand elasticity with respect to quantity is given by

$$\frac{\partial \varepsilon_{fiodt}}{\partial y_{fiodt}} \frac{y_{fiodt}}{\varepsilon_{fiodt}} = \frac{\partial \varepsilon_{fiodt}}{\partial p_{fiodt}} \frac{p_{fiodt}}{\varepsilon_{fiodt}} \frac{\partial p_{fiodt}}{\partial y_{fiodt}} \frac{y_{fiodt}}{p_{fiodt}} = -\Gamma_{fiodt}\varepsilon_{fiodt} \tag{B-35}$$

which is positive if and only if $\Gamma_{fiodt} < 0$.

Finally, for part (iv), the curvature of the demand function defined by Mrázová and Neary (2017) (see equations A1 and A2 on p. 3868) can be written as

$$-\frac{\partial^2 y_{fiodt}}{\partial (p_{fiodt})^2} \frac{p_{fiodt}}{\partial y_{fiodt}/\partial p_{fiodt}} \frac{1}{\varepsilon_{fiodt}} = \frac{\varepsilon_{fiodt}+1}{\varepsilon_{fiodt}} - \frac{\Gamma_{fiodt}}{\varepsilon_{fiodt}}$$

where the second derivative of the demand function is derived using the chain rule as follows:

$$\frac{\partial^2 y_{fiodt}}{\partial (p_{fiodt})^2} = -\frac{\partial y_{fiodt}}{\partial p_{fiodt}} \frac{\varepsilon_{fiodt}}{p_{fiodt}} + \frac{y_{fiodt}}{p_{fiodt}} \frac{\varepsilon_{fiodt}}{p_{fiodt}} - \frac{y_{fiodt}}{p_{fiodt}} \frac{\partial \varepsilon_{fiodt}}{\partial p_{fiodt}}$$
$$= \frac{y_{fiodt}}{p_{fiodt}} \frac{\varepsilon_{fiodt}}{p_{fiodt}} (\varepsilon_{fiodt}+1-\Gamma_{fiodt})$$

Thus, the demand function is "superconvex" if and only if $\frac{\varepsilon_{fiodt}+1}{\varepsilon_{fiodt}} - \frac{\Gamma_{fiodt}}{\varepsilon_{fiodt}} > \frac{\varepsilon_{fiodt}+1}{\varepsilon_{fiodt}}$, which is true if and only if $\Gamma_{fiodt} < 0$. $\square$

B.5 Proof of Lemma 3

Under oligopolistic competition, a firm endogenizes the price changes of its competitors in deciding its optimal markup under a preferential tariff change. In the absence of entry and exit, the firm's equilibrium markup adjustment is given by $-\Upsilon_{fiodt}\tau_{iodt}$ (see equations (B-24) and (B-25)). While it is straightforward to see from our derivations in subsection B.2.2 that $\Upsilon_{fiodt} \neq \Gamma_{fiodt}/(\Gamma_{fiodt} + \varepsilon_{fiodt} - 1)$ in general, the exact expression of Υ_{fiodt} depends on the distribution of market shares of all firms in the industry and cannot be easily compared to $\Gamma_{fiodt}/(\Gamma_{fiodt} + \varepsilon_{fiodt} - 1)$. However, it is possible to gain some insights from the *ex ante* symmetric case, in which it can be shown that

$$\frac{\Gamma_{fiodt}}{\Gamma_{fiodt} + \varepsilon_{fiodt} - 1} = \frac{ms_{fiodt}(1 - ms_{iodt})\mathbb{Y}_{iodt} + (1 - ms_{fiodt})(1 - \mathbb{X}_{iodt})}{ms_{fiodt}(1 - ms_{iodt})\mathbb{Y}_{iodt} + (1 - ms_{fiodt})(1 - \mathbb{X}_{iodt}) + \mathbb{X}_{iodt}}$$

with $\mathbb{X}_{iodt}$ and $\mathbb{Y}_{iodt}$ given by equation (B-33) and that

$$\frac{\Gamma_{fiodt}}{\Gamma_{fiodt} + \varepsilon_{fiodt} - 1} - \Upsilon_{fiodt} \approx \frac{\mathbb{X}_{iodt}}{\mathbb{X}_{iodt} + \mathbb{Y}_{iodt}} \left[1 - \frac{1}{ms_{fiodt} + (1 - ms_{fiodt})/(\mathbb{X}_{iodt} + \mathbb{Y}_{iodt})}\right].$$

Note that $\mathbb{X}_{iodt} + \mathbb{Y}_{iodt} < 1$ and $\Gamma_{fiodt}/(\Gamma_{fiodt} + \varepsilon_{fiodt} - 1) - \Upsilon_{fiodt} > 0$ when $ms_{fiodt} \neq 1$ and $\sigma > \rho$. Intuitively, given an idiosyncratic cost shock, oligopolistic competition means a firm would want to absorb part of the cost shock into its markups – this is what is captured by $\Gamma_{fiodt}/(\Gamma_{fiodt} + \varepsilon_{fiodt} - 1)$. However, the markup adjustment under a shock that simultaneously affects many firms in the industry will in general be smaller. For example, under a preferential tariff reduction, the fact that the firms' competitors from the preferred origin are also directly affected by the shock and want to lower their (tariff-inclusive) prices increases the competitive pressure facing the firm and lowers its desired markup increase (i.e., $\Upsilon_{fiodt} < \Gamma_{fiodt}/(\Gamma_{fiodt} + \varepsilon_{fiodt} - 1)$). In an extreme case, if all firms in the industry (including the domestic firms in the destination market) are hit by the same shock, there is no change in the relative competitiveness of firms in the industry and the markup adjustment is zero in the absence of entry and exit (see equation (B-18)). $\square$

Online Appendix for "The Pro-Competitive Effects of Trade Agreements"

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Contents

OA1 Supplementary data appendix

OA1.1 Feenstra and Romalis (2014)

We augment our tariff data with information on the phase-in of trade agreements contained in the dataset created by Feenstra and Romalis (2014), who compile data on MFN and preferential tariffs between 1984 and 2011 for a large number of countries at the 4-digit SITC (Revision 2) product level. They impute preferential tariffs by extracting information on the phase-in of preferential tariffs from more than 100 trade agreements, which they express as fractions of the MFN tariff and then multiply with the MFN tariffs in their dataset.

To recover data on the phase-in of trade agreements from this dataset, which is available from Robert Feenstra's website, we express preferential tariffs as a fraction of MFN tariffs, calculate the mode across products within a country-pair and year and then consider the fraction of products with a value equal to that mode. We drop country-pair-years with more than one mode, country-pair-years where fewer than 25% of industries have values equal to the mode and country-pair-years where more than 25% of industries have missing values. For the remaining country-pair-years, we imputed missing preferential tariffs in our dataset by multiplying our MFN tariff with the fraction we get from this procedure.

OA1.2 Consolidated product codes

We consolidate HS codes to ensure that the product codes in our analysis are consistent over time. Our trade, tariff and commodity classification data are reported based on the HS product classification system. Since our data span a large number of years and the HS system is updated periodically, our data could feature up to four different revisions of the HS system (HS1996, HS2002, HS2007 and HS2012). We transform HS codes into consolidated HS codes which are constant over time by identifying networks of related product codes and assigning a unique consolidated code to each network, similar to Cebeci (2015). This reduces the number of distinct products in the HS system from 6,293 to 4,039. The final estimation dataset includes observations in 3646 consolidated Harmonized System product codes.

