The Pro-competitive Effects of Trade Agreements

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Abstract

How do preferential trade agreements affect the ways firms compete? Do they lead to lower average markups and more efficient allocations, and thus bring in pro-competitive gains from trade? We develop a new model of multi-country trade featuring variable markups in which the intensity of competition differs among firms from the same origin versus different origins. This gives rise to a rich oligopolistic structure in which the elasticity of demand facing an exporting firm will depend on two market share distributions, one ranking the firm among exporters from its own origin and a second ranking a firm's origin country among all origin countries selling to a destination. Under realistic parameterizations, this demand system generates reductions in the average markup charged by foreign exporters when trade costs fall. Empirically, we integrate the detailed data on 257 preferential trade agreements from the World Bank's Deep Trade Agreements (DTA) database with administrative customs datasets of product-level exports by firms from eleven developing and emerging countries to estimate the responsiveness of firm entry, market shares, export prices, and markups to trade and domestic policy commitments enshrined in deep trade agreements. We find that tariff cuts have a pro-competitive effect on the markups of foreign exporters and that this effect is larger for more highly differentiated products.

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1 Introduction

The pricing decisions of a firm depend on the number and proximity of competitors it faces. In international markets, firms face competitors from dozens of different countries and the intensity of competition is shaped by participation in preferential and multilateral trade agreements. In this paper, we examine the global welfare consequences of trade liberalisations and emphasise the role of competition and market structure. Our main theoretical contribution is a new model with variable markups, oligopolistic competition and a rich set of multi-country competitive interactions. Empirically, we investigate how preferential trade liberalizations affect exporting firms participation, market power, and markups.

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.[1] However, there is little direct evidence on the price and markup responses of *foreign* exporting firms to a trade liberalization.[2] Yet the welfare implications of trade policy depend on the behaviour of both domestic firms and foreign exporters. Arkolakis, Costinot, Donaldson and Rodríguez-Clare (2018) show that the pro-competitive welfare gains of a trade liberalization are "elusive" in a large class of models featuring variable markups under reasonable calibrations of markup and demand elasticities, because any gains arising from reductions in the markups charged by domestic firms are offset by increases in markups charged by foreign exporters who enjoy an increase in their market power when trade is liberalized.

Our first contribution is theoretical. We develop the international pricing model of Atkeson and Burstein (2008) in two directions to offer new insights into the pro-competitive gains from trade. First, we extend the model to multiple countries to examine multi-country competition within a destination country's market and differences between preferential and multilateral trade liberalizations. Second, we introduce a triple-nested constant elasticity of demand preference structure with three levels of aggregation. At the highest level of aggregation, sectoral outputs are weakly substitutable. At the middle-level of aggregation, goods within a sector produced by different origin countries are moderately substitutable.

[1] In the case of India, De Loecker, Goldberg, Khandelwal and Pavcnik (2016) show that domestic price reductions were much smaller than what might have been expected given the sizeable cost reductions brought about by the trade liberalization. This incomplete pass through of cost reductions into output prices implies that markups rose for domestic Indian firms. In contrast, Edmond, Midrigan and Xu (2015) find in Taiwanese data that opening up to trade strongly increases competition and reduces markup distortions.

[2] 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 analysis of markups. A recent contribution from **?** uses survey data on Mexican firms to examine the impact of NAFTA on markups domestically and for exported products.

And finally, at the lowest level of aggregation, goods within a sector made by firms from the same origin country are highly substitutable. This stylized, tractable model enables us to examine trade liberalizations in multi-country world featuring oligopolistic competition and variable markups among firms. We use this model to explore the impacts of preferential trade agreements on global allocative efficiency in the presence of oligopolistic market power.

In this model, a firm's markup adjustment to a tariff cut depends on its elasticity of demand, which, in turn, depends on the market structure in the destination and the firm's market power. Each firm's elasticity of demand embeds three elasticities of substitution – across sectors, across origins within a sector, and across firms within an origin – and two market share measures. We show that exporters' markup adjustments after a preferential tariff cut depend on two reallocation effects captured by changes in these two different market shares. The first, "within-origin" reallocation effect captures how the changing market shares for individual firms within the same origin affect firms' markups. Lower tariffs on a country's exports lead to entry which can result in a decline in exporting firm's market shares in the destination among compatriot firms from the same origin. This, in turn, implies less market power vis-a-vis one's compatriot firms and an increase in the elasticity of demand facing a firm. The second, "cross-origin" reallocation effect captures how the changing competitiveness of the origin country as a whole affects origin firms' market power, and hence, markups. As the market share of the origin country rises relative to that of other origins, the elasticity of demand becomes less elastic. Depending on the direction and magnitude of these two reallocation effects, exporters enjoying a tariff liberalisation can either lower (pro-competitive) or raise (anti-competitive) their markups. Importantly, the model reveals that under some realistic parameterizations, a preferential trade liberalization leads to intense entry that implies a significant loss of market power vis-a-vis one's compatriot firms, an effect which can dominate any increase in the origin's market power as a whole. The net effect is an increase in the elasticity of demand, and a reduction in markups. Ultimately, this framework of tractable, multicountry imperfect competition enables us to compare changes in allocative efficiency in the global economy under preferential and multilateral trade liberalizations.

Our second set of contributions is empirical. We document that lower tariffs increase exporting firms' participation in a liberalizing market and reduce, on average, the pre-tariff markups of foreign exporting firms. Our analysis is based on a large panel dataset that integrates the universe of annual customs record from eleven low and middle income economies with information from 257 preferential trade agreements. The unique structure of this multiple-origin panel enables us to identify changes in the markups charged by exporting firms *after* controlling for unobserved time-variation in demand and supply for over 5000 products in 11 origin and 165 destination countries through the use of product-origin–year and product-destination–year fixed effects. We find foreign exporters reduce their markups by 0.4% in response to a 1% tariff reduction, with the magnitude of this elasticity rising to 1.0% when we restrict the analysis to highly differentiated consumption goods. To explore the modulating effects of market structure, our empirical analysis covers exporting firms' participation in foreign markets, their market shares among compatriot firms from the same origin, as well as an origin's market share in a destination. We find a preferential tariff cut in a destination induces participation by firms from the preferred origin, lowering on average a firm's import market share calculated *among* all firms from its own origin, while at the same time raising the origin's import market share in the destination. In addition to studying the direct effects of bilateral trade policy on firms from an origin, we also study the indirect effects on exporting firms' behaviour arising from changes in bilateral trade policy against firms from *other origin countries*, finding that exporters from one origin country reduce markups by 0.5% when an additional 10% of their third-country competitors from *other origin countries* participate in a preferential trade agreement with the destination country. This allows us present evidence on both foreign exporters and "quasi-domestic" firms.

Literature Review. The literature on the gains from trade over the last forty years has developed along three paths according to a fundamental assumption about market competition. On the one hand, perfectly competitive markets and underlying differences in technologies across countries in the Dornbusch, Fischer and Samuelson (1977); Eaton and Kortum (2002); and Caliendo and Parro (2015) tradition have emphasized the gains of trade arising under a global reallocation of production driven by Ricardian comparative advantages. On the other hand, models featuring monopolistic competition and increasing returns to scale have emphasized welfare gains from trade arising from, first, increases in the variety of goods (Krugman (1979); Krugman (1980)) and, secondly, from a domestic reallocation of production to more efficient producers (Melitz (2003)). Between these two extremes, a third-path in the literature with seminal contributions from Brander and Krugman (1983); Helpman and Krugman (1985); and Eaton and Grossman (1986) showed that the welfare gains of a trade liberalization in imperfectly competitive markets depended critically on the nature (price versus quantity, see Eaton and Grossman (1986)) and intensity of competition as well as specific features of market structure.[3].

While the trade literature emphasized quantifying the gains from a trade liberalization under different assumptions about market competition, the more macro-oriented literature

[3]Another vein in the literature pioneered by Bernard, Eaton, Jensen and Kortum (2003) introduces variable markups into a multi-country trade model by integrating Bertrand pricing and Ricardian comparative advantage. However, the winner-take-all nature of the Bertrand second-price auction implies that this model is not well-suited to examine reallocation of market share across firms. See also **?** and De Blas and Russ (2015)

on international pricing sought to understand puzzling departures from relative purchasing power parity across countries in the face of exchange rate fluctuations and other macroeconomic shocks. In a seminal contribution, Atkeson and Burstein (2008) introduced a tractable model of oligopolistic competition with endogenously produced variable markups and pricing-to-market by firms, a characteristic that Obstfeld and Rogoff (2000) have argued is necessary to resolve the purchasing power parity puzzle in international macroeconomics.

To examine allocative efficiency, we build upon Edmond, Midrigan and Xu (2015) who evaluate the global allocative efficiency implications of trade liberalisation in a two country Atkeson and Burstein (2008) model under different sets of assumptions about cross-country correlations in sectoral productivity. Our contibution to this literature is to examine and compare the changes in allocative efficiency between preferential trade agreements and multilateral trade liberalisations. We evaluate the allocation of market share across firms in the two countries participating in the trade agreement as well as in the "third" countries which are not party to the agreement, but which do engage in trade.

Our empirical research builds on a methodologically diverse body of work examining how prices and markups change in response to trade policy changes (Konings and Vandenbussche (2005), Bown and Crowley (2006), Amiti and Konings (2007), Pierce (2011), De Loecker, Goldberg, Khandelwal and Pavcnik (2016), Fitzgerald and Haller (2018). We also rely on the literature examining pricing to market and markup changes in response to exchange rate movements (Fitzgerald and Haller (2014), De Blas and Russ (2015), Amiti, Itskhoki and Konings (2019), Corsetti, Crowley, Han and Song (2019), Corsetti, Crowley and Han (2022)). Our approach builds on the basic insight from the structural gravity literature that changes in prices which reflect PTA-induced changes in the competitive environment in origin and destination countries are absorbed in time-varying multilateral resistance terms (product-origin-time and product-destination-time fixed effects Anderson and van Wincoop (2003); Feenstra (2004); Redding and Venables (2004); Head and Mayer (2014). See Limão (2016) for an extensive survey of this literature.) A novel feature of our approach is its examination of how third-country competition impacts prices and markups, building on previous models of trade policy "spillovers" into bilateral trade relations (Chang and Winters (2002), Bown and Crowley (2007), Lee, Mulabdic and Ruta (2019)).

The rest of the paper is organised as follows. Section 2 introduces our new model. Section 3 presents our data and our empricial strategy. We discuss our empirical results in section 4 Section 6 considers a case study of deep trade agreement provisions.

2 Conceptual Framework

In this section, we present a multi-country framework that allows us to study how firms compete and adjust their markups in response to bilateral and multilateral 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.[4]

The world consists of $H \geq 3$ countries and trade among countries is indexed by origin $o \in \mathcal{H}$ and destination $d \in \mathcal{H}$.[5] In each country, there is a continuum of unit mass of industries (indexed by i) selling tradable goods. The 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. The industry-level output y_{idt} and price p_{idt} are obtained by aggregating the products imported from different origins:

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

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 substitutions 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.[6]

The key difference of our setting compared to a standard two-country Atkeson and Burstein (2008) model is that we introduce an additional layer of aggregation across firms

[4] Atkeson and Burstein (2008) embed oligopolistic competition among firms in a two-level-nested CES demand structure in which the degree of substituability is different within industries (ρ) versus across industries (η). Under this setting the firm's optimal markup is an increasing function of its market share in the destination market.

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

[6] Throughout our paper, we indicate the levels of aggregation of variables in the model by their subscripts. The most disaggregated variables have five dimensions with f, i, o, d, t standing for firm, industry, origin, destination, and time respectively.

from the same origin (i.e., equation (3)), which allows for a different elasticity of substitution within and across origins, i.e., $\sigma \neq \rho$. For example, a consumer may view the product of one Chinese exporter, such as a spark plug or t-shirt, as a close substitute for the product of another Chinese exporter, but view the varieties made by firms in Japan as less suitable as substitutes when the first Chinese firm's variety is not available.

Production. Labor is inelastically supplied and immobile across countries. Wages are assumed to be identical across sectors and industries in a given country. The production function is assumed to be 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 in time t. We assume the firms draw their productivity independently from a Pareto distribution in period 1.[7]

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} denominated in the destination market's currency if they enter. Since the production function is assumed to be constant returns to scale, 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 and ζ_x is a constant per-period export 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 $W_{ot}\zeta_x$.[8]

Upon entry, the optimal price p_{fiodt} and markup μ_{fiodt} for an exporter f from origin o to destination d can be derived as:

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

[7] In our baseline counter-factual analysis, we abstract from firm-level idiosyncratic productivity shocks to keep our experiment as tractable as possible.

[8] The production and price decisions in the domestic market are symmetrically defined with a smaller fixed cost of operating in the domestic market, $\zeta_h < \zeta_x$.

where ε_{fiodt} is the price elasticity of demand. In what follows, we discuss the key implications of our extension for the firm's optimal markup μ_{fiodt} under different competition schemes.

2.1 Market structure, competition, and markups

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

The general functional form of the demand elasticity under a triple-nested demand structure can be derived as follows:[9]

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

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

$$ms_{fiodt} = \frac{p_{fiodt}y_{fiodt}}{\sum_{f\in\mathcal{F}_{iodt}} p_{fiodt}y_{fiodt}}, \quad ms_{iodt} = \frac{p_{iodt}y_{iodt}}{\sum_{o\in\mathcal{H}} p_{iodt}y_{iodt}} \tag{7}$$

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

Monopolistic competition. First, there are two important cases where our model converges to the classical Melitz (2003) type of market structure: (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:

$$\frac{\varepsilon_{fiodt}}{\varepsilon_{fiodt} - 1} = \frac{\sigma}{\sigma - 1} \tag{8}$$

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 so that a trade liberalization does not affect the way firms compete. Both (a) and (b) are strong theoretical assumptions which generate predictions that are not supported in the data. This lead 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),

[9] See Appendix B.1 for the complete derivation.

Edmond, Midrigan and Xu (2015), Amiti, Itskhoki and Konings (2019)) with the class introduced by Atkeson and Burstein (2008) being especially useful for studying pricing under oligopolistic competition at the level of industry.

Oligopolistic competition at the level of industry. 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 (6) can be simplified to

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

Note that $ms_{iodt} ms_{fiodt}$ is equivalent to the market share definition used by Atkeson and Burstein (2008), which captures the importance of the firm in the industry i of destination d at time t. A crucial implication of (9) is that a tariff reduction benefitting an origin country increases the importance of firms from that origin (i.e., $ms_{iodt} ms_{fiodt}$ increases) and thus leads to an increase in markups.

Oligopolistic competition at the level of origin. Naturally, as one can imagine, if the number of firms from the same 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-industry price index in the destination p_{iodt} but not the 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 (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 of the Atkeson and Burstein (2008) case, a tariff reduction will lead to a drop in the average markup of the continuing firms from the origin. Since the tariff reduction makes the firms from the origin more competitive, some small firms will find it optimal to export, and hence, enter the market, which reduces the average market share ms_{fiodt} of existing 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 the first model that formally characterizes this oligopolistic competition at the level of origin, to the best of our knowledge. 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.

A more general case: oligopolistic competition within origin and industry. If, in a more general case, we allow for a small number of competitors from the same origin as well as from other countries, the firm will likely view compatriot firms from the same origin *and* firms from other countries as its competitors. In addition, if we allow the degree of substitutability to be different for varieties produced within the same origin versus those produced in other origins (i.e., $\sigma \neq \rho$), then the 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 (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 the active firms from origin o in destination d (i.e., ms_{fiodt} goes down) and (2) a rise in the market share of origin o in destination d (i.e., ms_{iodt} goes up). As shown in (6), a drop in ms_{fiodt} increases the demand elasticity, whereas an increase in ms_{iodt} reduces the demand elasticity. So, the total effect on the demand elasticity and, consequently, the markup can go in either direction in response to a preferential tariff reduction. Whether the elasticity of demand rises or falls will depend on the relative importance of the two channels.