OA1.3 Product differentiation

We determine the degree of product differentiation for different products in our dataset by using the CCHS commodity classification system, which sorts products into highly and less differentiated goods. This classification is based on the fact that there are a large number of *measure words* in the Chinese language, and that the choice of measure word used for a given product is predetermined by Chinese grammar and linguistics and therefore reflects a good's intrinsic physical features. The core idea here is that goods whose quantity is recorded in specific countable units, such as motorcycles or consumer electronics, are more differentiated than goods whose quantity is recorded in continuous units, such as canned tomato paste or industrial chemicals. In Chinese trade data, quantity is reported in more than 30 indigenous Chinese units of measure, including distinct words representing the unit count of products such as wheeled vehicles, engines, and upper-body clothing articles, as well as more general terms for weight or volume. The CCHS classification exploits this distinction between what linguists refer to as count and mass measure words to construct a general product classification for the Harmonized System.[1]

The CCHS classification is available for more than 4,800 products at the HS6 level. In the 10 instances in which the CCHS code of a product is not the same for all HS6 codes within a consolidated HS code, we set the CCHS code to missing and disregard the product in our analysis.

OA1.4 Broad Economic Categories

To further refine the product space, we use information on product end-use categories provided by the UN's Broad Economic Categories classification (Revision 4) to distinguish between intermediate and consumption goods. This information is available via the UN Statistics Division's correspondence tables, which map HS6 codes to BEC categories and allow us to create a mapping from consolidated HS codes to BEC categories. There are only 17 consolidated codes with HS6 codes that correspond to more than on BEC category, and we omit these cases from our analysis.

[1]See Corsetti, Crowley, Han and Song (2023) for a more extensive discussion of measure words and evidence of how they are used in other East Asian customs records.

OA1.5 Additional statistics

Number of firms in granular markets. Table OA1-1 presents a more detailed overview of the number of exporters that operate in a given product-origin-destination-year market. It shows that the majority of these markets have only a handful of firms and demonstrates the importance of extensive margin decisions in this context.

Table OA1-1: The number of exporters in product-origin-destination-year markets

	Mean	25th Percentile	Median	75th Percentile	Observations
1. Present (t)					
# of Firms	11.97	1.00	3.00	7.00	1,303,733
2. Backward Looking ($t-1$ and t)					
# of Incumbents	4.35	0.00	1.00	2.00	1,303,733
# of Entrants	7.62	1.00	2.00	5.00	1,303,733
3. Forward Looking (t and $t+1$)					
# of Continuers	5.19	0.00	1.00	3.00	1,303,733
# of Exiters	6.78	1.00	2.00	5.00	1,303,733
4. Backward and Forward Looking ($t-1, t$ and $t+1$)					
# of Surviving Incumbents	2.70	0.00	0.00	2.00	1,303,733

Notes: This table presents summary statistics for the number of firms from an origin o selling product i to destination d at time t. It is based on data for product-origin-destination markets in our main estimation sample for all years in which there is at least one exporter in these markets. The first section reports features of the distribution of the number of firms across product-origin-destination-year markets. The second section splits firms in a market at time t into incumbents, firms already in that market at time $t-1$, and entrants, firms not yet in that market in $t-1$, while the third panel splits firms in a market at time t into continuers, firms also in that market at time $t+1$, and exiters, firms no longer in that market at time $t+1$. The fourth section reports the number of firms in a product-origin-destination market at times $t-1$, t and $t+1$.

The first section presents the number of firms in a product-origin-destination market at time t. The second section features a decomposition of that number into incumbents, firms already present in that market at time $t-1$, and entrants, firms new to that market at time t. The third section also decomposes the number of firms in a product-origin-destination market at time t, but looks forward in time, splitting it into the number of continuers, firms that are still in the market at time $t+1$, and the number of exiters, firms which leave that market after time t. The fourth and final section reports the number of firms that are present in a product-origin-destination market at times $t-1$, t and $t+1$. To ensure all four sections are comparable despite the fact that we do not observe outcomes at time $t-1$ in the first nor outcomes at time $t+1$ in the last year of the sample, table OA1-1 excludes both the first and the last years of our sample period for each of our eleven countries of origin.

Table OA1-1 highlights the importance of extensive margin decisions in highly disaggregated markets. On average, the number of entrants is higher than the number of incumbents, while the number of exiters is similar to the number of continuers. The high number of entrants relative to incumbents occurs because of the large number of granular product-origin-destination-year markets in which there is no incumbent firm.

Type of products sold to different countries. Table OA1-2 shows the overlap between our partitions of product and country space. As expected, the eleven countries in our sample export high differentiation and consumption goods primarily to high income countries, and low differentiation and intermediate goods primarily to low income countries.

Table OA1-2: Decomposition of products sold to countries of different income levels

	Highly Differentiated Goods		Less Differentiated Goods		Observations
	Consumption	Intermediate	Consumption	Intermediate	
High Income Countries					
	29.47	3.88	17.93	25.72	8,160,945
Middle Income Countries					
	22.24	5.09	15.88	30.64	4,277,859
Low Income Countries					
	12.89	5.43	13.85	39.86	865,706

Notes: This table presents the proportion of observations that fall into the four different product categories, broken down by destination income.

Summary statistics of our estimation sample. Table OA1-3 provides summary statistics for our main variables of interest based on our estimation sample and highlights two important features of our dataset. First, most product-origin-destination-time markets are sparsely populated. There are a large number of markets that are empty or served by only a handful of firms, as demonstrated by the fact that 75% of markets feature fewer than four firms, as well as a small number of markets in which the number of firms is large. This pattern also influences the average within-origin market share of a firm in our sample, which is around 7.2%, as there are a large number of firms with small within-origin market shares in product-origin-destination-time markets with many firms, as well as a large number of firms with large within-origin market shares in product-origin-destination-time markets with few firms. Second, our sample contains ample variation in tariffs while only 11% of our observations are subject to a preferential trade agreement.

Table OA1-3: Summary statistics

	Mean	S.D.	Percentile					Observations
			1^{st}	25^{th}	Median	75^{th}	99^{th}	
Trade value, $p_{fiodt}y_{fiodt}$	305,966	19.7M	16	2,339	11,437	51,261	3.1M	15,712,501
Tariff exclusive FOB price, p^b_{fiodt}	981	312,849	.046	1	2.6	8.2	4,000	15,712,501
Firm's within-origin market share, $ms_{fiodt} * 100$	7.2	19	.000058	.045	.4	3.2	100	15,712,501
Origin's trade value in a destination-product market, $\sum_{f \in \mathcal{F}_{iodt}} p_{fiodt}y_{fiodt}$	270M	2655M	901	513,433	3.4M	22M	4931M	15,712,501
Number of firms, N_{iodt}	11	71	0	0	1	5	178	1,563,040
Bilateral Ad Valorem Tariff (percent), $(\tau_{iodt} - 1) * 100$	7.8	10	0	1.6	5	12	40	15,712,501
Preferential Trade Agreement Dummy, PTA_{odt}	.11	.31	0	0	0	0	1	15,712,501

Notes: This table presents summary statistics based on our estimation sample for the variables used in the specifications reported in Table 3. All values are expressed in US dollars. The estimation sample is smaller than the full sample of 24,963,950 observations because fixed effects estimation excludes "singleton" observations. The row for "Number of firms" presents statistics for the sample including zero trade flows. We create a zero trade flow for year t whenever we see at least one firm exporting a product i from an origin o to a destination d in any year for which we observe o's exports but not in year t.

OA2 Supplementary estimation results

OA2.1 The origin's market share elasticities under alternative fixed effects and weighting schemes

Table 3 in our paper estimates the tariff elasticity of origin's market share in the destination ($\ln(ms_{iodt})$, column 4) on the same data sample and with the same fixed effects as the tariff elasticities of the firm's market share in the destination ($\ln(\omega_{fiodt}$, column 1) and the firm's within-origin market share ($\ln(ms_{fiodt}$, column 3). This effectively imposes the same set of controls and weighting scheme on each of these regressions and ensures that the three elasticities add up in the expected way, despite the fact that the origin's market shares in the destination, unlike the other two market shares, do not vary across firms within a product-origin-destination-year market. We choose this approach to be consistent with our model and because we are interested in the competitive pressure individual firms are faced with and the implications this has on their market power and markup responses. Thus, firms, as opposed to products, are the relevant units of observation for our purposes.

Table OA2-4 illustrates the differences between our strategy and a gravity specification based on data aggregated to the product-origin-destination-time level. Each column represents a regression of origin market shares in the destination $ln(ms_{iodt})$ on our trade agreement and tariff variables based on an alternative set of fixed effects or a different weighting scheme. Column (1) reproduces column (4) of table 3. This column is based on our full sample at the firm-product-origin-destination-year level and includes firm-product-origin-year, product-destination-year and origin-destination fixed effects. This means that the estimates in this column compare the market share for a product i from an origin o across destinations d in which firm f is active at time t, and that the (implicit) weighting of each product-origin-destination-year market in the regression is determined by the number of firms that export to it. Column (2) presents the estimates obtained in a traditional gravity specification based on data aggregated to the product-origin-destination-year level. This is the level of aggregation at which the origin's market share in a destination ms_{iodt} actually varies, and features product-origin-year instead of firm-product-origin-year fixed effects. In the column (2) specification, we are comparing the market share of an origin o across destinations d in which at least one firm f from the origin is active at time t. Implicitly, each (product-origin-destination-year) market has the same weight, regardless of the number of firms which serve the market.

The estimates in columns (1) and (2) are different for two reasons. First, they feature different fixed effects, and so the residual variation identifying the parameters is different.

Second, they each use a different weighting scheme. Column (1) effectively weights each (product-origin-destination-year) market by the number of firms, while column (2) weights each (product-origin-destination-year) market equally.

The specification in column (3) includes the same product-origin-year fixed effects as column (2), but employs the same (implicit) weighting scheme as column (1). Thus, the estimates in column (3) derive from the same identifying variation as in column (2) (i.e., the residual variation that remains after controlling for product-origin-year and other fixed effects) and the same implicit weighting of observations used in column (1)'s estimates.

Column (4) estimates a weighted version of column (2), using the number of firms in the market, N_{iodt}, as the weighting factor. This column, which features the same coefficient estimates as column (3), shows that the implicit weights of column (3) and the explicit weights of column (4) yield the same results once we use the same residual variation in both specifications.

Table OA2-4: Origin's market share elasticities under alternative fixed effects and weighting schemes

	(1)	(2)	(3)	(4)
Dependent variable	$\ln(ms_{fiodt})$	$\ln(ms_{iodt})$	$\ln(ms_{fiodt})$	$\ln(ms_{iodt})$
Weight of observation:	1	1	1	N_{iodt}
Tariff_{iodt}	-3.67***	-2.72***	-4.20***	-4.20***
	(0.429)	(0.312)	(0.467)	(0.491)
PTA_{odt}	-0.04	-0.04	-0.06*	-0.06*
	(0.031)	(0.027)	(0.034)	(0.036)
R^2	0.88	0.78	0.83	0.82
Observations	15,712,501	691,939	15,712,501	691,939
Fixed Effects				
Firm-product-origin-year	✓			
Product-origin-year		✓	✓	✓
Product-destination-year	✓	✓	✓	✓
Origin-destination	✓	✓	✓	✓

Notes: The dependent variable is the log of the country's (tariff-inclusive) export value to the destination market, $\ln(ms_{iodt})$, in all four columns. N_{iodt} represents the number of firms in the product-origin-destination market in year t. Standard errors, reported in parentheses, are clustered at the product-destination level, and we denote statistical significance with *** p<0.01, ** p<0.05, and * p<0.1. Estimates are based on an integrated dataset of firms' exports from eleven countries built from the World Bank Exporter Dynamics Database, China's Customs Authority, and Egypt's Customs Authority, as well as tariff data from the WTO and Feenstra and Romalis (2014), and the World Bank Deep Trade Agreements Database.

OA2.2 Preferential trade agreements

Tables OA2-5, OA2-6 and OA2-7 show that our main results for elasticities to the tariff are robust to modest changes in the specification. In our baseline estimates in table 3, the coefficient estimates on the preferential trade agreements dummy are small in magnitude, imprecise, and, at times, counterintuitive. This is because our specification includes origin-destination fixed effects to absorb cross-sectional variation in trade agreements and control for unobservable factors that shape bilateral trade relationships, while our dataset covers developing and emerging economies who sign relatively few trade agreements and whose agreements tend to focus on liberalising tariff rather than non-tariff barriers.

Table OA2-5 shows that our preferential trade agreement coefficients have the expected signs and significance once we replace our origin-destination fixed effects δ_{od} with a number of typical gravity controls (distance, contiguity, common language, common religion, common currency and colonial history) and exploit the cross-sectional variation in trade agreements that predominates in our sample. Preferential trade agreements now increase a firm's overall market share by 14% and a country's market share by 20%, but reduce a firm's within-origin market share by 5%. They also have the expected effect on markups, which decline by 4%, and the number of firms, which rises by 11%.

Tables OA2-6 and OA2-7 demonstrate that excluding the preferential trade agreements (PTA) dummy from our baseline specifications does not change our main results. The tariff elasticity estimates in table OA2-6, which presents specifications that simply omit PTA dummies, barely change compared to table 3, while the tariff elasticity estimates in table OA2-7, which replaces the PTA dummy (PTA_{odt}) with origin-destination-year fixed effects δ_{odt}, are, if anything, even more pronounced than in table 3.