2.1.1 Markup elasticities

More formally, using (5) and (6), we can 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) a cross-origin reallocation effect that captures the markup adjustments due to changes in cross-origin market shares $\widehat{ms}_{iodt}$:[10]

$$\widehat{\mu}_{fiodt} = \underbrace{\frac{\sigma - \varepsilon_{fiodt}}{\varepsilon_{fiodt}(\varepsilon_{fiodt} - 1)}\widehat{ms}_{fiodt}}_{\text{Within-origin reallocation effect}} + \underbrace{\frac{(\rho - \eta) ms_{fiodt} ms_{iodt}}{\varepsilon_{fiodt}(\varepsilon_{fiodt} - 1)}\widehat{ms}_{iodt}}_{\text{Cross-origin reallocation effect}} \tag{11}$$

Equation (11) shows that the relative importance of the two channels is governed by (a) the initial market shares before the policy change (i.e., ms_{fiodt} and ms_{iodt}) and (b) the differences in the substitutability across products. Figure 1 presents a visualization of the magnitude of these two effects under different parameter and market share values. From figures 1(a1) and 1(a2), we can see that the market share changes have a bigger effect on markups if the firm is larger within the origin country (i.e., ms_{fiodt} is high) or the origin country as whole accounts for a larger share of the industry in the destination market (i.e., ms_{iodt} is high). In addition, comparing figures 1(a1) and 1(a2), we see the within-origin reallocation effect is in general larger under our benchmark calibration of $\sigma = 20, \rho = 10.5$

[10]Note that $\widehat{\mu}_{fiodt} = -\frac{1}{\varepsilon_{fiodt}-1}\widehat{\varepsilon}_{fiodt}$ and $\widehat{\varepsilon}_{fiodt} = -\frac{\sigma-\varepsilon_{fiodt}}{\varepsilon_{fiodt}}\widehat{ms}_{fiodt} - \frac{(\rho-\eta)ms_{fiodt}ms_{iodt}}{\varepsilon_{fiodt}}\widehat{ms}_{iodt}$.

and $\eta = 1.2$. Figures 1(b1) and 1(b2) show the magnitude of the two effects by fixing the initial market shares and varying the within-origin and cross-origin elasticities. While figures 1(b1) and 1(b2) show highly non-linear patterns, we find the within-origin reallocation effect on markups is more pronounced and the cross reallocation effect is less pronounced the larger the distance between ρ and η.

In the above discussions, we analyzed the within-origin and across-origin reallocation effects for a given (1%) change in the two market shares. It is worth noting that these two market shares are also endogenous objects in the model. In what follows, we conduct a quantitative counterfactual analysis also incorporating the endogenous changes of the market shares.

2.2 A quantitative assessment on the effect of a bilateral tariff reduction

To guide our empirical analysis and illustrate the key differences in the various cases of the models discussed above, we conduct quantitative assessments on the effects of a preferential tariff reduction. Specifically, we simulate a model of 10 countries and 1000 industries for two periods and give a 10% preferential tariff reduction to all products sold by origin 1 to destination 2 in the second period. We investigate changes in market share and markup distributions of firms from origin 1 which sell to destination 2 in response to this preferential tariff reduction.

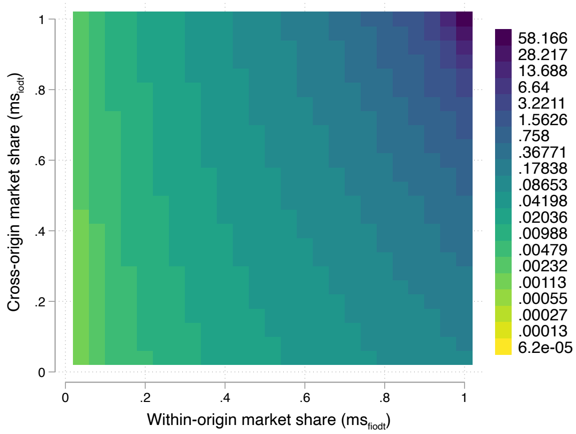
To compare the markup responses under alternative market structures, we simulate three specifications of the model. In our first specification, we simulate a multi-country version of the model of Atkeson and Burstein (2008) (hereafter, AB) by setting the elasticity of substitution within an origin σ to be the same as that across origins ρ. We set the elasticity of substitution across industries $\eta = 1.2$, and $\sigma = \rho = 10.5$ as in Edmond, Midrigan and Xu (2015). In our second specification, which we refer to as the CHP (Crowley-Han-Prayer) model, we allow the degree of substitutability to be different for products from different origins and set $\eta = 1.2$, $\rho = 10.5$, and $\sigma = 20.0$. In our final specification, which we refer to as "CHP with low ρ," we set a lower elasticity of substitution across origins in order to magnify the effect of within-origin reallocation on markups.[11] Our chosen parameterization is: $\eta = 1.2$, $\rho = 3.0$, and $\sigma = 20.0$.[12]

[11] Figure 1(b) indicates that, holding σ constant, the markup responsiveness increases as ρ falls.

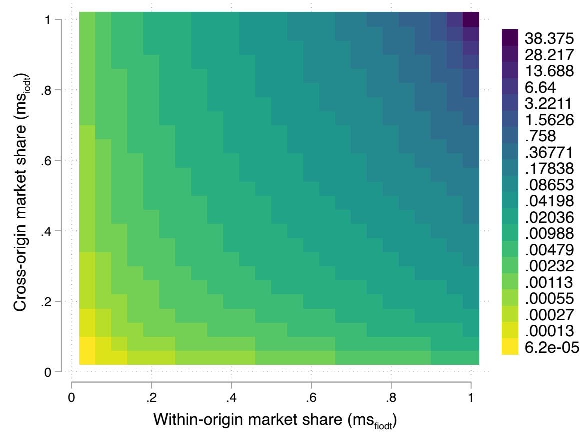
[12] Following Edmond, Midrigan and Xu (2015), we set the Pareto parameter that governs the productivity dispersion of firms to 4.5. We set the maximum number firms from a industry-origin-destination triplet to 4 so that the maximum number of active firms in a destination market for a specific industry is $40 = 4 \times 10$, where 10 is the number of countries in our simulation. Under this setting, the world economy can have maximum $400,000 = 4 \times 10 \times 1000 \times 10$ active firms. We calibrate the fixed cost of operating in the domestic

Figure 1: The within- and cross-origin reallocation effects on markups for a 1% increase in firm market share (ms_{fiodt} left column) and origin market share (ms_{iodt} right column)

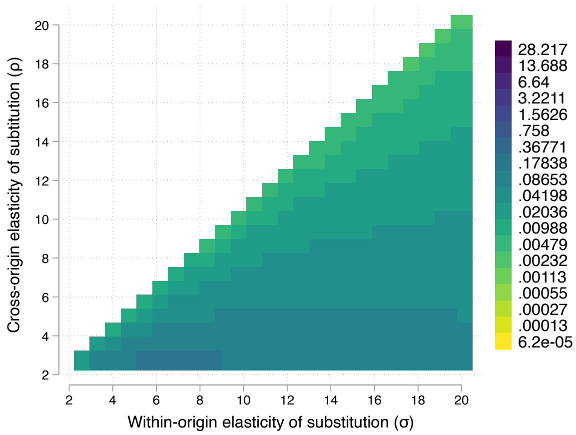
(a1) Within-origin reallocation effect
(fixing $\sigma = 20, \rho = 10.5, \eta = 1.2$;
varying market shares)



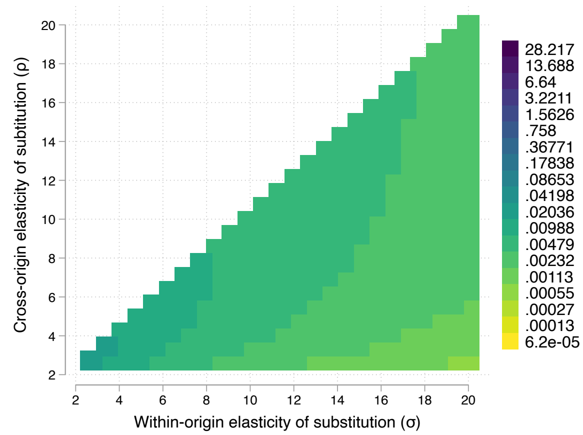
(a2) Cross-origin reallocation effect
(fixing $\sigma = 20, \rho = 10.5, \eta = 1.2$;
varying market shares)



(b1) Within-origin reallocation effect
(fixing $ms_{fiodt} = .5, ms_{iodt} = .1, \eta = 1.2$;
varying ρ and σ)



(b2) Cross-origin reallocation effect
(fixing $ms_{fiodt} = .5, ms_{iodt} = .1, \eta = 1.2$;
varying ρ and σ)



Note: The above figures plot the percentage change in markups in response to a 1% change in market share (i.e., $\widehat{ms}_{fiodt} = 1\%$ for a1 and b1 and $\widehat{ms}_{iodt} = 1\%$ for a2 and b2) under different parameter and market share values. Figures (a1) and (b1) plot the within-origin reallocation effect, i.e., $(\sigma - \varepsilon_{fiodt})/[\varepsilon_{fiodt}(\varepsilon_{fiodt} - 1)]$ (first term of equation (11)), whereas figures (a2) and (b2) plot the cross-origin reallocation effect, i.e., $[(\rho - \eta) ms_{fiodt} ms_{iodt}]/[\varepsilon_{fiodt}(\varepsilon_{fiodt} - 1)]$ (second term of equation (11)). The legend on the right hand side of each figure shows the magnitude of the markup changes. For example, at an extreme, when $ms_{fiodt} \to 1$ and $ms_{iodt} \to 1$, a one percent increase in the within-origin market share ($\widehat{ms}_{fiodt} = 1\%$) can lead to a rise of the desire markup by 58.166% (see the top right cell of figure a1).

Finally, we investigate how the distributions of market shares and markups differ depending on firms' market entry decisions. Thus, we estimate two versions of each specification. In the first version, we restrict the set of firms that operates in each market to be the same before and after the tariff cut. In the second version, we allow firms to re-optimize their market participation decisions after the tariff cut.

Market share distributions and within-origin reallocation effects. Figure 2 shows the changes in the distribution of within-origin market shares (ms_{fiodt} defined in equation (7)) for firms from origin 1 selling to destination 2 under six different model specifications. As shown in three figures on the left, with fixed entry, although there are some small changes to the distribution of market shares of firms from the same origin in response to a bilateral tariff cut, the within-origin reallocation effect is modest. In all three specifications on the left, the mean market share (indicated by the vertical dashed line) is the same before and after the tariff cut. In contrast, in the three figures on the right, the within-origin reallocation effect – an increase in the mass allocated to small market share firms – is much more pronounced once we allow firms to re-optimize their market participation decisions in response to the tariff cut. This extensive margin activity is the driving force behind the within-origin reallocation in the three specifications on the right. Under flexible entry, the tariff reduction leads less productive firms from the origin to enter the destination market. This, in turn, reduces the average market share for firms from that origin. Comparing figures from the left and right panels, we see that the within-origin reallocation effect is much larger under flexible entry and exit for all three model specifications.

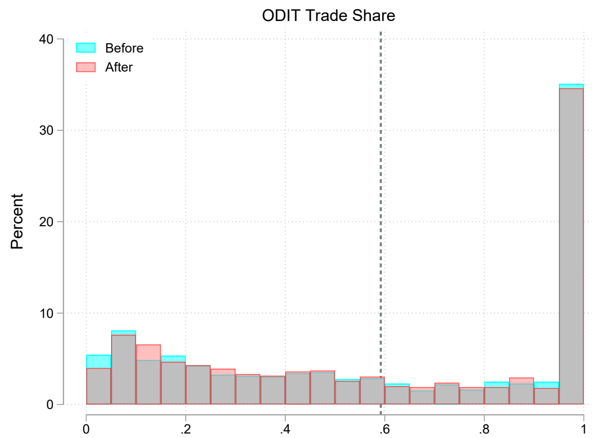
Markup distributions. How do the within-origin reallocations affect the distribution of markups? Figure 3 shows the changes in the distribution of markups for firms from origin 1 selling to destination 2 in response to the preferential tariff reduction. Notably, as shown in the three figures in the left, if the set of firms operating in each market does not change after the tariff reduction, the average markup goes up slightly in all three models. (The vertical dashed orange line which represents the average markup after the tariff cut is to the right of the vertical blue dashed line which captures the average markup before the tariff cut.) The post-tariff cut markup increase is mainly driven by the fact that origin 1 takes up a much larger market share in the destination (i.e., ms_{iodt} goes up) thanks to the tariff reduction. As shown in (11), a higher ms_{iodt} leads to a lower demand elasticity and thus increases the optimal markup.

In a sharp contrast, the three panels on the right show markedly different changes in the distribution of markups for the same-sized preferential tariff cut. To start, comparing the

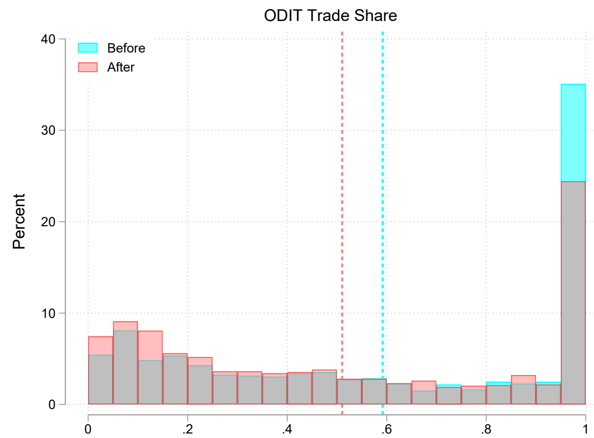
market and exporting separately for each specification such that around 20-30% of firms are active in the domestic or foreign markets.

Figure 2: Within-origin reallocation effects in response to a 10% bilateral tariff reduction