Table OA2-5: Elasticities to tariffs and trade agreements controlling for gravity variables

	Firm's mkt share in the dest. $\ln(\omega_{fiodt})$ (1)	Markups $\ln(\mu_{fiodt})$ (2)	Firm's within origin mkt share $\ln(ms_{fiodt})$ (3)	Origin's mkt share $\ln(ms_{iodt})$ (4)	No. of firms (PPML) (5)
Tariff_{iodt}	-1.70***	0.25***	3.98***	-5.69***	-4.41***
	(0.178)	(0.048)	(0.267)	(0.353)	(0.204)
PTA_{odt}	0.13***	-0.04***	-0.05**	0.18***	0.10***
	(0.014)	(0.006)	(0.020)	(0.026)	(0.015)
R^2	0.65	0.90	0.79	0.86	-
Observations	15,707,406	15,707,406	15,707,406	15,707,406	1,555,960
Gravity Controls	✓	✓	✓	✓	✓
Fixed Effects					
Firm-product-origin-year	✓	✓	✓	✓	
Product-origin-year					✓
Product-destination-year	✓	✓	✓	✓	✓

Notes: The dependent variable is the firm's log (tariff-inclusive) export value in column (1), the firm's log (tariff-exclusive) unit value in column (2), the log of the firm's share of its country's trade with the destination in column (3), the log of the country's (tariff-inclusive) export value to the destination market in column (4) and the number of firms in column (5). All five columns include controls for distance, contiguity, common language, common religion, common currency and colonial history. Standard errors, reported in parentheses, are clustered at the product-destination level, and we denote statistical significance with *** p<0.01, ** p<0.05, and * p<0.1. Estimates are based on an integrated dataset of firms' exports from eleven countries built from the World Bank Exporter Dynamics Database, China's Customs Authority, and Egypt's Customs Authority, as well as tariff data from the WTO and Feenstra and Romalis (2014), and the World Bank Deep Trade Agreements Database.

Table OA2-6: Elasticities to tariffs excluding trade agreements

	Firm's mkt share in the dest. $\ln(\omega_{fiodt})$ (1)	Markups $\ln(\mu_{fiodt})$ (2)	Firm's within origin mkt share $\ln(ms_{fiodt})$ (3)	Origin's mkt share $\ln(ms_{iodt})$ (4)	No. of firms (PPML) (5)
Tariff_{iodt}	-0.79***	0.41***	2.87***	-3.66***	-2.43***
	(0.242)	(0.073)	(0.321)	(0.427)	(0.183)
R^2	0.65	0.90	0.79	0.88	-
Observations	15,712,501	15,712,501	15,712,501	15,712,501	1,563,040
Fixed Effects					
Firm-product-origin-year	✓	✓	✓	✓	
Product-origin-year					✓
Product-destination-year	✓	✓	✓	✓	✓
Origin-destination	✓	✓	✓	✓	✓

Notes: The dependent variable is the firm's log (tariff-inclusive) export value in column (1), the firm's log (tariff-exclusive) unit value in column (2), the log of the firm's share of its country's trade with the destination in column (3), the log of the country's (tariff-inclusive) export value to the destination market in column (4) and the number of firms in column (5). Standard errors, reported in parentheses, are clustered at the product-destination level, and we denote statistical significance with *** $p<0.01$, ** $p<0.05$, and * $p<0.1$. Estimates are based on an integrated dataset of firms' exports from eleven countries built from the World Bank Exporter Dynamics Database, China's Customs Authority, and Egypt's Customs Authority, as well as tariff data from the WTO and Feenstra and Romalis (2014).

Table OA2-7: Elasticities to tariffs using origin-destination-year fixed effects

	Firm's mkt share in the dest. $\ln(\omega_{fiodt})$ (1)	Markups $\ln(\mu_{fiodt})$ (2)	Firm's within origin mkt share $\ln(ms_{fiodt})$ (3)	Origin's mkt share $\ln(ms_{iodt})$ (4)	No. of firms (PPML) (5)
Tariff_{iodt}	-1.40***	0.42***	3.61***	-5.01***	-3.03***
	(0.304)	(0.088)	(0.402)	(0.537)	(0.224)
R^2	0.65	0.90	0.79	0.88	-
Observations	15,710,933	15,710,933	15,710,933	15,710,933	1,548,858
Fixed Effects					
Firm-product-origin-year	✓	✓	✓	✓	
Product-origin-year					✓
Product-destination-year	✓	✓	✓	✓	✓
Origin-destination-year	✓	✓	✓	✓	✓

Notes: The dependent variable is the firm's log (tariff-inclusive) export value in column (1), the firm's log (tariff-exclusive) unit value in column (2), the log of the firm's share of its country's trade with the destination in column (3), the log of the country's (tariff-inclusive) export value to the destination market in column (4) and the number of firms in column (5). Standard errors, reported in parentheses, are clustered at the product-destination level, and we denote statistical significance with *** p<0.01, ** p<0.05, and * p<0.1. Estimates are based on an integrated dataset of firms' exports from eleven countries built from the World Bank Exporter Dynamics Database, China's Customs Authority, and Egypt's Customs Authority, as well as tariff data from the WTO and Feenstra and Romalis (2014).

OA2.3 Tariff outliers

Since some tariffs in our dataset are extremely large, table OA2-8 presents results for a subset of our data which excludes all observations where the destination applies a tariff in excess of 40%, the 99$^{\text{th}}$ percentile of the tariff distribution in our sample, on that product against any of its trading partners in that year. The results are again qualitatively similar to but larger in magnitude than those in table 3.

Table OA2-8: Elasticities excluding tariff outliers

	Firm's mkt share in the dest. $\ln(\omega_{fiodt})$ (1)	Markups $\ln(\mu_{fiodt})$ (2)	Firm's within origin mkt share $\ln(ms_{fiodt})$ (3)	Origin's mkt share $\ln(ms_{iodt})$ (4)	No. of firms (PPML) (5)
Tariff$_{iodt}$	-0.92***	0.46***	3.48***	-4.40***	-2.69***
	(0.265)	(0.080)	(0.326)	(0.446)	(0.192)
PTA$_{odt}$	0.02	-0.02**	0.06**	-0.04	-0.07***
	(0.021)	(0.008)	(0.027)	(0.031)	(0.011)
R^2	0.65	0.90	0.79	0.88	-
Observations	15,459,818	15,459,818	15,459,818	15,459,818	1,549,636
Fixed Effects					
Firm-product-origin-year	✓	✓	✓	✓	
Product-origin-year					✓
Product-destination-year	✓	✓	✓	✓	✓
Origin-destination	✓	✓	✓	✓	✓

Notes: The dependent variable is the firm's log (tariff-inclusive) export value in column (1), the firm's log (tariff-exclusive) unit value in column (2), the log of the firm's share of its country's trade with the destination in column (3), the log of the country's (tariff-inclusive) export value to the destination market in column (4) and the number of firms in column (5). Standard errors, reported in parentheses, are clustered at the product-destination level, and we denote statistical significance with *** p<0.01, ** p<0.05, and * p<0.1. Estimates are based on an integrated dataset of firms' exports from eleven countries built from the World Bank Exporter Dynamics Database, China's Customs Authority, and Egypt's Customs Authority, as well as tariff data from the WTO and Feenstra and Romalis (2014), and the World Bank Deep Trade Agreements Database.

OA2.4 Elasticities with standard errors clustered at the firm level

Table OA2-9 presents results with standard errors clustered at the firm level for the four dependent variables which we estimate at this level of aggregation. While the standard errors on the tariff coefficient in the regressions for the firm's overall market share $ln(w_{fiodt})$, the firm's markup $ln(\mu_{fiodt})$ and the origin's market share $\ln(ms_{iodt})$ are higher than in table 3, the opposite is true for the standard error on the tariff coefficient in the regression for the firm's within-origin market share $ln(ms_{fiodt})$.