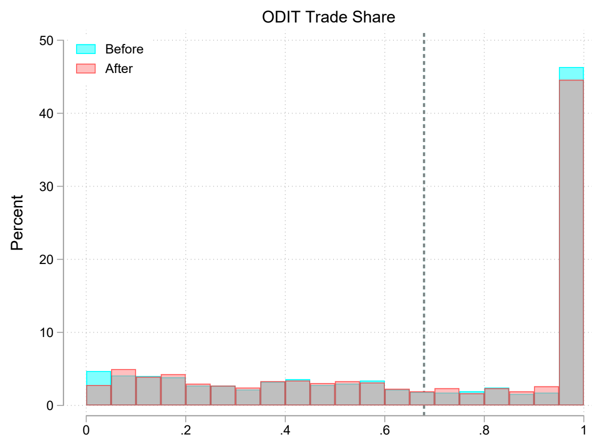
(a1) AB - Fixed Entry



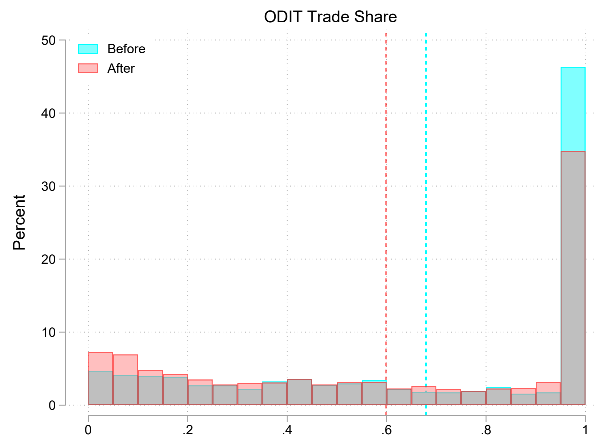
(a2) AB - Flexible Entry



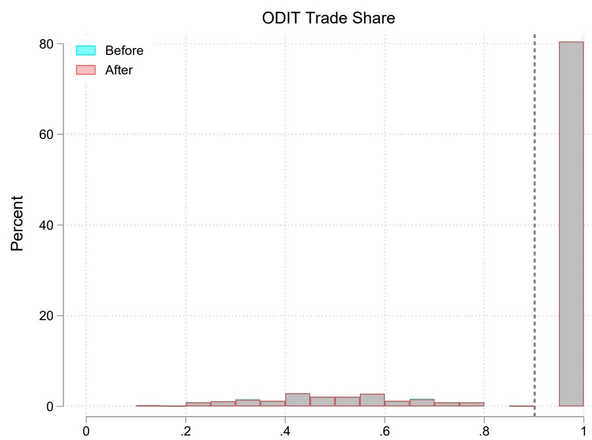
(b1) CHP - Fixed Entry



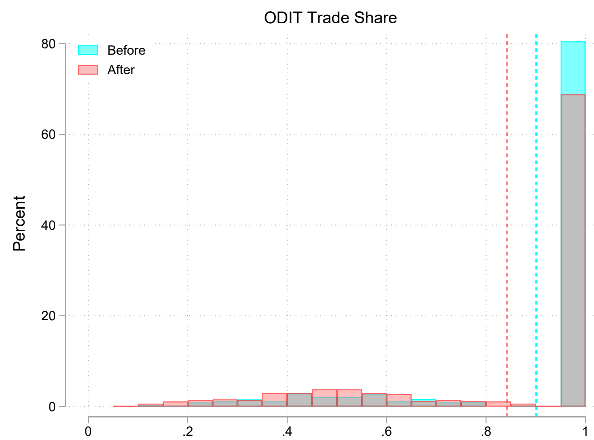
(b2) CHP - Flexible Entry



(c1) CHP with low ρ - Fixed Entry



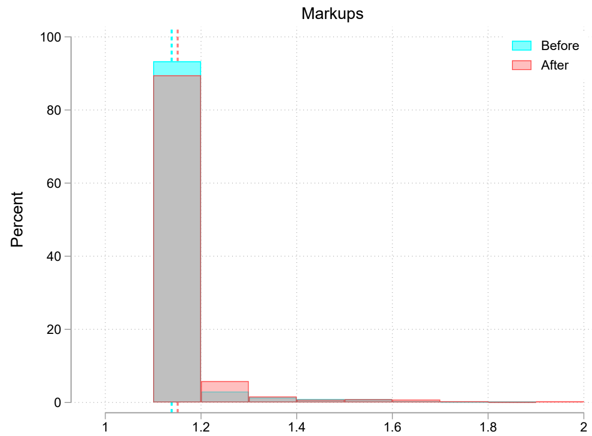
(c2) CHP with low ρ - Flexible Entry



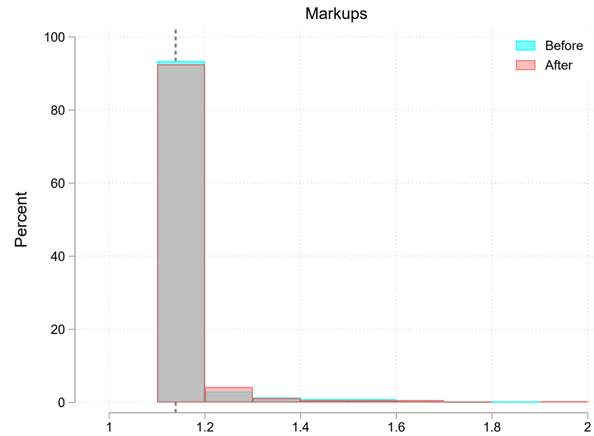
Note: Simulation results based on a model of 10 countries and 1000 industries. AB: $\eta = 1.2$, $\rho = 10.5$, $\sigma = 10.5$; CHP: $\eta = 1.2$, $\rho = 10.5$, $\sigma = 20.0$; CHP with low ρ: $\eta = 1.2$, $\rho = 3.0$, $\sigma = 20.0$. The vertical dashed line indicates the mean market share for all active firms.

Figure 3: Changes in markup distributions in response to a 10% bilateral tariff reduction

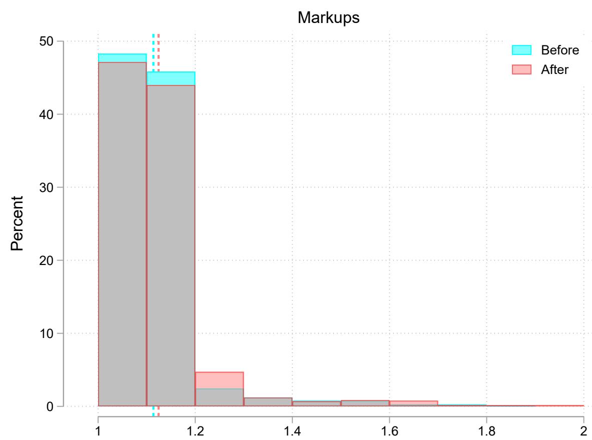
(a1) AB - Fixed Entry



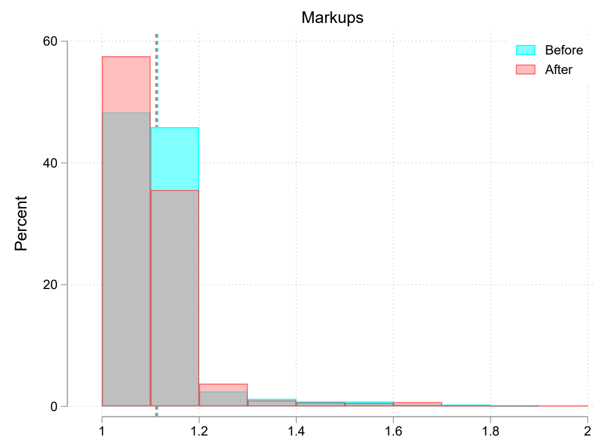
(a2) AB - Flexible Entry



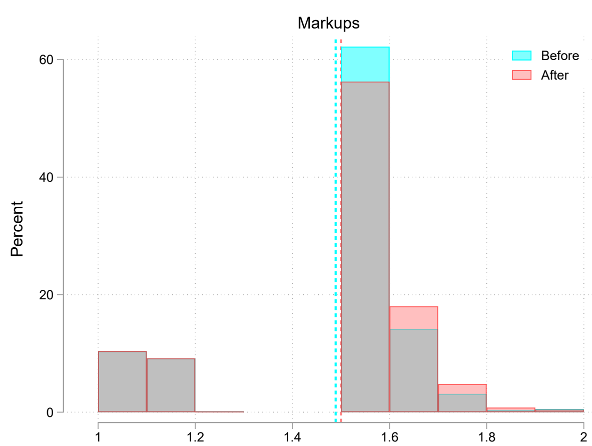
(b1) CHP - Fixed Entry



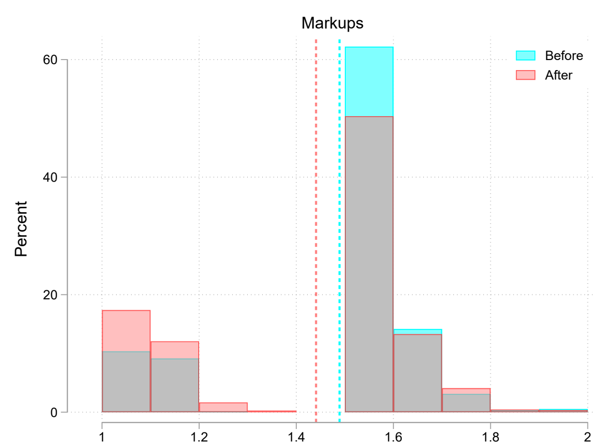
(b2) CHP - Flexible Entry



(c1) CHP with low ρ - Fixed Entry



(c2) CHP with low ρ - Flexible Entry



Note: Simulation results based on a model of 10 countries and 1000 industries. Calibration: AB: $\eta = 1.2$, $\rho = 10.5$, $\sigma = 10.5$; CHP: $\eta = 1.2$, $\rho = 10.5$, $\sigma = 20.0$; CHP with low ρ: $\eta = 1.2$, $\rho = 3.0$, $\sigma = 20.0$. The vertical dashed line indicates the mean markup for all active firms.

fixed entry cases in figures 3(a1) and 3(b1) to the flexible entry cases in figures 3(a2) and 3(b2), we see that changes to the average markup after a tariff cut are smaller in the free entry cases. This is because, with flexible entry, the within-origin reallocation effect kicks in so that the average market share of firms operating in the market is smaller due to entry by less efficient firms after the trade liberalization. In these cases, we have two competing forces as shown in (11). On the one hand, the average firm market share within the origin ms_{fiodt} goes down, which leads to a higher demand elasticity and a lower optimal markup. On the other hand, the origin accounts for a larger market share ms_{iodt} in the destination, which results in a lower demand elasticity and a higher optimal markup. Therefore, the total effect is ambiguous and depends on the model settings. While the change in the average markup looks similar in figures 3(a2) and 3(b2), there are small quantitative differences in the predictions of these two models. In fact, in all of our simulations, the cross-origin reallocation effect of changing ms_{iodt} always dominates in the Atkeson and Burstein (2008) model and the average markup actually increases slightly as in the case with fixed entry. Conversely, the within-origin reallocation effect tends to dominate in our CHP models and the average markup in fact drops slightly in figure 3(b2). The within-origin reallocation effect is much more pronounced when the difference between the within- and cross-origin elasticities is large. As shown in figure 3(c2), the reduction in the average markup is large and economically significant thanks to a much larger within-origin reallocation effect.

So which model is more realistic? In what follows, we investigate this problem empirically and estimate firms' pricing and market share responses to trade policy changes using firm level trade data from eleven developing countries.

3 Data and Empirical Strategy

We bring together information on i) firms' product-level export values and quantities from eleven countries, ii) product-level imports from 250 countries, iii) 257 preferential trade agreements, and iv) bilateral tariffs from 165 countries. Our final dataset spans the years 2000-2013 and contains 26,281,389 firm-product-origin-destination-year quintuplets, of which 88% are from 2000-2006, 93% from 2000-2009 and 99% from 2000-2012.

3.1 Firm-level trade

We use administrative data on the universe of firm-level exports 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

Table 1: Firm-Level Trade Data: Countries and Years

Country	Years	Value	Volume	Firms	Observations	... with PTA	... with Competitor PTA
Albania	2004 - 2012	✓	✓	6,314	66,397	6,090	53,138
Bulgaria	2001 - 2006	✓	✓	50,780	780,816	524,232	669,734
Burkina Faso	2005 - 2007	✓	✓	718	6,492	3,413	4,374
	2008 - 2012	✓	✓	1,173	10,305	6,016	7,105
China	2000 - 2006	✓	✓	230,339	20,043,162	1,168,391	15,107,487
Egypt	2005 - 2013	✓	✓	20,461	612,907	496,316	445,718
Malawi	2006 - 2008	✓	✓	1,360	9,409	5,903	8,594
	2009 - 2012	✓	✓	3,036	20,536	13,818	18,726
Mexico	2000 - 2007	✓	✓	106,688	1,904,144	1,230,160	1,631,202
	2008 - 2009	✓	✓	44,971	635,065	399,090	575,846
	2010 - 2011	✓	✓	43,866	678,719	415,385	623,286
	2012	✓	✓	32,706	390,582	308,744	364,802
Peru	2000 - 2013	✓	✓	28,851	888,886	339,287	784,356
Senegal	2000 - 2012	✓	✓	2,919	82,275	44,955	36,686
Uruguay	2001 - 2012	✓	✓	7,300	132,844	45,210	111,979
Yemen	2008 - 2012	✓	✓	1,242	18,850	11,533	11,334

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" and "...with Competitor PTA" report the number of observations for which our PTA_{odt} and Competitors' Avg $\text{PTA}_{i(-o)dt}$ variables take positive values. For PTA_{odt}, this amounts to the number of observations for which there is an active PTA between the origin and the destination. The variable Competitors' Avg $\text{PTA}_{i(-o)dt}$ appears in our dataset with a positive value if two conditions are met: (1) the destination has an active PTA with a competitor country and (2) the destination had non-zero imports of product i from this competitor in $t-1$. Thus, of 66k export observations from Albania, 53k of these exports were to destinations in which at least one competitor had a PTA.

World Bank Exporter Dynamics Database, data for Egypt from the Economic Research Forum Exports Dataset and data for China from the Chinese Customs Database.[13]

Apart from the Chinese Customs Database, which contains monthly data on HS08 products, these datasets provide information on non-zero annual firm-product level export values and volumes to individual foreign destinations based on HS06 products. To ensure the data are comparable and easily matched to our tariff and commodity classification data, we aggregate the Chinese data to the annual and HS06 product levels. As summarised in table 1, data for different countries is available for different years. Export values are free on board figures reported in US dollars for all countries other than Senegal, for which export values represent cost, insurance and freight figures. With the exception of China and Egypt, which use a variety of measures, as well as Mexico, which reports quantity over 2000-2009 but does not specify the measure(s) used, export volumes are reported as net weight in kilograms. Similar to other studies using administrative data, we use trade unit values as a proxy for prices.

3.2 Empirical strategy

We investigate the responses of firms to trade policy changes by estimating the following reduced form specification:

$$\begin{aligned} \text{Outcome}_{fiodt} = \quad & \beta_1 \cdot \text{PTA}_{odt} + \beta_2 \cdot \text{Tariff}_{iodt} \\ & + \beta_3 \cdot \text{Competitors' Avg PTA}_{i(-o)dt} + \beta_4 \cdot \text{Competitors' Avg Tariff}_{i(-o)dt} \\ & + \text{Fixed Effects} + \epsilon_{fiodt} \end{aligned} \tag{12}$$

We study the responsiveness of six key outcome variables suggested by our model. We start by examining the conventional effect of trade policy changes on trade flows using the export value at the firm-product-origin-destination-year level ($p^b_{fiodt} y_{fiodt}$) as the outcome variable.[14] We then investigate the two reallocation effects discussed in subsection 2.1.1 using empirical measures corresponding to the two market shares defined in (7) as the outcome variables, ms_{fiodt} and ms_{iodt}.[15] Next, we verify the extent of firm entry and exit associated

[13] For more information about the World Bank Exporter Dynamics Database, see Cebeci, Fernandes, Freund and Pierola (2012) and Bortoluzzi, Fernandes and Pierola (2015).

[14] The export price $p^b_{fiodt} \equiv p_{fiodt}/\tau_{iodt}$ is FOB price excluding tariffs and other trade costs.

[15] Note that the second is not a firm-level variable. Also, the object that our model points to is the origin's market share in the destination, inclusive of domestic producers. Our empirical proxy for this is the origin's import market share in the destination as domestic production data at the HS06 level in each destination

with a trade policy change—a key driving force of markup changes as discussed in subsection 2.2—using the number of firms operating at the product-origin-destination-year level as the outcome variable.[16] Finally, we directly quantify firms' price and markup adjustments in response to trade policy changes using the border price (p^b_{fiodt}) as the outcome variable.[17] All outcomes other than the count of participating firms enter the equation in natural logs.

As to the key policy change measures, the first two variables on the right hand side of equation (12) capture the direct effect of trade policy changes between the origin and destination. PTA_{odt} is a dummy variable equal to one if the origin and the destination have an active trade agreement in year t. Tariff_{iodt} denotes the natural logarithm of one plus the tariff the destination charges on imports of product i from the origin. To control for changes in competitors' trade policies, we construct variables in the second line of (12) in a way that is analogous to Amiti, Itskhoki and Konings (2019). The variable Competitors' Avg $\text{PTA}_{i(-o)dt}$ represents the weighted proportion of an origin country's competitors which have access to an active trade agreement with the destination, using the previous period's trade shares as weights. Similary, the variable Competitors' Avg $\text{Tariff}_{i(-o)dt}$, is the natural logarithm of one plus the weighted tariff faced by the origin's competitors in a given product in the destination. We provide detailed instructions and graphical illustrations on the construction of these two variables in Appendix A.7.

3.2.1 Fixed effects

Our baseline specification includes three sets of fixed effects capture variation at the firm-product-origin-time, product-destination-time and origin-destination levels. When the log export price $ln(p^b_{fiodt})$ is the dependent variable, 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.This specification allows us to identify how the component of the markup that is specific to a destination (i.e., the pricing-to-market component) changes when a country joins a PTA, has competitors join a PTA in a destination, faces tariff changes in the destination, etc.

The product-destination-time fixed effects absorb the impacts of any general changes in industry price levels p_{idt} and/or demand shifts y_{idt} in a destination market. For example, if a destination's participation in a PTA is pro-competitive, inducing a fall in average prices or markups, this impact will be captured by the product-destination-time fixed effect. Our

does not exist.

[16] We use PPML to estimate the responsiveness of the count of participating firms.