Table OA2-9: Elasticities with standard errors clustered at the firm level

	Firm's mkt share in the dest. $\ln(\omega_{fiodt})$ (1)	Markups $\ln(\mu_{fiodt})$ (2)	Firm's within origin mkt share $\ln(ms_{fiodt})$ (3)	Origin's mkt share $\ln(ms_{iodt})$ (4)	No. of firms (PPML) (5)
Tariff_{iodt}	-0.78*	0.41**	2.88***	-3.67***	-2.45***
	(0.453)	(0.170)	(0.242)	(0.527)	(0.184)
PTA_{odt}	0.02	-0.02	0.06**	-0.04	-0.06***
	(0.042)	(0.014)	(0.027)	(0.041)	(0.011)
R^2	0.65	0.90	0.79	0.88	-
Observations	15,712,501	15,712,501	15,712,501	15,712,501	1,563,040
Fixed Effects					
Firm-product-origin-year	✓	✓	✓	✓	
Product-origin-year					✓
Product-destination-year	✓	✓	✓	✓	✓
Origin-destination	✓	✓	✓	✓	✓

Notes: The dependent variable is the firm's log (tariff-inclusive) export value in column (1), the firm's log (tariff-exclusive) unit value in column (2), the log of the firm's share of its country's trade with the destination in column (3), the log of the country's (tariff-inclusive) export value to the destination market in column (4) and the number of firms in column (5). Standard errors, reported in parentheses, are clustered at the firm level in columns (1) - (4) and the product-destination level in column (5), and we denote statistical significance with *** p<0.01, ** p<0.05, and * p<0.1. Estimates are based on an integrated dataset of firms' exports from eleven countries built from the World Bank Exporter Dynamics Database, China's Customs Authority, and Egypt's Customs Authority, as well as tariff data from the WTO and Feenstra and Romalis (2014), and the World Bank Deep Trade Agreements Database.

OA3 Supplementary model results

OA3.1 Deriving the demand elasticity under Bertrand price competition

Define the price elasticity of demand as

$$\varepsilon_{fiodt} \equiv -\frac{\partial y_{fiodt}}{\partial p_{fiodt}} \frac{p_{fiodt}}{y_{fiodt}},$$

which can be re-expressed as

$$\varepsilon_{fiodt} = -\frac{\partial \left[p_{fiodt}^{-\sigma}(p_{iodt})^{\sigma-\rho}(p_{idt})^{\rho-\eta}\right]}{\partial p_{fiodt}} \frac{p_{fiodt}}{p_{fiodt}^{-\sigma}(p_{iodt})^{\sigma-\rho}(p_{idt})^{\rho-\eta}}.$$

We now calculate the elements of the demand elasticity one-by-one using the chain rule:

$$\begin{aligned}
\frac{\partial \left[p_{fiodt}^{-\sigma}(p_{iodt})^{\sigma-\rho}(p_{idt})^{\rho-\eta}\right]}{\partial p_{fiodt}} =& \frac{\partial \left[p_{fiodt}^{-\sigma}(p_{iodt})^{\sigma-\rho}\right]}{\partial p_{fiodt}}(p_{idt})^{\rho-\eta} + p_{fiodt}^{-\sigma}(p_{iodt})^{\sigma-\rho}\frac{\partial\left[(p_{idt})^{\rho-\eta}\right]}{\partial p_{fiodt}},\\
\frac{\partial \left[p_{fiodt}^{-\sigma}(p_{iodt})^{\sigma-\rho}\right]}{\partial p_{fiodt}} =& -\sigma(p_{fiodt})^{-\sigma-1}(p_{iodt})^{\sigma-\rho} + p_{fiodt}^{-\sigma}\frac{\partial\left[(p_{iodt})^{\sigma-\rho}\right]}{\partial p_{fiodt}},\\
\frac{\partial\left[(p_{iodt})^{\sigma-\rho}\right]}{\partial p_{fiodt}} =& \frac{\partial\left(\sum_{f\in\mathcal{F}_{iodt}}\alpha_{fiodt}p_{fiodt}^{1-\sigma}\right)^{\frac{\sigma-\rho}{1-\sigma}}}{\partial p_{fiodt}} = (\sigma-\rho)\alpha_{fiodt}p_{fiodt}^{-\sigma}(p_{iodt})^{2\sigma-\rho-1},\\
\frac{\partial\left[(p_{idt})^{\rho-\eta}\right]}{\partial p_{fiodt}} =& \frac{\partial\left[\left(\sum_{o\in\mathcal{H}}p_{iodt}^{1-\rho}\right)^{\frac{\rho-\eta}{1-\rho}}\right]}{\partial p_{fiodt}} = \alpha_{fiodt}(\rho-\eta)p_{fiodt}^{-\sigma}(p_{iodt})^{\sigma-\rho}(p_{idt})^{2\rho-\eta-1},\\
\frac{\partial \left[p_{fiodt}^{-\sigma}(p_{iodt})^{\sigma-\rho}(p_{idt})^{\rho-\eta}\right]}{\partial p_{fiodt}} =& \frac{\partial \left[p_{fiodt}^{-\sigma}(p_{iodt})^{\sigma-\rho}\right]}{\partial p_{fiodt}}(p_{idt})^{\rho-\eta} + p_{fiodt}^{-\sigma}(p_{iodt})^{\sigma-\rho}\frac{\partial\left[(p_{idt})^{\rho-\eta}\right]}{\partial p_{fiodt}}\\
=& -p_{fiodt}^{-\sigma-1}(p_{iodt})^{\sigma-\rho}(p_{idt})^{\rho-\eta}\left[\sigma-(\sigma-\rho)ms_{fiodt}-(\rho-\eta)ms_{fiodt}ms_{iodt}\right].
\end{aligned}$$

Using the above relationships, we can express the demand elasticity as a function of market shares:

$$\varepsilon_{fiodt} = \sigma - ms_{fiodt}[\sigma-\rho+(\rho-\eta)ms_{iodt}].$$

OA3.1.1 Visualization of the $A(.)$ and $B(.)$ functions

Figure OA3-1 presents a visualization of the $A(.)$ and $B(.)$ functions under different values of within- and across-origin elasticities while fixing the firm's within-origin market share

ms_{fiodt} to 50%, the origin's market share in the destination ms_{iodt} to 10% and the elasticity of substitution across products η to 1.2. While the exact quantitative number differs for firms and origins with different market shares, the qualitative pattern remains the same.

The top left panel of figure OA3-1 shows percentage changes in the markup for a 1% change in the firm's within-origin market share, holding the origin's market share in the destination fixed (i.e., $\widehat{ms}_{fiodt} = 1\%$ and $\widehat{ms}_{iodt} = 0$). Each colored square represents the value of $A(.)$ for a given calibration of the within-origin elasticity of substitution σ, measured on the x-axis, and the across-origin elasticity of substitution ρ, measured on the y-axis. Focusing on the diagonal elements, we can see that the number in the coloured cell goes down as the two elasticities increase, reflecting the fact that firms which sell more substitutable goods have less market power and make smaller markup adjustments for a given change in their market share. While values of the off-diagonal elements (i.e., when $\sigma \neq \rho$) show highly non-linear patterns, we find that the within-origin reallocation effect on markups is in general *more* pronounced the larger the distance between the two elasticities.

The top right panel of figure OA3-1 shows percentage changes in the markup for a 1% change in the origin's market share in the destination, holding firms' within-origin market shares fixed (i.e., $\widehat{ms}_{fiodt} = 0$ and $\widehat{ms}_{iodt} = 1\%$). As expected, the values of the diagonal elements of $B(.)$ are exactly the same as those of $A(.)$, as the two market share changes have the same effect on markups in the Atkeson and Burstein (2008) model. Intuitively, this is because, when the two elasticities are the same, firms face the same competitive pressure from price adjustments by competitors from their own origin as from other, different origins. Despite the diagonal elements being the same, the off-diagonal elements of $B(.)$ show dramatically different patterns compared to $A(.)$: the across-origin reallocation effect on markups is *less* pronounced the larger the distance between the two elasticities.

The different patterns of the off diagonal elements for functions $A(.)$ and $B(.)$ suggest that the two reallocation effects will not in general cancel out even if the two market shares move in exactly the opposite direction and sum to zero. The bottom left panel of figure OA3-1 shows the percentage change in a markup if the firm's within-origin market share increases by 1% while the origin's market share in the destination drops by 1% (i.e., $\widehat{ms}_{fiodt} = 1\%$ and $\widehat{ms}_{iodt} = -1\%$). We can see clearly in the off-diagonal elements that the within-origin reallocation effect dominates when $\sigma > \rho$ as predicted in Proposition 1. Moreover, the magnitude of the level differences of these two effects is largely dictated by the pattern of the within-origin reallocation effect (i.e., $A(.)$) when $\sigma > \rho$.

Finally, the bottom right panel of figure OA3-1 shows the ratio of the two functions $(A(.)/B(.))$, which gives information on the extent to which the origin's market share in the destination $\widehat{ms}_{iodt}$ would need to drop in order to offset the effect of a 1% increase in the firm's within-origin market share $\widehat{ms}_{fiodt}$ on markups. The diagonal elements of 1.0 indicates the origin's market share in the destination $\widehat{ms}_{iodt}$ would need to drop by 1% to offset the effect of a 1% increase in the firm's within-origin market share $\widehat{ms}_{fiodt}$ in the Atkeson and Burstein (2008) case. Focusing on the off-diagonal elements, we can see clearly that the ratio increases dramatically as the distance between the two elasticities becomes larger. At an extreme, when $\rho = 2$ and $\sigma = 10$, the origin's market share in the destination $\widehat{ms}_{iodt}$ would need to drop by more than 100% to offset the effect of a 1% increase in the firm's within-origin market share $\widehat{ms}_{fiodt}$.

OA3.1.2 Within- and across-origin reallocation effects for firms and origins with different initial market shares

Figure OA3-2 shows values of the $A(.)$ and $B(.)$ functions fixing the three elasticities (i.e., σ, ρ, η) while varying the initial market shares of firms and origins. The top-left panel of OA3-2 shows the markup adjustments for a 1% increase in the firm's within-origin market share while keeping the origin's market share in the destination fixed ($\widehat{ms}_{fiodt} = 1\%$ and $\widehat{ms}_{iodt} = 0\%$).

In contrast, the top-right panel of OA3-2 shows the markup adjustments for a 1% increase in the origin's market share in the destination while keeping the firm's within-origin market share fixed ($\widehat{ms}_{fiodt} = 0\%$ and $\widehat{ms}_{iodt} = 1\%$). The x-axis in each figure measures the firm's initial within-origin market share ms_{fiodt} and the y-axis measures the origin's initial market share in the destination ms_{iodt}.

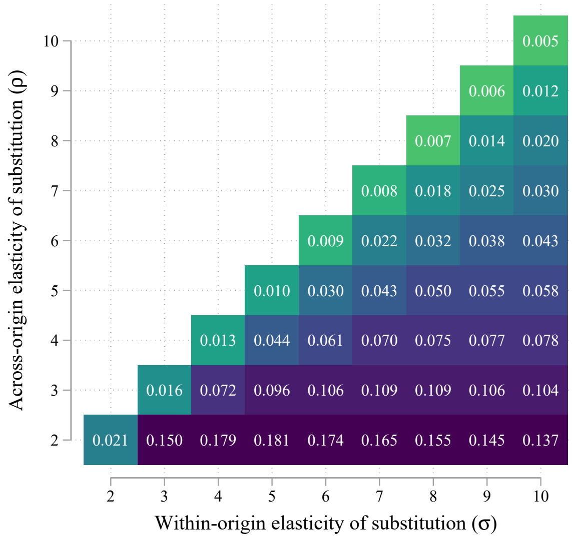
We can see from the top two figures that markup adjustments are larger as the two initial market shares (ms_{fiodt} and ms_{iodt}) increase. This is a very intuitive result. As a firm or a origin becomes more important, a 1% change in its market share will have a much bigger impact on the market structure and thus the firm (and its competitors) make larger markup adjustments.

The bottom left panel shows markup adjustments for a 1% increase in the firm's within-origin market share and a 1% drop in the origin's market share in the destination, which together keep the firm's overall market share in the destination constant ($\widehat{ms}_{fiodt} = 1\%$, $\widehat{ms}_{iodt} = -1\%$ and $\widehat{\omega}_{fiodt} = \widehat{ms}_{fiodt} + \widehat{ms}_{iodt} = 0\%$). As predicted by Proposition 1, we find the within-origin reallocation effect dominates when $\sigma > \rho$.

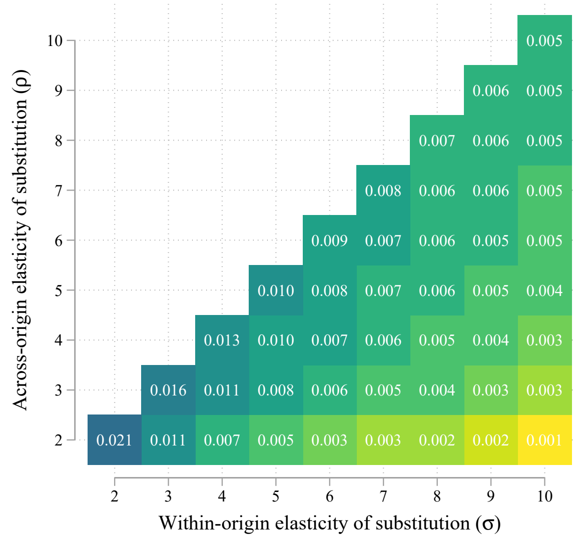
The bottom-right panel shows the ratio of the two functions (i.e., $A(.)/B(.)$). An interesting feature we find in this panel is that the ratio tends to be significantly larger for origins with relatively small market shares in the destination. This implies that the within-origin reallocation effect is more likely to dominate the direction of markup adjustments for origins with small market shares. It is worth noting that this happens to be the case for our data

Figure OA3-1: Visualizing the two reallocation effects on a firm's markup adjustment under different within- and across-origin elasticities
(varying ρ and σ while fixing $ms_{fiodt} = 0.5, ms_{iodt} = 0.1$, and $\eta = 1.2$)