[17] As detailed in the following subsection, we use granular firm-product-origin-time fixed effects to control for the marginal cost of the firm in the markup estimations.

use of direct PTA, tariff, and trade agreement provision variables as well as trade-weighted competitors' variables enables us to decompose the remaining variation in prices and markups by exporters into (partial) pro-competitive effects of direct policy changes as well as those due to increased competition from policy changes against competitors.[18]

We further include origin-destination fixed effects to absorb time-invariant gravity factors between the origin and the destination. For example, the existence of PTAs 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 in that it might be large trade flows which cause the PTA, rather than the PTA which causes large trade flows. To the extent that this is a problem, it is likely to be an issue at the aggregate level, and since we are making comparisons across destinations within firm-product-year triplets, the main reverse causality problem is likely to be cross-sectional. Accounting for unobserved heterogeneity at the country-pair level should therefore all but resolve these concerns (see Baier and Bergstrand (2007)).[19]

To estimate the firms' price responses to trade policy changes, we estimate firms' price elasticities using equation (12) with product-destination-time, origin-destination, and firm fixed effects. The firm fixed effects capture variation related to a firm's time-invariant productivity, size, or, possibly, market power. Hence, we can interpret the magnitude of both the direct and third country effects arising from PTAs, tariffs, or trade agreement provisions as the responsiveness for an average firm in our eleven country exporter's dataset.

We estimate our specifications for firm-level trade values using panel OLS regressions, rather than PPML, as creating a full panel of zero trade flows at the firm and product-level for eleven countries would result in a dataset of several billion observations, making estimation of PPML with our current 32-core server infeasible in a reasonable time period. This means that we only use positive trade flow observations. However, it is important to note that the inclusion of our granular firm-product-origin-time, product-destination-time and origin-destination fixed effects should absorb most of the variation in trade costs that

[18] When we estimate the changes in trade flows using $ln(p^b_{fiodt} y_{fiodt})$ as the dependent variable, the product-origin-time element of the firm-product-origin-time fixed effects and the product-destination-time fixed effects capture multilateral resistance terms, as is standard in the gravity literature (Anderson and van Wincoop, 2003; Feenstra, 2004; Redding and Venables, 2004; Head and Mayer, 2014; Baier, Bergstrand and Feng, 2014).

[19] Additionally, the inclusion of origin-destination fixed effects absorbs pricing variation associated with time-invariant features such as distance or quality (Bastos and Silva (2010)) or via, for instance, the Alchian-Allen effect (Hummels and Skiba (2004)). For example, if prices within a bilateral pair are generally higher or lower relative to the average for a product in the destination, this control will allow us to identify the average effect of policy on prices across all bilateral pairs. The product-origin-time fixed effect serves as a control for cost-push inflationary pressures on prices, such as increases in industry wages.

prevents firms from entering a market and thus accounts for the selection process that gives rise to the positive trade flows as noted in Baier, Bergstrand and Feng (2014) and Corsetti, Crowley, Han and Song (2019). Further, as noted above, we analyse the count of firm participating from each origin to each destination for all HS06 products; that *iodt* panel includes a full matrix of cells in which zero firms are operating.

4 Empirical Results

Preferential trade agreements signed by low and middle income countries typically involve much larger tariff cuts than those among high income countries. Our analysis finds exporting firms respond strongly to the tariff cuts associated with preferential trade aggreements; preferential tariff cuts lead to lower prices and lower markups.[20] These empirical findings on the price and markup responses to tariff cuts highlight the importance of oligopolistic competition and the market share reallocation mechanisms at work in our theoretical framework. In our model, declines in prices and markups are only observed if the within-origin reallocation effect of a tariff dominates that of the cross-origin reallocation effect so that the elasticity of demand facing a firm rises as tariffs fall. The richness of our multi-origin panel allows us to trace out not only changes in prices and markups, but also the the role of these different market share variables in contributing to these changes. The punchline is that preferential trade agreements stimulate entry from a 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 that could help with understanding the puzzling empirical finding that the (ex-tariff) prices of Chinese exports were virtually unchanged in the face of US tariffs imposed as part of the US-China Trade War.[21]

[20] Interestingly, we find that the signing of a preferential trade agreements between the eleven countries in our sample and their trade partners has no measurable effect on firms' trade flows or prices beyond that due to tariff reductions. We thank Jeff Bergstrand for pointing out the importance of tariff reductions in lower income countries' PTAs and help in interpreting the small magnitude of the PTA effect relative to other studies.

[21] Although the US-China Trade War studies of both Amiti, Redding and Weinstein (2019) and Fajgelbaum, Goldberg, Kennedy and Khandelwal (2020) found large declines in the value of trade from China, their analyses of import unit values from China showed almost no decline in response to steep tariff hikes. This type of phenomenon could arise if the two reallocation effects discussed in subsection 2.1.1 have offsetting impacts on prices. That is, on the one hand, the US tariff hike can induce less productive Chinese producers to exit the US market. Therefore, continuing Chinese producers would face less competitive pressure from their Chinese peers, and their markups would tend to rise. This is the within-origin reallocation effect. On the other hand, continuing Chinese producers would become less competitive relative to firms in competing origins due to the direct effect of the tariff hike on Chinese merchandise, which would lead them to loweir their markups. This is the cross-origin reallocation effect. In our empirical analysis, for which Chinese data is available over 2000- 2006, we find the within-origin reallocation effect dominates in the effect of prices and

Table 2: Impacts of preferential trade agreements on firms' outcomes

	Values	No. of Firms (PPML)	Firm's MS ms_{fiodt}	Origin's MS ms_{iodt}	Prices	Markups
	(1)	(2)	(3)	(4)	(5)	(6)
All Goods						
PTA_{odt}	0.01	0.00	0.01	0.03	-0.03***	-0.02***
	(0.024)	(0.009)	(0.029)	(0.026)	(0.010)	(0.009)
Tariff_{iodt}	-1.78***	-2.20***	2.85***	-3.29***	0.48***	0.40***
	(0.242)	(0.162)	(0.322)	(0.271)	(0.117)	(0.073)
Observations	15,853,618	2,750,833	15,853,618	1,067,240	15,793,386	15,793,386
All Goods						
PTA_{odt}	-0.00	0.02**	0.00	0.06**	-0.03***	-0.03***
	(0.025)	(0.010)	(0.030)	(0.026)	(0.010)	(0.009)
Tariff_{iodt}	-1.49***	-1.91***	2.55***	-2.68***	0.46***	0.37***
	(0.265)	(0.161)	(0.339)	(0.279)	(0.112)	(0.074)
Competitors' Avg $\text{PTA}_{i(-o)dt}$	-0.18**	0.21***	-0.06	0.39***	-0.05*	-0.05**
	(0.073)	(0.041)	(0.112)	(0.082)	(0.030)	(0.021)
Competitors' Avg $\text{Tariff}_{i(-o)dt}$	3.29***	2.96***	-3.18**	9.47***	-0.06	-0.23
	(0.942)	(0.587)	(1.412)	(1.237)	(0.277)	(0.225)
Observations	14,918,948	2,600,069	14,918,948	1,031,516	14,860,585	14,860,585
Fixed Effects						
Firm-product-origin-year	✓		✓			✓
Firm					✓	
Product-origin-year		✓		✓	✓	
Product-destination-year	✓	✓	✓	✓	✓	✓
Origin-destination	✓	✓	✓	✓	✓	✓

Notes: The dependent variable is the firm's log value in column (1), the number of firms 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 share of the destination market in column (4) and the firm's log unit value in columns (5) and (6). In column (6) the inclusion of firm-origin-product-year fixed effects implies that results are for the markup. Significance: *** p<0.01, ** p<0.05, and * p<0.1 are based on standard errors clustered at the destination-product level, which are reported in parentheses. Data sources: eleven datasets of firms' exports from the World Bank Exporter Dynamics Database, China's Customs Authority, and Egypt's Customs Authority.

We present our main results in table 2. The top panel presents estimates of the overall effect of joining a PTA and of the preferential tariff reductions it embodies. The bottom panel additionally brings in the indirect effects on a firm when the competitive environment in a destination changes because other origin countries have joined a PTA with the destination. Beginning with the direct effects in the top panel, the first column shows that the value of a firm's trade at the level of an HS06 product rises strongly with a preferential tariff cut. A 1% reduction in tariffs is associated with a 1.8% increase in the trade value. Interestingly, the inclusion of product-destination-year fixed effects, which control for idiosyncratic product-level demand shifts in the destination, implies that the parameter estimate on the tariff can be interpreted as the responsiveness of a firm's product-level market share in the destination (relative to all producers). In the Atkeson and Burstein (2008) model of oligopolistic competition, which emphasizes competition among all firms within an industry, this parameter would be a sufficient statistic for signing 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, and a rise in the firm's markup.

However, our analysis shows more subtle forces are at play. We find that market participation by exporting firms rises with the magnitude of the tariff cuts in a PTA (column (2)). 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 leads to changes in two different market shares that our theoretical model suggests influence the impact of a trade liberalization on markups; a firm's share of trade among compatriot firms from its origin and an origin's share of trade in a destination. Beginning with a firm's trade share in a destination among all firms from its own origin, we find that a 1% reduction in the bilateral tariff is associated with substantial *decreases* in the average market share of an exporting firm of 2.9% (see column (3)). Next, using a traditional definition of import market share, that of the origin in the destination (see column 4)), we find a country's market share rises 3.3% when it is the beneficiary of a 1% preferential tariff cut. Unsurprisingly, when one country enjoys a tariff cut in a destination that is not offered to competing origins, the country's market share rises.

Our theoretical model highlights the importance of decomposing the firm's market share in the destination into two parts, the firm's share of its country's trade with the destination

markups. Over 2000-2006, it may have been that the varieties made by Chinese producers were substantially more substitutable among themselves than with the products made by other countries. However, as China developed and moved up the quality and technology ladders, the degree of substitutablity among Chinese products relative to that with foreign products may have declined (so that the values of σ and ρ became more similar). If this happened, it would be reasonable to expect the within-origin reallocation effect to have become weaker by the time of the US-China Trade War so that the two reallocation effects cancelled out to result in the zero markup response documented in the recent literature.

(ms_{fiodt}), and the origin country's share of the destination market (ms_{iodt}). 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. Depending on precise parameter values, a tariff change can lead to a within-origin reallocation effect that puts downward pressure on markups and a cross-origin reallocation effect that puts upward pressure on markups. The estimates on the tariffs in columns (3) and (4) show that these two reallocation channels are creating opposing pressures on markups. Thus, the net effect on prices and markups willl depend empirically on which of these two effects dominates. Loosely speaking, this boils down to whether origin firms regard compatriot firms or firms from other origins as their core competitors.

This brings us to columns (5) and (6) which report the effects of preferential tariff cuts on prices and markups. For prices (column (5)), the standout result is that an exporting firm's price in a destination is increasing in the tariff. Thus, a 10% drop in tariffs leads to a sizeable 4.8% drop in prices. This specification controls for firm fixed effects, absorbing variation related to a firm's time-invariant productivity, size, or, indirectly, market power, as well as product-origin-time fixed effects to control for industry-level supply shocks in the origin, product-destination-time fixed effects to control for shifts in destination demand, and origin-destination fixed effects to capture pair-specific features such as distance or common legal system or language.

Turning to markups, the dependent variable in column (6) is the log unit value (price); therefore, 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. This allows us to identify how the component of the markup that is specific to a destination (i.e., the residual component of the markup that varies across destination markets) changes when a country joins a PTA. We find that a 10% reduction in the tariff on a product is associated with a 4% decline in its markup. Altogether, these findings imply that the within-origin reallocation effect dominates the cross-origin reallocation effect so that the elasticity of demand facing a firm falls with the tariff. Interpreted through the lens of the triple-nested CES model, it seems that consumers' preferences across varieties are such that firms in our dataset view compatriot firms from their own origin as more relevant competitors in the destination market than firms from other origins. This leads origin firms to react more strongly to the additional entrants from their own origin than to the fall in their trade costs in setting prices.

The bottom panel of table 2 introduces the proxy measures of third country competition coming from competitors's access to a PTA in the destination and the competitors' average tariff for each product in the destination. In all specifications, the magnitudes of the direct effects of tariffs are similar to those in the top panel, albeit slightly muted. Overall, in examining the indirect effects of preferential trade agreements and tariffs, classic Vinerian forces of trade diversion appear to be at play. A reduction in the average tariff on producers located in competing origins leads to a 3.3% decline in exports from the first origin's firms (see column (1)). In the same vein, export participation from an origin is higher when the average tariff imposed on competing origins is higher (see column (2)). Moving across, a firm's market share measured among firms from its origin falls when the firm's competitors from other origin countries face a higher tariff; a 1 percent decline in the competitors' average tariff is associated with a 3.2% decline in a firm's market share. Presumably this occurs because relatively high tariffs on imports from other origins stimulate increased market participation from the origin. Column (4) reports the market share of an origin country is strongly increasing in the average tariff facing competing origins.

Turning to the effect of a competitors' PTA on prices (column (5)), we find that if an additional 10% of a firm's competitors in a destination sign a PTA, then prices charged by firms from the first origin decline by a modest 0.5%. Although modest in magnitude, we think this finding is interesting and important because our measure shows the existence of a pro-competitive effect arising from destinations' PTAs with third countries (even after we have controlled for changes in multilateral resistance in the destination with product-destination-time fixed effects (Anderson and van Wincoop (2003)).[22] We find that markups decline 0.5% when an additional 10% of a firm's third-country competitors have signed a PTA with the destination.

4.1 The impact of preferential trade agreements by the degree of product differentiation

Exporting firms' responses to the introduction of a preferential trade agreement, broken down by the degree of product differentiation, are reported in table 3. The table is divided into two panels; the top and bottom panels utilize a breakdown of commodity space into highly differentiated goods and less differentiatied goods introduced by Corsetti, Crowley, Han and Song (2019) (CCHS). The 5200 products in the Harmonized System are categorized as highly differentiated or less differentiated according to observable characteristics.[23] With

[22]The subtlety in the identification strategy is that the product-destination-time fixed effects control for factors such as the time varying product-level price level in a destination, but with eleven origin countries, each signing its own set of trade agreements, changes in the destination country's competitive environment facing firms from each origin country will be different. This provides the empirical variation to identify the changes in indirect effects.

[23]Chinese linguistic particles used in the Chinese Customs Database are used to identify discrete versus continuous items; we assume discrete goods are inherently more differentiated than continuous goods. See

this refinement of commodity space into two groups, we can examine whether the direct effects of PTAs on firm-level market participation, prices, and markups are systematically different for products in which firms might be expected to wield greater market power.

Estimates in the top panel of table 3 are for highly differentiated products. In the CCHS classification, roughly one-half of goods classified as "differentiated" according to Rauch (1999) are classified as highly differentiated. In product markets in which firms hold greater market power because the elasticity of substitution across varieties is lower, a reduction in barriers to trade might be expected to have a larger pro-competitive effect on prices and markups. (However, this is not necessarily the case; multiple parameters matter in our rich theoretical model). We find that export values, market participation, firm's and origin's market shares, prices, and markups of highly differentiated goods are more responsive to preferential tariff changes than they are for all traded goods (see table 2) and especially for less differentiated goods (see the bottom panel of table 3). Particularly interesting is the fact that both prices and markups are increasing in the tariff a firm faces in a destination; a 1% increase in the tariff in a destination is associated with a 1.00% increase in the price and a 0.84% increase in the markup. Together, these two facts suggest that almost 85% the price cut associated with a tariff cut comes from firms reducing their markups in the destination. Furthermore, for highly differentiated goods, competitors' PTAs have slightly larger effects on prices and markups than those found for all goods. The formation of a PTA among a destination and third countries reduces the markup charged by firms from origin o by 0.9%, evidence of a pro-competitive effect that is substantially larger than the pro-competitive effect for the complete dataset of all goods.

The bottom panel restricts the dataset to goods which are less differentiated; this includes commodities and simple manufactured goods like processed foods. Overall, while the direction of the impact of tariff cuts on market participation and market shares are the same as those of highly differentiated goods, the magnitudes are much smaller. Most interesting, for these goods, tariff cuts have no impact on firms' prices or markups after controlling for the general level of the price in the destination with product-destination-year fixed effects. One interpretation is that trade in these goods is well-approximated by perfect competition and that there is little scope for market power to play a role.

4.2 DTAs and Global Value Chains

In this section, we explore the role of PTA participation in global value chains. Our focus is on identifying differences, if any exist, in the effect of PTAs on the markups of intermediate

Corsetti, Crowley, Han and Song (2019) for details.

Table 3: Impacts of trade agreements for highly differentiated vs. less differentiated goods

	Values	No. of Firms (PPML)	Firm's MS ms_{fiodt}	Origin's MS ms_{iodt}	Prices	Markups
	(1)	(2)	(3)	(4)	(5)	(6)
High Differentiation Goods						
PTA_{odt}	0.00	0.03*	0.16***	0.00	-0.03	-0.04**
	(0.048)	(0.017)	(0.054)	(0.044)	(0.018)	(0.017)
Tariff_{iodt}	-1.89***	-2.23***	3.40***	-3.67***	1.00***	0.84***
	(0.442)	(0.195)	(0.442)	(0.369)	(0.124)	(0.106)
Competitors' Avg $\text{PTA}_{i(-o)dt}$	0.07	0.51***	-0.31**	0.59***	-0.07**	-0.09***
	(0.113)	(0.051)	(0.131)	(0.127)	(0.035)	(0.031)
Competitors' Avg $\text{Tariff}_{i(-o)dt}$	5.60***	5.53***	-2.30*	11.58***	-0.13	-0.23
	(1.425)	(0.710)	(1.396)	(1.484)	(0.396)	(0.356)
Observations	5,448,525	847,894	5,448,525	336,543	5,437,597	5,437,597
Low Differentiation Goods						
PTA_{odt}	0.06**	0.03**	-0.04	0.08**	-0.04***	-0.03***
	(0.029)	(0.012)	(0.034)	(0.034)	(0.012)	(0.011)
Tariff_{iodt}	-0.80***	-1.24***	0.99**	-1.91***	0.07	0.03
	(0.308)	(0.197)	(0.412)	(0.398)	(0.096)	(0.086)
Competitors' Avg $\text{PTA}_{i(-o)dt}$	-0.23***	0.07	0.06	0.24**	0.00	-0.00
	(0.084)	(0.057)	(0.157)	(0.109)	(0.023)	(0.022)
Competitors' Avg $\text{Tariff}_{i(-o)dt}$	2.68**	1.64**	-4.76**	8.93***	0.06	-0.17
	(1.081)	(0.656)	(2.200)	(1.702)	(0.288)	(0.275)
Observations	7,313,838	1,670,588	7,313,838	653,784	7,273,653	7,273,653
Fixed Effects						
Firm-product-origin-year	✓		✓			✓
Firm					✓	
Product-origin-year		✓		✓	✓	
Product-destination-year	✓	✓	✓	✓	✓	✓
Origin-destination	✓	✓	✓	✓	✓	✓

Notes: The dependent variable is the firm's log value in column (1), the log number of firms 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 share of the destination market in column (4) and the firm's log unit value in columns (5) and (6). In column (6) the inclusion of firm-origin-product-year fixed effects implies that results are for the markup. Significance: *** p<0.01, ** p<0.05, and * p<0.1 are based on standard errors clustered at the destination-product level, which are reported in parentheses. Data sources: eleven datasets of firms' exports from the World Bank Exporter Dynamics Database, China's Customs Authority, and Egypt's Customs Authority.

inputs versus final consumption goods. To do this, we subdivide the firm and product level administrative data into ever more refined subsamples. We then apply the regression models used previously on each subsample of data. The first, most basic split is between final consumption goods and intermediate inputs. We then refine these subsamples into groups of consumption and intermediate goods that are highly differentiated versus less differentiated.

Table 4: PTAs and Global Value Chains: Changes in Markups by End-Use Category

	All consumption goods (1)	All intermediate goods (2)	High-diff consumption goods (3)	Low-diff consumption goods (4)	High-diff intermediate goods (5)	Low-diff intermediate goods (6)
PTA_{odt}	-0.03***	-0.03*	-0.07***	-0.02	-0.01	-0.03**
	(0.012)	(0.015)	(0.018)	(0.017)	(0.051)	(0.016)
Tariff_{iodt}	0.61***	0.14	0.97***	0.00	0.45	0.16
	(0.093)	(0.120)	(0.124)	(0.129)	(0.404)	(0.125)
Competitors' Avg $\text{PTA}_{i(-o)dt}$	-0.05**	-0.02	-0.13***	-0.01	-0.03	0.01
	(0.023)	(0.029)	(0.035)	(0.031)	(0.113)	(0.031)
Competitors' Avg $\text{Tariff}_{i(-o)dt}$	-0.27	0.45	-0.18	-1.11***	1.33	0.57
	(0.279)	(0.379)	(0.367)	(0.408)	(1.789)	(0.410)
Observations	6,461,099	5,361,440	3,818,548	2,492,165	646,962	4,344,748
Fixed Effects						
Firm-origin-product-year	✓	✓	✓	✓	✓	✓
Product-destination-year	✓	✓	✓	✓	✓	✓
Origin-destination	✓	✓	✓	✓	✓	✓

Notes: The dependent variable is the log unit value at the firm-product-origin-destination-year level in all columns. The inclusion of firm-origin-product-year fixed effects implies that results are for the markup. Significance: *** p<0.01, ** p<0.05, and * p<0.1 are based on standard errors clustered at the the destination-product level, which are reported in parentheses. Data sources: eleven datasets of firms' exports from the World Bank Exporter Dynamics Database, China's Customs Authority, and Egypt's Customs Authority.

The overall pattern is that the impact of tariff cuts on markups is larger for final than intermediate goods. Interestingly, the most differentiated consumption goods enjoy the largest markup reductions associated with the tariff cuts of joining a PTA, a 0.97% reduction in the markup for every 1% reduction in the tariff (see column (3)). As a validation check, tariffs have no effect on the markups of intermediate inputs, goods for which the elasticity of substitution across varieties is thought to be relatively high.

5 Mapping Empirical Patterns to the Theoretical Model

To what extent can oligopolistic competition models replicate the empirical patterns? In what follows, we apply our key empirical specifications to simulated data from different versions of the model discussed in Section 2 and investigate how the estimated markup and market share elasticities depend on the degree of competition within and across origins as well as the degree of product differentiation. The key takeaway of this analysis that the model is able to better match the quantitative empirical estimates when we allow for a higher elasticity substitution within an origin than across origins, i.e., $\sigma > \rho$.

Specifically, we simulate 15 years of data for a world with 10 countries and 200 industries for different combinations of σ and ρ.[24] We fix the elasticity of substitution across industries $\eta = 1.2$ and the Pareto parameter governing the productivity dispersion to $\xi = 4.5$, and thenvary σ and ρ between 2 and 20, stipulating $\sigma \geq \rho$. In our interpretation, industries with high σ and ρ sell low differentiation goods and those with low σ and ρ sell high differentiation goods.

Countries sign trade agreements which we model as tariff shocks that occur in every period.[25] To make sure the estimated elasticities are comparable across calibrations and to minimize disturbances due to large level shifts in the initial market share distributions, we adjust the per-period costs of exporting and domestic operations (i.e., ζ_x and ζ_d) such that the proportion of active firms is around 20-30% in period 0 before any the tariff shocks are introduced. To illustrate the importance of firm entry and exit in shaping the distribution of market shares and markups, we run the model both with a fixed set of firms as well as with flexible, optimal participation by firms highlight the role of extensive margin dynamics.

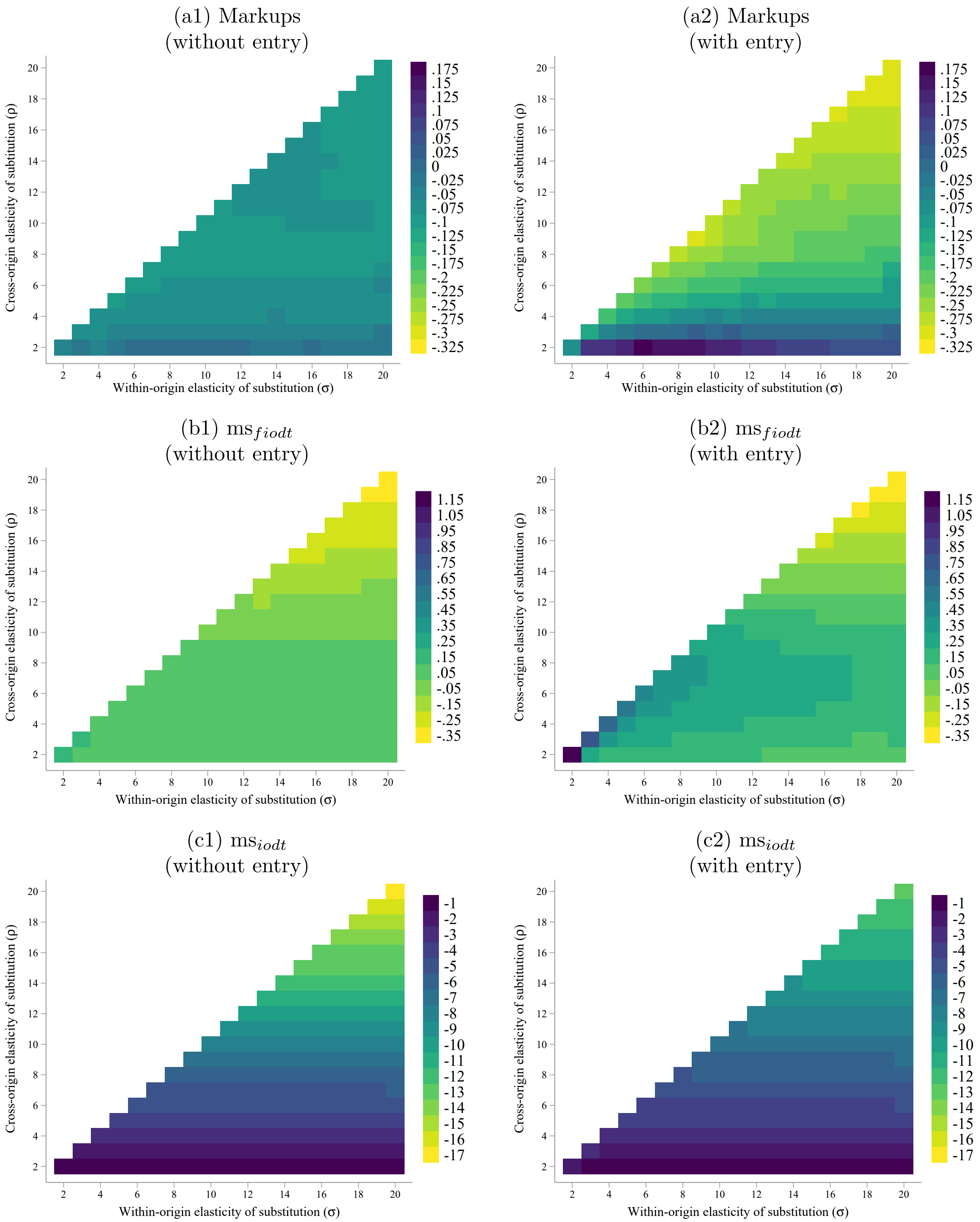
Figure 4 presents a visualization of the effect of tariffs on ms_{iodt}, ms_{fiodt} and markups in our model. It plots the regression coefficients obtained from applying our empirical specifications to our simulated data. In all six panels, the diagonal represents specifications for which $\sigma = \rho$ so that our model collapses to a multi-country Atkeson and Burstein (2008) model.

Panels (a1) and (a2) show the effect of a 1% bilateral tariff change on exporters' markups. On the left, in panel (a1) we see that firms almost always absorb part of a change in tariffs into their markups under fixed entry, suggesting a anti-competitive effect from the foreign exporters as described in Arkolakis, Costinot, Donaldson and Rodríguez-Clare (2018). In sharp contrast, once we incorporate the impacts of entry and exit, panel (a2) shows a much

[24]We allow for 4 potential entrants at the industry-origin-destination level and the maximum number of active firms in a narrowly defined industry/product is $40 = 4 \times 10$.

[25]We draw baseline MFN tariffs from a lognormal distribution with mean -2 and variance 1, and baseline preferential tariffs from a lognormal distribution with mean -2 and variance 2. We then draw a directional trade agreement indicator from a Bernoulli distribution with success probability 10%. The baseline tariff a country faces is the MFN tariff, unless it benefits from a trade agreement, in which case the country faces the preferential tariff provided this is lower than the MFN tariff. In each period, both the MFN and the preferential tariffs are subject to shocks drawn from a normal distribution with mean 0 and variance 1, which are exponentiated and multiplied with the baseline tariff to calculate that period's tariff.

Figure 4: Contrasting the estimated tariff elasticities of markups and market shares with and without free entry for various parameter values using simulated data from the model



Note: The figures plot coefficient estimates based on simulated data for a model of 200 industries, 10 countries and 15 years. Each coloured square represents the estimated elasticity by regressing the log of market shares or markups on the log of tariffs, with firm-product-origin-year (product-origin-year), product-destination-year and origin-destination fixed effects, using simulated data from a model with the specified combination of σ and ρ. Figures (a1), (b1) and (c1) plot this coefficient under the assumption of no entry, whereas figures (a2), (b2) and (c2) plot it under the assumption of free entry.

larger range for the markup elasticities under the same parameter combinations. Notably, the markup adjustments can be positive or negative in response to a bilateral tariff cut depending on the values of σ and ρ. From the diagonal elements of panel (a2), we see exporters always increase markups after a bilateral cut in the original Atkeson and Burstein (2008) model, evidence of an anti-competitive effect. Exporters reduce markups in response to a bilateral tariff cut only in the off-diagonal elements when the degree of substitutability of varieties is different within versus across origins. Consistent with our empirical findings, we find a higher positive markup elasticity when σ and ρ are low and goods are more differentiated.

As discussed analytically in section 2, the large difference in the markup responses are driven by the differential within and across origin reallocation effects in different settings. Panels (b1) and (b2) show the degree of within-origin reallocations under different parameter and entry settings. We see the exporter's importance among all firms from the same origin (indicated by ms_{fiodt}) may rise or fall with tariffs, and that it is more likely to fall for larger values of ρ. Without entry and exit, the range of values is more modest and skewed towards negative numbers, whereas we see potentially large positive numbers, especially along the diagonal, once we incorporate changes from the extensive margin. Recall that an increase in ms_{fiodt} increases the exporters' market power among firms from the same origin and thus leads to markup increases.

Panels (c1) and (c2) shows the degree of cross-origin reallocations. We see that tariffs reduce a country's share of a destination's market, and that this reduction is larger the greater the substitutability across sectors ρ. Since a reduction in ms_{iodt} reduces the market power of firms from the origin and leads to lower markups, the cross-origin reallocation is in general anti-competitive for tariff cuts. Comparing (c1) and (c2), we see that entry and exit after the trade policy change partly offset the tariff effects on the market shares. The effect of changing σ on cross-origin market shares in (c2) is much less visible compared to its impact on the within-origin market shares in (b2), suggesting the large variation in within-origin market share adjustments plays an important role in explaining the wide range of markup responses observed in (a2).

6 A Case Study on Competition Policy Provisions in Deep Trade Agreements

To wrap up our study, we turn to an assessment of the role of Deep Trade Agreement provisions on competition. A fundamental question about the value of so-called "deep" trade agreements is whether their provisions have profound impacts on trade or merely pay lip-service to the cause of deeper economic integration. We examine different competition policy provisions of deep trade agreements to get at this question. Our analysis focuses on two distinct questions in the DTA database. Both provisions focus on commitments in PTA chapters covering intellectual property, government procurement, e-Commerce, agriculture or investment that prohibit or regulate anticompetitive behaviours. The first provision asks, "Does the agreement prohibit or regulate cartels or concerted practices?" while the second asks "Does the agreement prohibit or regulate abuse of market dominance?" Notably, in our sample of 257 agreements, there are 61 PTAs that commit to prohibiting or regulating cartels and 68 with a specific obligation to prohibit or regulate market dominance. To refer to these provisions, we adopt the short names "prohibits cartels" and "prohibits market dominance." Because both the "prohibits cartels" and "prohibits market dominance" provisions are commitments that rely on the existence of domestic bodies with a competition mandate, we see both of these provisions as substantive domestic policy commitments that go well beyond the shallow commitment to reduce tariffs.

We find the two provisions that explicitly limit specific anticompetitive behaviours are associated with increases in the value of trade of around 15% (table 5 columns (1) and (2)). Further, when one's competitors in a destination have committed to prohibiting cartels or regulating market dominance in their PTAs with the destination, this also has a trade-expanding effect on the origin. In other words, the general practice of making a substantive commitment to competition agencies is associated with greater trade from all destinations. One possible interpretation of these results is that provisions which included substantive commitments to competition generate real improvements in economic integration by expanding the value of trade among partners.