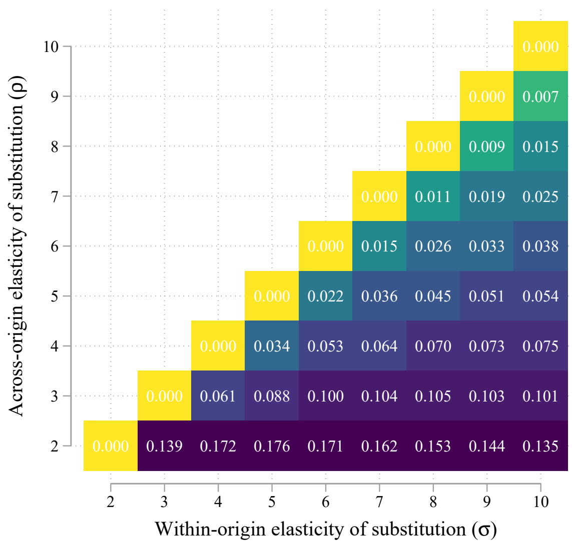
(A) Within-origin reallocation effect
(for a 1% change in the firm's within-origin market share i.e., $\widehat{ms}_{fiodt} = 1\%$)



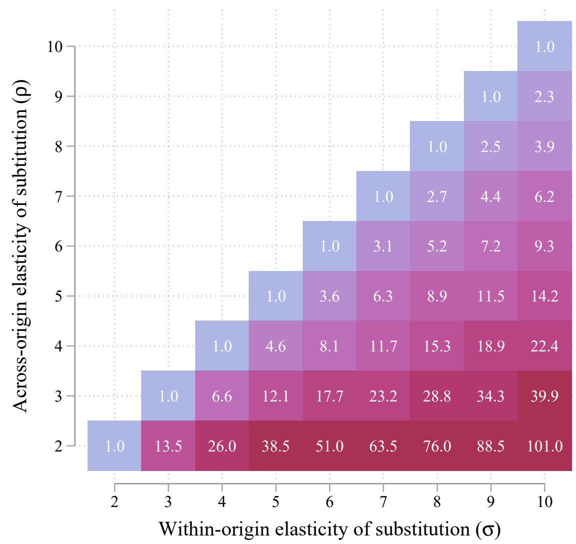
(B) Across-origin reallocation effect
(for a 1% change in the origin's market share in the destination, i.e., $\widehat{ms}_{iodt} = 1\%$)



$(A - B)$ Level difference of the two effects



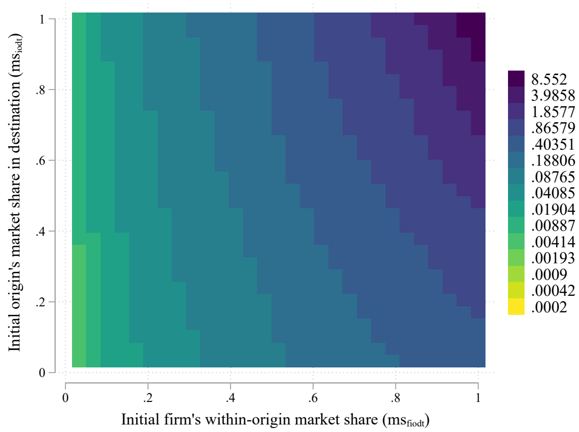
(A/B) Ratio of the two effects



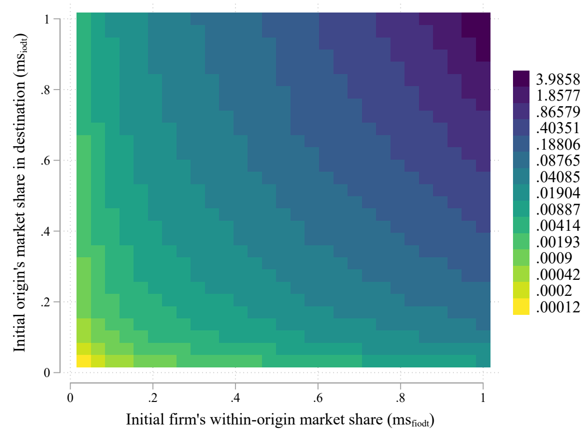
Note: The above figures show the values of $A(\sigma, \rho, \eta, ms_{fiodt}, ms_{iodt})$ (top-left), $B(\sigma, \rho, \eta, ms_{fiodt}, ms_{iodt})$ (top-right), $A(.) - B(.)$ (bottom-left) and $A(.)/B(.)$ (bottom-right) varying ρ and σ while fixing $ms_{fiodt} = 0.5, ms_{iodt} = 0.1$, and $\eta = 1.2$. Each colored square indicates the value of the corresponding function (e.g., $A(.)$ for the top-left panel) for a given calibration of the within-origin elasticity of substitution σ and the across-origin elasticity of substitution ρ. The numbers in the coloured cells of the top two figures and the bottom-left figure show the corresponding markup adjustments in percentages. For example, the value 0.021 in the bottom-left cell ($\sigma = 2$ and $\rho = 2$) in the top-left figure reflects a 0.021% markup increase. The numbers in the coloured cells of the bottom-right figure give the ratio of the two reallocation effects (i.e., $A(.)/B(.)$) and are based on a different colour scheme than the other three figures to highlight the different scales.

Figure OA3-2: Visualizing the within- and across-origin reallocation effects on markups varying market shares while fixing $\sigma = 4.0$, $\rho = 2.5$, and $\eta = 1.2$

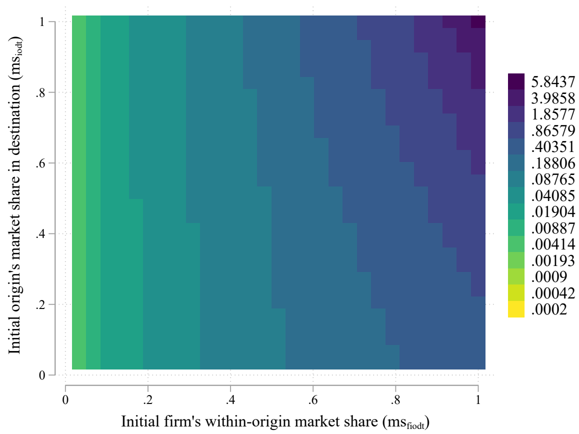
(A) Within-origin reallocation effect (for a 1% change in the firm's within-origin market share i.e., $\widehat{ms}_{fiodt} = 1\%$)



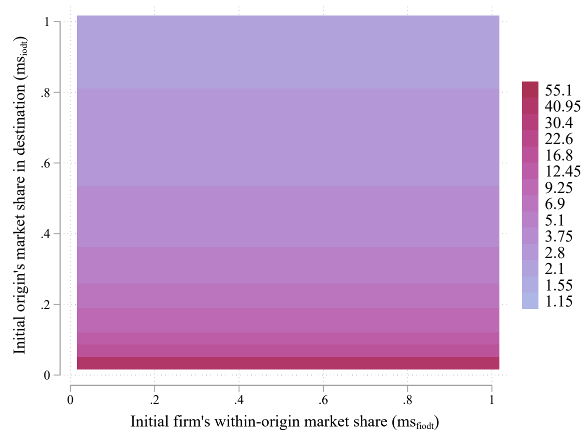
(B) Across-origin reallocation effect (for a 1% change in the origin's market share in the destination, i.e., $\widehat{ms}_{iodt} = 1\%$)