Table 5: Impacts from Competition Provisions in a PTA

	Value	Value	Prices	Prices	Markups	Markups
	(1)	(2)	(3)	(4)	(5)	(6)
Prohib Cartel$_{odt}$	0.16**		-0.00		-0.04**	
	(0.068)		(0.022)		(0.018)	
Comps' Prohib Cartel$_{i(-o)dt}$	0.94***		0.03		0.04	
	(0.133)		(0.052)		(0.037)	
Prohib Prohib Mkt Dom$_{odt}$		0.15**		0.00		-0.04**
		(0.065)		(0.021)		(0.018)
Comps' Prohib Mkt Dom$_{i(-o)dt}$		0.93***		0.03		0.04
		(0.133)		(0.052)		(0.036)
PTA$_{odt}$	-0.07***	-0.07**	-0.03**	-0.03**	-0.01	-0.02
	(0.025)	(0.025)	(0.013)	(0.013)	(0.011)	(0.011)
Tariff$_{iodt}$	-1.61***	-1.61***	0.46***	0.46***	0.36***	0.36***
	(0.265)	(0.265)	(0.112)	(0.112)	(0.075)	(0.075)
Competitors' Avg PTA$_{i(-o)dt}$	-0.53***	-0.52***	-0.06	-0.06	-0.06**	-0.06**
	(0.094)	(0.094)	(0.040)	(0.040)	(0.026)	(0.026)
Competitors' Avg Tariff$_{i(-o)dt}$	1.85**	1.86**	-0.11	-0.11	-0.28	-0.29
	(0.880)	(0.881)	(0.276)	(0.276)	(0.228)	(0.228)
Observations	14,918,948	14,918,948	14,860,585	14,860,585	14,860,585	14,860,585
Fixed Effects						
Firm-product-origin-year	✓	✓			✓	✓
Firm			✓	✓		
Product-origin-year			✓	✓		
Product-destination-year	✓	✓	✓	✓	✓	✓
Origin-destination	✓	✓	✓	✓	✓	✓

Notes: The dependent variable is the log export value, columns (1) - (2), and the log unit value, columns (3) - (6), at the firm-product-origin-destination-year level. The inclusion of firm-origin-product-year fixed effects in columns (5) and (6) implies that results are for the markup. Significance: *** p<0.01, ** p<0.05, and * p<0.1 are based on standard errors clustered at the destination-product level, which are reported in parentheses. Data sources: eleven datasets of firms' exports from the World Bank Exporter Dynamics Database, China's Customs Authority, and Egypt's Customs Authority.

In columns (3) - (6), we examine the effect of competition policy provisions on prices and markups. Although the provisions have no discernible effect on prices, we find an important impact on markups. The inclusion of substantial commitments to prohibit or regulate anticompetitive practices yields real reductions in markups of 4.0% regardless of whether the commitment is to limit cartels or market dominance.

In summary, our analysis of competition policy provisions points to the effectiveness and utility of examining the substance of trade agreement provisions in a more refined econometric and modelling framework. Specific legal commitments to regulate anticompetitive behaviours are shown to enhance trade value and reduce markups.

7 Conclusion

Understanding the welfare implications of trade agreements has long been a central focus of the international economics literature.[26] Despite recent contributions from De Loecker, Goldberg, Khandelwal and Pavcnik (2016) and Edmond, Midrigan and Xu (2015), an open question remains about the extent to which firms' markup adjustments affect the gains from trade. Intuitively, if cuts in trade barriers enhance competition and lead to markup reductions, then the welfare gains from trade agreements will be larger as they shift resources to more productive firms and bring in the additional "pro-competitive" gains of trade.

This intuitive explanation is complicated by two factors. The first one, as argued by Arkolakis, Costinot, Donaldson and Rodríguez-Clare (2018), is the different responses to a trade agreement by domestic and foreign firms – domestic firms *reduce* markups in response to the increased foreign competition while foreign firms benefiting from any tariff reduction tend to *increase* their markups in standard models. The second one, which is highlighted in this paper, is the extent of competition among firms from the same origin versus different origins. We show that if foreign exporters treat their peers from the same origin as their key competitors, they will in general *reduce* (as opposed to increase) their markups in response to tariff cuts due to the additional competitive pressure brought by entrants from the same origin. In this case, the "within-origin reallocation effect" dominates and our model suggests strong "pro-competitive" effects not only for domestic producers but also for foreign exporters. Conversely, if foreign exporters treat firms from other origins as their key competitors, they will *increase* their markups in response to tariff cuts because the "cross-origin

[26] 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)).

reallocation effect" dominates; under this scenario the "pro-competitive" gains from trade are "elusive" as argued by Arkolakis, Costinot, Donaldson and Rodríguez-Clare (2018).

The key feature of our theoretical framework is that we do not need to take a stand on the two reallocation effects ex ante. These two reallocation effects can co-exist in our triple-nested demand framework and the ultimate markup adjustments and their associated pro-competitive effects depend on which of the two effects dominate. While our empirical results suggest the "within-origin allocation effects" dominate for the eleven low and middlle income countries in our study over the period we examine, it is also possible that these two effects can cancel out each other and result in no change in the average markups of exporters in many other cases. In this vein, our framework provides a natural theoretical explanation for the lack of markup adjustments by Chinese exporters during the US-China Trade War (see e.g., Amiti, Redding and Weinstein (2019), Fajgelbaum, Goldberg, Kennedy and Khandelwal (2020), Cavallo, Gopinath, Neiman and Tang (2021)).

Empirically, this paper introduces a new methodology for examining whether preferential trade agreements (PTAs) and their detailed provisions lead to more intense competition and less market power for firms. We show how firm-level exports from multiple countries can be used to assess both the direct and indirect third-country impacts of preferential trade agreements, tariffs, and trade agreement provisions while controlling for multilateral resistance at the product level in both the origin and destination. Most interestingly, we find evidence of a pro-competitive effect of PTAs arising from reductions in foreign exporters' markups. A firm's product-level price and markup in a destination tend to decline when its origin country participates in a PTA with a destination. We also find that substantive commitments that prohibit or regulate anticompetitive behaviours are associated with more trade and lower markups.[27]

[27] A recent paper by Grossman, McCalman and Staiger (2021) finds that detailed regulatory commitments are required to achieve efficiency in a trade agreement featuring a local consumer tastes vary considerably. Our empirical finding is that a broad regulatory to support competition is pro-competitive.

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A Data Appendix

A.1 Product-Level Imports

To calculate the trade shares which feature in our main independent variables of interest – competitors' PTA, competitors' average tariff, and competitors' access to a specific DTA provision– we use import data at the HS06 level, reported inclusive of cost, insurance and freight, for the years 1999-2012 from UN Comtrade.

A.2 Trade Agreements

Our data on trade agreements comes from the new World Bank Deep Trade Agreements (WB DTA) Database, which contains detailed information on various disaggregated provisions in 257 agreements which entered into force between 1958 and 2015. We focus on four provisions in particular. The first two provisions are related to rules of origin (ROO) and respectively encode whether i) certificates can be issued by the exporter/importer without the need for authentication by a competent (government) authority and ii) certificates have to be issued by competent (government) authorities of the exporting party.[28] The second two provisions are about technical barriers to trade and specify whether the agreement contains i) mutual recognition of standards and ii) mutual recognition of conformity assessment.[29]

A.3 Tariffs

Our data on bilateral ad-valorem tariffs is constructed from data on preferential and applied most favoured nation (MFN) tariffs available on the WTO website.[30] Where destinations report preferential tariffs, we set our bilateral tariff variable equal to the lowest reported

[28]Trade agreement provisions related to rules of origin are found in Chapter 8 of the WB DTA Database. We refer to the first ROO provision as self-certification by the exporting firm. This is a binary variable coded as 1 when the answer to the following question about the PTA is yes. "Can the [origin] certificate be issued on the basis of self-certification by the exporter / producer / importer without need for authentication by the competent authority?" The second ROO provision we study is one indicating that origin certifications must by issued by a government or other designated authority. It is coded as 1 when the answer to the following question is yes. "Does the certificate have to be issued by competent authorities of the exporting party, including customs administrations, other government authorities, and designated private ones?"

[29]Trade agreement provisions related to trade facilitation through mutual recognition are found in Chapter 11 of the WB DTA Database. The first mutual recognition provision is a binary variable coded as 1 when the answer to the following question about the PTA is yes. "Standards: - Is mutual recognition in force?" The second mutual recognition provision is a binary variable equal to 1 when the answer to the following question is yes. "Conformity Assessment - Is mutual recognition in force? "

[30]Preferential and applied MFN tariffs are available for 138 and 165 of the 250 importers in our sample, respectively.

preferential tariff a destination offers to exporters from a given origin. Otherwise, we use data on the MFN tariff applied by the destination.[31]

In many cases, countries do not report their tariff schedules to the WTO every year. Whenever possible, we attempt to impute missing values, following the steps set out in 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, which are frequently phased-in after an agreement is negotiated, we attempt to replace missing values with information we extract from the data collected by Feenstra and Romalis (2014).

A.4 Classification of Product Differentiation

Our analysis of markups and pricing-to-market responses is predicated on the idea that some firms hold significant market power in at least some products traded internationally. In prior work (Corsetti, Crowley, Han and Song (2019)), we document that market power and pricing-to-market vary systematically across different types of globally traded products. To investigate the competitive effects of trade policy for different types of products, we employ the CCHS commodity classification system to determine the degree of product differentiation. Our empirical analysis begins with the universe of traded goods. We then restrict our analysis to a sample of highly differentiated goods to determine if the sales values, prices or markups of products in which firms presumably hold more market power respond differently to trade policy changes.[32]

The CCHS classification sorts products into two distinct groups, high and low differentiation goods, according to a linguistic feature of the Chinese language that is present in China's quantification of export volumes in customs declarations. The core idea is a simple one: traded goods whose quantity is recorded in customs data in countable units are more differentiated than goods whose quantity is recorded by weight or volume (e.g., motorcycles and consumer electronics are more differentiated than canned tomato paste or industrial chemicals). In Chinese trade data, we find quantity reported in more than 30 indigenous

[31] We have data on bilateral tariffs for 26,283,633 of the 27,549,039 observations in our final dataset.

[32] 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—high and low differentiation. Corsetti, Crowley, Han and Song (2019) 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.

Chinese units of measure, including distinct words representing the unit count of wheeled vehicles, engines, upper-body clothing articles, etc. Because the choice of the *measure word* used to record a product's quantity is predetermined by Chinese grammar and linguistics, it reflects a good's intrinsic physical features, and pre-dates modern customs systems of recording quantity. By exploiting the distinction between what linguists refer to as count versus mass measure words, we are able to construct a general product classification for the Harmonized System.[33]

A.5 Broad Economic Categories

To partition the product space even further we use the fourth revision of the UN's Broad Economic Categories (BEC) classification, which categorises all internationally traded goods according to their end-use, to distinguish between intermediate and consumption goods. This is particularly useful because it enables us to examine the differential impacts of PTAs on trade values, markups and, indirectly, competition across these two types of goods, allowing us to investigate the effect which PTAs have on global value chains.

A.6 HS Product Classification

Our firm- and product-level trade, tariff and commodity classification data are reported based on the HS product classification system. As our data span a large number of years and the HS system is updated periodically, our data feature five different revisions of the HS system (HS1992, HS1996, HS2002, HS2007 and HS2012). To ensure that the product codes in our analysis are consistent over time, we follow Cebeci (2015) and consolidate HS codes, by identifying networks of related product codes in the HS system and assigning a unique consolidated code to each network. This reduces the number of distinct products in the HS system from 6,293 to 4,039.

A.7 Construction of Empirical Measures

To create measures of competitors' policy changes, we first multiply the trade share of each of the origin's competitors in the destination in the previous period with the bilateral tariff τ_{icdt} or an indicator for whether this competitor and the destination currently have an active trade agreement PTA_{cdt}. We then sum across these countries to find the trade weighted share of countries, excluding the origin. To turn this into the proportion of the origin's competitors

[33]See Corsetti, Crowley, Han and Song (2019) for a more extensive discussion of measure words and evidence of how they are used in other East Asian customs recording systems.

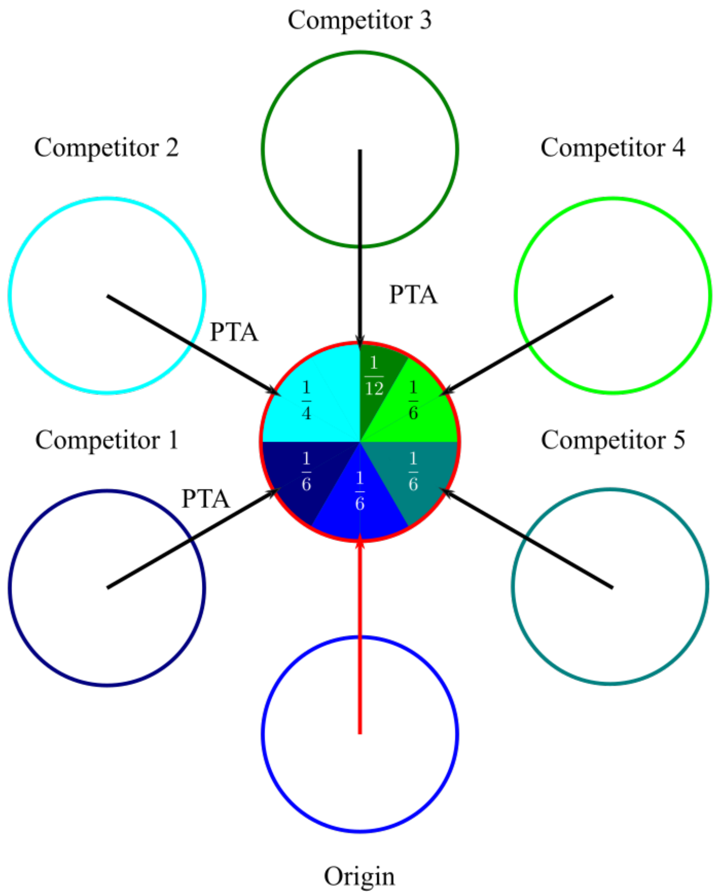
who benefit from preferential treatment, we normalise by dividing by the total trade share of the origin's competitors in the destination in the previous period. Table A6 provides a formal definition and figures A5 and A6 illustrates the construction of the measures in two stylized examples.

As we use product level trade shares in these calculations, the constructed measures vary across products as well as across country pairs and time. This means that Competitors' Avg $\text{PTA}_{i(-o)dt}$ can take different values for different products within a given origin-destination country pair and year, provided there is variation in the product-level trade shares of the origin's competitors in the destination in the previous year. Notice that unlike the PTA variable, there should be no endogeneity concerns surrounding the competitor PTA variable so long as policymakers only consider direct bilateral trade flows with their PTA partners when deciding whether or not to sign a PTA.

As a robustness check, we also constructed competitor variables using the product-level import shares of competitor countries averaged over years $t-1$ to $t-3$ and obtain similar estimation results.

Table A6: Variable Definitions

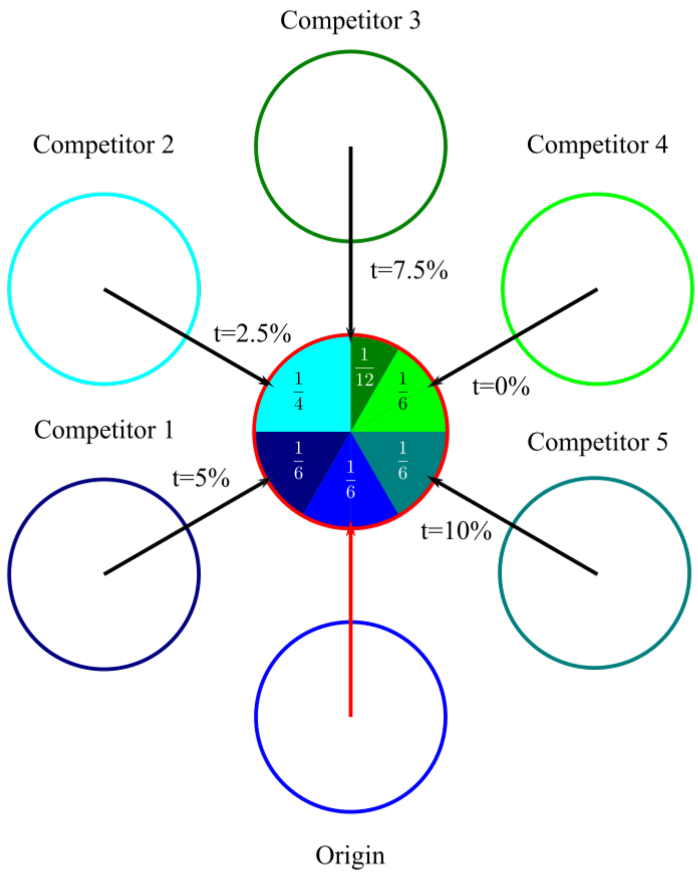
Variable	Definition
Competitors' Avg $\text{Tariff}_{i(-o)dt}$	$\ln\left(1+\frac{\sum_{c\in\mathcal{H}\neq o}\tau_{icdt}\times trade\_share_{cdit-1}}{\sum_{c\in\mathcal{H}\neq o} trade\_share_{icdt-1}}\right)$ past trade share weighted average tariff faced by competitors c in destination d and product i at time t
Competitors' Avg $\text{PTA}_{i(-o)dt}$	$\frac{\sum_{c\in\mathcal{H}\neq o}\text{PTA}_{cdt}\times trade\_share_{icdt-1}}{\sum_{c\in\mathcal{H}\neq o} trade\_share_{icdt-1}}$ past trade share weighted proportion of competitors c in product i with access to a trade agreement with destination d at time t



$$\text{Competitors' Avg PTA}_{i(-o)dt} = \frac{\frac{1}{6}*1+\frac{1}{4}*1+\frac{1}{12}*1+\frac{1}{5}*1+\frac{1}{6}*0}{\frac{1}{6}+\frac{1}{4}+\frac{1}{12}+\frac{1}{6}+\frac{1}{6}} = 0.6$$

Figure A5: Calculating the Proportion of Competitors with Access to a PTA

Note: This figure illustrates how we calculate the variable Competitors' Avg $\text{PTA}_{i(-o)dt}$, which captures the effect of competitors' trade agreements on trade flows. Consider a scenario in which our origin country of interest, the deep blue circle at the bottom, competes with five other countries, the five other blue and green circles on the sides, to sell a given product in a destination, the red circle in the centre. Suppose that the previous year's $(t-1)$ trade shares of the six exporting countries are given by the numbers in the figure. We start by multiplying each of the five competitors' trade shares in the previous year with an indicator for whether this competitor currently has access to a PTA with the destination and then adding these terms together. This is shown in the numerator of the equation at the bottom of the figure. To avoid creating a mechanical relationship between our variable and the origin's trade share, we further normalize by dividing by the total trade share of all five competitors in the previous year. This is the rationale behind the denominator. In this example, our calculations reveal that 60% of the origin country's competitors in the product we are considering have access to a PTA with the destination.



$$\text{Competitors' Avg Tariff}_{i(-o)dt} = \ln\left(1 + \frac{\frac{1}{6} * 5\% + \frac{1}{4} * 2.5\% + \frac{1}{12} * 7.5\% + \frac{1}{6} * 0\% + \frac{1}{6} * 10\%}{\frac{1}{6} + \frac{1}{4} + \frac{1}{12} + \frac{1}{6} + \frac{1}{6}}\right) \approx 0.045$$

Figure A6: Calculating the Average Tariff Faced by Competitors

Note: This figure illustrates how we calculate the variable Competitors' Avg $\text{Tariff}_{i(-o)dt}$, which captures the effect of the average tariff faced by a country's competitors on trade flows. The calculation in this graph is almost identical to that presented in figure A5, with the exception that we use bilateral tariff rates rather than PTA status indicators to construct this variable. As before, the blue circle at the bottom represent an origin country which is competing with five other countries, the remaining blue and green circles, to sell a given product in a destination, the red circle in the centre. The numbers in the centre red circle again indicate the trade shares of these countries in the previous year $(t-1)$. We start by multiplying each of the five competitors' trade shares in the previous year with the bilateral tariff they currently face in the destination and then adding these terms together. This is shown in the numerator of the equation at the bottom of the figure. To avoid creating a mechanical relationship between our variable and the origin's trade share, we further normalize by dividing by the total trade share of all five competitors in the previous year. This is the rationale behind the denominator. In this example, our calculations reveal that the origin country's competitors face an average tariff of 4.5% in the product we are considering.

B Additional Model Results

B.1 Deriving the demand elasticity under our triple-nested CES demand framework

Upon entry, the operational profit of the firm is given by

$$\begin{aligned}\pi^{operational}_{fiodt} &= \left(\frac{p_{fiodt}}{\tau_{odt}} - mc_{fiot}\right) y_{fiodt} \\ &= \left(\frac{p_{fiodt}}{\tau_{odt}} - mc_{fiot}\right) \alpha_{fiodt} p^{-\sigma}_{fiodt} (p_{iodt})^{\sigma-\rho} (p_{idt})^{\rho-\eta} P^{\eta}_{dt} Y_{dt}\end{aligned}$$

Maximizing profits with respect to p_{fiodt}, yields the first order condition which can be rearranged to get:

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

Define the price elasticity of demand as

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

For a given ε_{fiodt}, the optimal price can be easily derived and is given by (5). The tricky part, however, is to calculate the demand elasticity ε_{fiodt}, which can be expressed as

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

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

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

$$\begin{aligned}\frac{\partial \left[p^{-\sigma}_{fiodt} (p_{iodt})^{\sigma-\rho}\right]}{\partial p_{fiodt}} &= -\sigma (p_{fiodt})^{-\sigma-1} (p_{iodt})^{\sigma-\rho} + p^{-\sigma}_{fiodt} \frac{\partial \left[(p_{iodt})^{\sigma-\rho}\right]}{\partial p_{fiodt}} \\ &= -\sigma (p_{fiodt})^{-\sigma-1} (p_{iodt})^{\sigma-\rho} + p^{-\sigma}_{fiodt} \frac{\partial \left[(p_{iodt})^{\sigma-\rho}\right]}{\partial p_{fiodt}} \\ &= -\sigma (p_{fiodt})^{-\sigma-1} (p_{iodt})^{\sigma-\rho} + (\sigma-\rho) \alpha_{fiodt} p^{-2\sigma}_{fiodt} (p_{iodt})^{2\sigma-\rho-1}\end{aligned}$$

$$\frac{\partial\left[(p_{iodt})^{\sigma-\rho}\right]}{\partial p_{fiodt}} = \frac{\partial\left(\sum_{f\in\mathcal{F}_{iodt}}\alpha_{fiodt}p_{fiodt}^{1-\sigma}\right)^{\frac{\sigma-\rho}{1-\sigma}}}{\partial p_{fiodt}}$$
$$=(\sigma-\rho)\alpha_{fiodt}p_{fiodt}^{-\sigma}\left(\sum_{f\in\mathcal{F}_{iodt}}\alpha_{fiodt}p_{fiodt}^{1-\sigma}\right)^{\frac{\sigma-\rho}{1-\sigma}-1}$$
$$=(\sigma-\rho)\alpha_{fiodt}p_{fiodt}^{-\sigma}(p_{iodt})^{2\sigma-\rho-1}$$

$$\frac{\partial\left[(p_{idt})^{\rho-\eta}\right]}{\partial p_{fiodt}} = \frac{\partial\left[\left(\sum_{o\in\mathcal{H}}p_{iodt}^{1-\rho}\right)^{\frac{\rho-\eta}{1-\rho}}\right]}{\partial p_{fiodt}}$$
$$=\frac{\partial\left[\left(\sum_{o\in\mathcal{H}}p_{iodt}^{1-\rho}\right)^{\frac{\rho-\eta}{1-\rho}}\right]}{\partial p_{iodt}}\frac{\partial p_{iodt}}{\partial p_{fiodt}}$$
$$=(\rho-\eta)p_{iodt}^{-\rho}(p_{idt})^{2\rho-\eta-1}\cdot\alpha_{fiodt}p_{fiodt}^{-\sigma}(p_{iodt})^{\sigma}$$
$$=\alpha_{fiodt}(\rho-\eta)p_{fiodt}^{-\sigma}(p_{iodt})^{\sigma-\rho}(p_{idt})^{2\rho-\eta-1}$$

$$\frac{\partial\left[p_{fiodt}^{-\sigma}(p_{iodt})^{\sigma-\rho}(p_{idt})^{\rho-\eta}\right]}{\partial p_{fiodt}} = \frac{\partial\left[p_{fiodt}^{-\sigma}(p_{iodt})^{\sigma-\rho}\right]}{\partial p_{fiodt}}(p_{idt})^{\rho-\eta} + p_{fiodt}^{-\sigma}(p_{iodt})^{\sigma-\rho}\frac{\partial\left[(p_{idt})^{\rho-\eta}\right]}{\partial p_{fiodt}}$$
$$= -\sigma(p_{fiodt})^{-\sigma-1}(p_{iodt})^{\sigma-\rho}(p_{idt})^{\rho-\eta} + (\sigma-\rho)\alpha_{fiodt}p_{fiodt}^{-2\sigma}(p_{iodt})^{2\sigma-\rho-1}(p_{idt})^{\rho-\eta}$$
$$+\alpha_{fiodt}(\rho-\eta)p_{fiodt}^{-2\sigma}(p_{iodt})^{2\sigma-2\rho}(p_{idt})^{2\rho-\eta-1}$$
$$= -p_{fiodt}^{-\sigma-1}(p_{iodt})^{\sigma-\rho}(p_{idt})^{\rho-\eta}\left[\sigma-(\sigma-\rho)ms_{fiodt}-(\rho-\eta)ms_{fiodt}ms_{iodt}\right]$$

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

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

B.2 GE conditions

The competitive equilibrium is characterized as follows. Firms in each country make decisions on whether to sell in each country and set prices to optimize their profits given their marginal cost. Goods and labour markets clear:

Goods market clearing:

$$y_{fiodt} = A_{fiot} L_{fiodt} \quad \forall f, i, o \in \mathcal{H}, d \in \mathcal{H}, t \tag{13}$$

Labor market clearing:

$$\sum_i \sum_{d \in \mathcal{H}} \sum_f L_{fiodt} + L_{ot}^{\zeta_x} + L_{ot}^{\zeta_d} = \overline{L}_{ot} \quad \forall o \in \mathcal{H}, t \tag{14}$$

Balance of trade:

$$\sum_i \sum_{o \in \mathcal{H} \& o \neq h} \sum_f p_{fioht} y_{fioht} / \tau_{ioht} = \sum_i \sum_{d \in \mathcal{H} \& d \neq h} \sum_f p_{fihdt} y_{fihdt} / \tau_{ihdt} \quad \forall h \in \mathcal{H}, t \tag{15}$$

B.3 Aggregation and welfare

Let A_{ot} denote the aggregate productivity of country o at time t. The total production of country o at time t is given by

$$\widetilde{Y}_{ot} \equiv \sum_i \sum_{d \in \mathcal{H}} \sum_f y_{fiodt} = \sum_i \sum_{d \in \mathcal{H}} \sum_f A_{fiot} L_{fiodt} = A_{ot} L_{ot}$$

where $L_{ot} \equiv \sum_i \sum_{d \in \mathcal{H}} \sum_f L_{fiodt}$, and A_{ot} is the aggregate productivity of country o at time t, which is a quantity weighted harmonic mean of firm productivities as in Edmond, Midrigan and Xu (2015):

$$A_{ot} = \left[\sum_i \sum_{d \in \mathcal{H}} \sum_f \left(\frac{1}{A_{fiot}} \right) \frac{y_{fiodt}}{\widetilde{Y}_{ot}} \right]^{-1} \tag{16}$$

Define aggregate markup as

$$\mu_{ot} \equiv \frac{P_{ot}}{W_{ot} / A_{ot}} \tag{17}$$

It is straightforward to show that the aggregate markup is a revenue-weighted harmonic mean of firm markups:

$$\mu_{ot} = \left[\sum_i \sum_{d \in \mathcal{H}} \sum_f \left(\frac{1}{\mu_{fiodt}} \right) \frac{p_{fiodt} y_{fiodt}}{\tau_{odt} P_{dt} Y_{dt}} \frac{P_{dt} Y_{dt}}{P_{ot} Y_{ot}} \frac{Y_{ot}}{\widetilde{Y}_{ot}} \right]^{-1} \tag{18}$$

The aggregate productivity – the welfare measure of the model – can be decomposed as follows:

$$A_{ot} = \left[\sum_i (A_{iot})^{\eta-1} \left(\frac{\mu_{iot}}{\mu_{ot}} \right)^{-\eta} \frac{\widetilde{Y}_{iot}}{Y_{iot}} \frac{Y_{ot}}{\widetilde{Y}_{ot}} \right]^{\frac{1}{\eta-1}}, \tag{19}$$

$$A_{iot} = \left[\sum_{d\in\mathcal{H}} (A_{iodt})^{\rho-1} \left(\frac{\mu_{iodt}}{\mu_{iot}} \right)^{-\rho} \left(\frac{P_{iot}}{P_{idt}} \right)^{-\rho} \frac{Y_{idt}}{Y_{iot}} \frac{\widetilde{Y}_{iodt}}{Y_{iodt}} \frac{Y_{iot}}{\widetilde{Y}_{iot}} \right]^{\frac{1}{\rho-1}}, \tag{20}$$

$$A_{iodt} = \left[\sum_f \alpha_{fiodt} (A_{fiot})^{\sigma-1} (\tau_{odt})^{-\sigma} \left(\frac{\mu_{fiodt}}{\mu_{iodt}} \right)^{-\sigma} \frac{Y_{iodt}}{\widetilde{Y}_{iodt}} \right]^{\frac{1}{\sigma-1}} \tag{21}$$

where

$$\mu_{fiodt} \equiv \frac{p_{fiodt}}{\tau_{odt} W_{ot}/A_{fiot}} = \frac{\varepsilon_{fiodt}}{\varepsilon_{fiodt}-1}, \quad \mu_{iodt} \equiv \frac{P_{iodt}}{W_{ot}/A_{iodt}}, \quad \mu_{iot} \equiv \frac{P_{iot}}{W_{ot}/A_{iot}} \tag{22}$$

B.3.1 Derivations

The product-origin-destination level total output $\widetilde{Y}_{iodt}$ can be written as:

$$\widetilde{Y}_{iodt} \equiv \sum_f y_{fiodt} = \sum_f A_{fiot} L_{fiodt} = A_{iodt} L_{iodt} \tag{23}$$

where

$$A_{iodt} \equiv \left[\sum_f \left(\frac{1}{A_{fiot}} \right) \frac{y_{fiodt}}{\widetilde{Y}_{iodt}} \right]^{-1}, \qquad L_{iodt} \equiv \sum_f L_{fiodt} \tag{24}$$

The industry level total output $\widetilde{Y}_{iot}$ can be written as:

$$\widetilde{Y}_{iot} \equiv \sum_{d\in\mathcal{H}} \sum_f y_{fiodt} = \sum_{d\in\mathcal{H}} \sum_f A_{fiodt} L_{fiodt} = \sum_{d\in\mathcal{H}} A_{iodt} L_{iodt} = A_{iot} L_{iot} \tag{25}$$

where

$$A_{iot} \equiv \left[\sum_{d\in\mathcal{H}} \left(\frac{1}{A_{iodt}} \right) \frac{\widetilde{Y}_{iodt}}{\widetilde{Y}_{iot}} \right]^{-1}, \qquad L_{iot} \equiv \sum_{d\in\mathcal{H}} L_{iodt} \tag{26}$$

The country level total output $\widetilde{Y}_{ot}$ can be written as:

$$\widetilde{Y}_{ot} \equiv \sum_i \sum_{d\in\mathcal{H}} \sum_f y_{fiodt} = \sum_i \sum_{d\in\mathcal{H}} A_{iodt} L_{iodt} = \sum_i A_{iot} L_{iot} = A_{iot} L_{iot} \tag{27}$$

where

$$A_{ot} \equiv \left[\sum_i \left(\frac{1}{A_{iot}} \right) \frac{\widetilde{Y}_{iot}}{\widetilde{Y}_{ot}} \right]^{-1}, \qquad L_{ot} \equiv \sum_i L_{iot} \tag{28}$$