$(A-B)$ Level difference of the two effects



(A/B) Ratio of the two effects



Notes: The above figures show the values of $A(\sigma, \rho, \eta, ms_{fiodt}, ms_{iodt})$ (top-left), $B(\sigma, \rho, \eta, ms_{fiodt}, ms_{iodt})$ (top-right), $A(.) - B(.)$ (bottom-left) and $A(.)/B(.)$ (bottom-right) varying ms_{fiodt} and ms_{iodt} while fixing $\rho = 4.0$, $\sigma = 2.5$ and $\eta = 1.2$. Each colored square indicates the value of the corresponding function (e.g., $A(.)$ for the top-left panel) for the pair of initial market shares (i.e., ms_{fiodt} and ms_{iodt}). The coloured cells of the top two figures and the bottom-left figure indicate the corresponding markup adjustments in percentages. The numbers in the coloured cells of the bottom-right figure give the ratio of the two reallocation effects (i.e., $A(.)/B(.)$) and are based on a different colour scheme than the other three figures due to the different scales.

since the origin's market share in the destination is small for most industries for the eleven origin countries in our dataset (except perhaps for China). While it is possible that future studies, which investigate different datasets, will find different (and maybe weaker) markup adjustments, the two opposing reallocation effects we consider should remain important and could explain exporters markup responses even in cases where standard oligopolistic competition models cannot.

OA3.2 Deriving the demand elasticity under Cournot quantity competition

The inverse demand functions are given by

$$\frac{p_{fiodt}}{p_{iodt}} = \left(\frac{y_{fiodt}}{\alpha_{fiodt} y_{iodt}}\right)^{-\frac{1}{\sigma}}, \quad \frac{p_{iodt}}{p_{idt}} = \left(\frac{y_{iodt}}{y_{idt}}\right)^{-\frac{1}{\rho}}, \quad \text{and} \quad \frac{p_{idt}}{P_{dt}} = \left(\frac{y_{idt}}{Y_{dt}}\right)^{-\frac{1}{\eta}},$$

which can be re-expressed as

$$p_{fiodt} = \left(\frac{y_{fiodt}}{\alpha_{fiodt}}\right)^{-\frac{1}{\sigma}} (y_{iodt})^{\frac{1}{\sigma}-\frac{1}{\rho}} (y_{idt})^{\frac{1}{\rho}-\frac{1}{\eta}} (Y_{dt})^{\frac{1}{\eta}} P_{dt}.$$

To derive the demand elasticity, we note the following relationship hold:

$$\frac{1}{\varepsilon_{fiodt}} = -\frac{\partial p_{fiodt}}{\partial y_{fiodt}} \frac{y_{fiodt}}{p_{fiodt}} = \frac{1}{\sigma} - \left(\frac{1}{\sigma} - \frac{1}{\rho}\right) \frac{\partial y_{iodt}}{\partial y_{fiodt}} \frac{y_{fiodt}}{y_{iodt}} - \left(\frac{1}{\rho} - \frac{1}{\eta}\right) \frac{\partial y_{idt}}{\partial y_{fiodt}} \frac{y_{fiodt}}{y_{idt}}$$

where

$$\frac{\partial y_{iodt}}{\partial y_{fiodt}} \frac{y_{fiodt}}{y_{iodt}} = \left(\alpha_{fiodt} \frac{y_{iodt}}{y_{fiodt}}\right)^{(1-\sigma)/\sigma} = ms_{fiodt} \quad \text{and}$$
$$\frac{\partial y_{idt}}{\partial y_{fiodt}} \frac{y_{fiodt}}{y_{idt}} = \frac{y_{fiodt}}{y_{idt}} \left(\frac{y_{idt}}{y_{iodt}}\right)^{1/\rho} \frac{\partial y_{iodt}}{\partial y_{fiodt}} = ms_{fiodt} ms_{iodt}.$$

Rearrange and get

$$\varepsilon_{fiodt} = \left[\frac{1}{\sigma} + \left(\frac{1}{\rho} - \frac{1}{\sigma}\right) ms_{fiodt} + \left(\frac{1}{\eta} - \frac{1}{\rho}\right) ms_{fiodt} ms_{iodt}\right]^{-1}. \tag{OA3-1}$$

When $\sigma = \rho$, we get back to the Atkeson and Burstein (2008) case where

$$\varepsilon_{fiodt} = \left[\frac{1}{\sigma} + \left(\frac{1}{\eta} - \frac{1}{\sigma}\right) ms_{fiodt} ms_{iodt}\right]^{-1}.$$

Optimal price. Upon entry, the operational profit of the firm is given by

$$\pi_{fiodt}^{operational} = \left(\frac{p_{fiodt}}{\tau_{iodt}} - mc_{fiot}\right) y_{fiodt}$$

Maximizing profits with respect to y_{fiodt} yields the first order condition:

$$\left(\frac{p_{fiodt}}{\tau_{iodt}} - mc_{fiot}\right) + \frac{\partial p_{fiodt}}{\partial y_{fiodt}} \frac{y_{fiodt}}{\tau_{iodt}} = 0.$$

Rearrange and we get the same pricing equation:

$$p_{fiodt} = \frac{\varepsilon_{fiodt}}{\varepsilon_{fiodt} - 1} mc_{fiot} \tau_{iodt}.$$

Within- and across-origin reallocation effects. Loglinearizing (OA3-1), we get

$$-\frac{\widehat{\varepsilon}_{fiodt}}{\varepsilon_{fiodt}} = \left(\frac{1}{\varepsilon_{fiodt}} - \frac{1}{\sigma}\right) \widehat{ms}_{fiodt} + \left(\frac{1}{\eta} - \frac{1}{\rho}\right) ms_{fiodt} ms_{iodt} \widehat{ms}_{iodt}$$

Markup changes can be derived as

$$\widehat{\mu}_{fiodt} = \underbrace{A(\sigma, \rho, \eta, ms_{fiodt}, ms_{iodt}) \cdot \widehat{ms}_{fiodt}}_{\text{Within-origin reallocation effect}} + \underbrace{B(\sigma, \rho, \eta, ms_{fiodt}, ms_{iodt}) \cdot \widehat{ms}_{iodt}}_{\text{Across-origin reallocation effect}}$$

where

$$A(.) \equiv \mu_{fiodt} \left(\frac{1}{\varepsilon_{fiodt}} - \frac{1}{\sigma}\right), \quad B(.) \equiv \mu_{fiodt} \left(\frac{1}{\eta} - \frac{1}{\rho}\right) ms_{fiodt} ms_{iodt}. \tag{OA3-2}$$

Since the markup $\mu_{fiodt} > 1$, the sign of $A(.) - B(.)$ depends on the sign of

$$\frac{1}{\varepsilon_{fiodt}} - \frac{1}{\sigma} - \left(\frac{1}{\eta} - \frac{1}{\rho}\right) ms_{fiodt} ms_{iodt} = \left(\frac{1}{\rho} - \frac{1}{\sigma}\right) ms_{fiodt}.$$

As in the price competition case, $A(.) - B(.) > 0$ iff $\sigma > \rho$ and $A(.) - B(.) = 0$ iff $\sigma = \rho$.

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