B.3.2 Decomposition of aggregate productivity measures

$$\begin{aligned}
A_{ot} &= \left[\sum_i \left(\frac{1}{A_{iot}} \right) \frac{\widetilde{Y}_{iot}}{\widetilde{Y}_{ot}} \right]^{-1} = \left[\sum_i \left(\frac{1}{A_{iot}} \right) \left(\frac{Y_{iot}}{Y_{ot}} \right) \frac{\widetilde{Y}_{iot}}{Y_{iot}} \frac{Y_{ot}}{\widetilde{Y}_{ot}} \right]^{-1} \\
&= \left[\sum_i \left(\frac{1}{A_{iot}} \right) \left(\frac{P_{iot}}{P_{ot}} \right)^{-\eta} \frac{\widetilde{Y}_{iot}}{Y_{iot}} \frac{Y_{ot}}{\widetilde{Y}_{ot}} \right]^{-1} = \left[\sum_i \left(\frac{1}{A_{iot}} \right) \left(\frac{\mu_{iot} W_{ot}}{A_{iot} P_{ot}} \right)^{-\eta} \frac{\widetilde{Y}_{iot}}{Y_{iot}} \frac{Y_{ot}}{\widetilde{Y}_{ot}} \right]^{-1} \\
&= \left[\sum_i (A_{iot})^{\eta-1} \left(\frac{\mu_{iot}}{\mu_{ot}} A_{ot} \right)^{-\eta} \frac{\widetilde{Y}_{iot}}{Y_{iot}} \frac{Y_{ot}}{\widetilde{Y}_{ot}} \right]^{-1} = \left[\sum_i (A_{iot})^{\eta-1} \left(\frac{\mu_{iot}}{\mu_{ot}} \right)^{-\eta} \frac{\widetilde{Y}_{iot}}{Y_{iot}} \frac{Y_{ot}}{\widetilde{Y}_{ot}} \right]^{\frac{1}{\eta-1}}
\end{aligned} \tag{29}$$

$$\begin{aligned}
A_{iot} &= \left[\sum_{d \in \mathcal{H}} \left(\frac{1}{A_{iodt}} \right) \frac{\widetilde{Y}_{iodt}}{\widetilde{Y}_{iot}} \right]^{-1} \\
&= \left[\sum_{d \in \mathcal{H}} \left(\frac{1}{A_{iodt}} \right) \left(\frac{Y_{iodt}}{Y_{idt}} \right) \frac{Y_{idt}}{Y_{iot}} \frac{\widetilde{Y}_{iodt}}{Y_{iodt}} \frac{Y_{iot}}{\widetilde{Y}_{iot}} \right]^{-1} \\
&= \left[\sum_{d \in \mathcal{H}} \left(\frac{1}{A_{iodt}} \right) \left(\frac{P_{iodt}}{P_{idt}} \right)^{-\rho} \frac{Y_{idt}}{Y_{iot}} \frac{\widetilde{Y}_{iodt}}{Y_{iodt}} \frac{Y_{iot}}{\widetilde{Y}_{iot}} \right]^{-1} \\
&= \left[\sum_{d \in \mathcal{H}} \left(\frac{1}{A_{iodt}} \right) \left(\frac{\mu_{iodt} W_{ot}}{A_{iodt} P_{idt}} \right)^{-\rho} \frac{Y_{idt}}{Y_{iot}} \frac{\widetilde{Y}_{iodt}}{Y_{iodt}} \frac{Y_{iot}}{\widetilde{Y}_{iot}} \right]^{-1} \\
&= \left[\sum_{d \in \mathcal{H}} \left(\frac{1}{A_{iodt}} \right) \left(\frac{\mu_{iodt} W_{ot}}{A_{iodt} P_{iot}} \right)^{-\rho} \left(\frac{P_{iot}}{P_{idt}} \right)^{-\rho} \frac{Y_{idt}}{Y_{iot}} \frac{\widetilde{Y}_{iodt}}{Y_{iodt}} \frac{Y_{iot}}{\widetilde{Y}_{iot}} \right]^{-1} \\
&= \left[\sum_{d \in \mathcal{H}} (A_{iodt})^{\rho-1} \left(\frac{\mu_{iodt}}{\mu_{iot}} A_{iot} \right)^{-\rho} \left(\frac{P_{iot}}{P_{idt}} \right)^{-\rho} \frac{Y_{idt}}{Y_{iot}} \frac{\widetilde{Y}_{iodt}}{Y_{iodt}} \frac{Y_{iot}}{\widetilde{Y}_{iot}} \right]^{-1} \\
&= \left[\sum_{d \in \mathcal{H}} (A_{iodt})^{\rho-1} \left(\frac{\mu_{iodt}}{\mu_{iot}} \right)^{-\rho} \left(\frac{P_{iot}}{P_{idt}} \right)^{-\rho} \frac{Y_{idt}}{Y_{iot}} \frac{\widetilde{Y}_{iodt}}{Y_{iodt}} \frac{Y_{iot}}{\widetilde{Y}_{iot}} \right]^{\frac{1}{\rho-1}}
\end{aligned} \tag{30}$$

$$
\begin{aligned}
A_{iodt} &= \left[\sum_f \left(\frac{1}{A_{fiot}}\right)\frac{y_{fiodt}}{\widetilde{Y}_{iodt}}\right]^{-1} \\
&= \left[\sum_f \left(\frac{1}{A_{fiot}}\right)\left(\frac{y_{fiodt}}{Y_{iodt}}\right)\frac{Y_{iodt}}{\widetilde{Y}_{iodt}}\right]^{-1} \\
&= \left[\sum_f \alpha_{fiodt}\left(\frac{1}{A_{fiot}}\right)\left(\frac{p_{fiodt}}{P_{iodt}}\right)^{-\sigma}\frac{Y_{iodt}}{\widetilde{Y}_{iodt}}\right]^{-1} \\
&= \left[\sum_f \alpha_{fiodt}\left(\frac{1}{A_{fiot}}\right)\left(\frac{\mu_{fiodt}\tau_{odt}W_{ot}}{A_{fiot}P_{iodt}}\right)^{-\sigma}\frac{Y_{iodt}}{\widetilde{Y}_{iodt}}\right]^{-1} \\
&= \left[\sum_f \alpha_{fiodt}\left(A_{fiot}\right)^{\sigma-1}\left(\frac{\mu_{fiodt}}{\mu_{iodt}}\tau_{odt}A_{iodt}\right)^{-\sigma}\frac{Y_{iodt}}{\widetilde{Y}_{iodt}}\right]^{-1} \\
&= \left[\sum_f \alpha_{fiodt}\left(A_{fiot}\right)^{\sigma-1}\left(\tau_{odt}\right)^{-\sigma}\left(\frac{\mu_{fiodt}}{\mu_{iodt}}\right)^{-\sigma}\frac{Y_{iodt}}{\widetilde{Y}_{iodt}}\right]^{\frac{1}{\sigma-1}}
\end{aligned} \tag{31}
$$

$$
\begin{aligned}
\mu_{ot} = \frac{P_{ot}}{W_{ot}}A_{ot} &= \left[\sum_i\sum_{d\in\mathcal{H}}\sum_f \left(\frac{1}{A_{fiot}}\right)\frac{W_{ot}y_{fiodt}}{P_{ot}Y_{ot}}\frac{Y_{ot}}{\widetilde{Y}_{ot}}\right]^{-1} \\
&= \left[\sum_i\sum_{d\in\mathcal{H}}\sum_f \left(\frac{1}{\mu_{fiodt}}\right)\frac{p_{fiodt}y_{fiodt}}{\tau_{odt}P_{ot}Y_{ot}}\frac{Y_{ot}}{\widetilde{Y}_{ot}}\right]^{-1} \\
&= \left[\sum_i\sum_{d\in\mathcal{H}}\sum_f \left(\frac{1}{\mu_{fiodt}}\right)\frac{p_{fiodt}y_{fiodt}}{\tau_{odt}P_{dt}Y_{dt}}\frac{P_{dt}Y_{dt}}{P_{ot}Y_{ot}}\frac{Y_{ot}}{\widetilde{Y}_{ot}}\right]^{-1}
\end{aligned} \tag{32}
$$

C Results Appendix

C.1 Standard Errors Clustered at Firm Level

Table C7: Impacts of preferential trade agreements on firms' outcomes

	Values	No. of Firms (PPML)	Firm's MS ms_{fiodt}	Origin's MS ms_{iodt}	Prices	Markups
	(1)	(2)	(3)	(4)	(5)	(6)
All Goods						
PTA_{odt}	0.01	0.00	0.01	0.03	-0.03*	-0.02
	(0.047)	(0.009)	(0.029)	(0.042)	(0.016)	(0.015)
$Tariff_{iodt}$	-1.78***	-2.20***	2.85***	-3.29***	0.48***	0.40**
	(0.451)	(0.162)	(0.322)	(0.269)	(0.164)	(0.169)
Observations	15,853,618	2,750,833	15,853,618	1,067,240	15,793,386	15,793,386
All Goods						
PTA_{odt}	-0.00	0.02**	0.00	0.06	-0.03*	-0.03
	(0.053)	(0.010)	(0.030)	(0.042)	(0.017)	(0.017)
$Tariff_{iodt}$	-1.49***	-1.91***	2.55***	-2.68***	0.46***	0.37**
	(0.389)	(0.161)	(0.339)	(0.259)	(0.151)	(0.152)
Competitors' Avg $PTA_{i(-o)dt}$	-0.18*	0.21***	-0.06	0.39***	-0.05**	-0.05
	(0.107)	(0.041)	(0.112)	(0.065)	(0.026)	(0.029)
Competitors' Avg $Tariff_{i(-o)dt}$	3.29***	2.96***	-3.18**	9.47***	-0.06	-0.23
	(0.978)	(0.587)	(1.412)	(1.036)	(0.286)	(0.294)
Observations	14,918,948	2,600,069	14,918,948	1,031,516	14,860,585	14,860,585
Fixed Effects						
Firm-product-origin-year	✓		✓			✓
Firm					✓	
Product-origin-year		✓		✓	✓	
Product-destination-year	✓	✓	✓	✓	✓	✓
Origin-destination	✓	✓	✓	✓	✓	✓

Notes: The dependent variable is the number of firms in column (1), the log number of firms 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 share of the destination market in column (4) and the firm's log unit value in columns (5) and (6). In column (6) the inclusion of firm-origin-product-year fixed effects implies that results are for the markup. Significance: *** p<0.01, ** p<0.05, and * p<0.1 are based on standard errors clustered at the firm level for columns (1), (4), (5), (6) and at the destination-product level in columns (2) and (3), which are reported in parentheses. Data sources: eleven datasets of firms' exports from the World Bank Exporter Dynamics Database, China's Customs Authority, and Egypt's Customs Authority.

C.2 Changes in Prices by End-Use Category

Table C8: PTAs and Global Value Chains: Changes in Prices by End-Use Category

	All consumption goods (1)	All intermediate goods (2)	High-diff consumption goods (3)	Low-diff consumption goods (4)	High-diff intermediate goods (5)	Low-diff intermediate goods (6)
PTA_{odt}	0.00	-0.03**	-0.01	0.00	-0.00	-0.04***
	(0.011)	(0.013)	(0.015)	(0.015)	(0.043)	(0.014)
Tariff_{iodt}	0.82***	0.42***	1.08***	0.25**	1.02**	0.43***
	(0.089)	(0.132)	(0.109)	(0.124)	(0.411)	(0.134)
Competitors' Avg $\text{PTA}_{i(-o)dt}$	-0.03	0.02	-0.10***	0.01	0.18*	0.05
	(0.022)	(0.033)	(0.029)	(0.030)	(0.099)	(0.033)
Competitors' Avg $\text{Tariff}_{i(-o)dt}$	0.16	1.43***	-0.01	-0.81**	1.27	1.48***
	(0.299)	(0.536)	(0.368)	(0.411)	(1.860)	(0.545)
Observations	9,659,143	8,838,279	5,806,613	3,621,671	958,106	7,314,953
Fixed Effects						
Firm-origin-product-year	✓	✓	✓	✓	✓	✓
Product-destination-year	✓	✓	✓	✓	✓	✓
Origin-destination	✓	✓	✓	✓	✓	✓

Notes: The dependent variable is the log unit value at the firm-product-origin-destination-year level in all columns. Significance: *** p<0.01, ** p<0.05, and * p<0.1 are based on standard errors clustered at the destination-product level, which are reported in parentheses. Data sources: eleven datasets of firms' exports from the World Bank Exporter Dynamics Database, China's Customs Authority, and Egypt's Customs Authority.

C.3 Changes in Prices by End-Use Category (Quantity Sample)

Table C9: PTAs and Global Value Chains: Changes in Prices (Quantity Sample) by End-Use Category

	All consumption goods (1)	All intermediate goods (2)	High-diff consumption goods (3)	Low-diff consumption goods (4)	High-diff intermediate goods (5)	Low-diff intermediate goods (6)
PTA_{odt}	-0.03**	-0.04***	-0.05***	-0.01	-0.01	-0.04***
	(0.012)	(0.015)	(0.018)	(0.017)	(0.050)	(0.015)
$Tariff_{iodt}$	0.63***	0.24*	0.93***	0.04	0.77*	0.29**
	(0.100)	(0.135)	(0.127)	(0.142)	(0.446)	(0.135)
Competitors' Avg $PTA_{i(-o)dt}$	-0.05**	-0.02	-0.14***	0.01	-0.10	0.02
	(0.026)	(0.032)	(0.036)	(0.033)	(0.111)	(0.032)
Competitors' Avg $Tariff_{i(-o)dt}$	0.19	0.51	0.05	-0.63	-1.37	0.88*
	(0.318)	(0.423)	(0.391)	(0.440)	(2.133)	(0.475)
Observations	6,461,099	5,361,440	3,818,548	2,492,165	646,962	4,344,748
Fixed Effects						
Firm-origin-product-year	✓	✓	✓	✓	✓	✓
Product-destination-year	✓	✓	✓	✓	✓	✓
Origin-destination	✓	✓	✓	✓	✓	✓

Notes: The dependent variable is the log unit value at the firm-product-origin-destination-year level in all columns. Significance: *** p<0.01, ** p<0.05, and * p<0.1 are based on standard errors clustered at the destination-product level, which are reported in parentheses. Data sources: eleven datasets of firms' exports from the World Bank Exporter Dynamics Database, China's Customs Authority, and Egypt's Customs Authority.

C.4 Changes in Firms' MS by End-Use Category

Table C10: PTAs and Global Value Chains: Changes in Firms' MS by End-Use Category

	All consumption goods (1)	All intermediate goods (2)	High-diff consumption goods (3)	Low-diff consumption goods (4)	High-diff intermediate goods (5)	Low-diff intermediate goods (6)
PTA_{odt}	0.18***	-0.12***	0.26***	0.10*	-0.04	-0.10**
	(0.048)	(0.040)	(0.074)	(0.055)	(0.092)	(0.042)
$Tariff_{iodt}$	4.24***	0.72	4.64***	1.42***	-2.13	0.98
	(0.400)	(0.620)	(0.545)	(0.496)	(1.327)	(0.678)
Competitors' Avg $PTA_{i(-o)dt}$	-0.70***	0.50**	-0.85***	-0.50***	0.95**	0.41*
	(0.110)	(0.198)	(0.139)	(0.166)	(0.373)	(0.225)
Competitors' Avg $Tariff_{i(-o)dt}$	-1.62	-7.79**	-2.99**	-0.75	1.91	-7.49**
	(1.121)	(3.370)	(1.434)	(1.756)	(7.922)	(3.530)
Observations	6,464,985	5,402,467	3,819,386	2,495,142	651,378	4,380,373
Fixed Effects						
Firm-origin-product-year	✓	✓	✓	✓	✓	✓
Product-destination-year	✓	✓	✓	✓	✓	✓
Origin-destination	✓	✓	✓	✓	✓	✓

Notes: The dependent variable is the log of a firm's share in its country's exports of a given product to a given destination in all columns. Significance: *** p<0.01, ** p<0.05, and * p<0.1 are based on standard errors clustered at the destination-product level, which are reported in parentheses. Data sources: eleven datasets of firms' exports from the World Bank Exporter Dynamics Database, China's Customs Authority, and Egypt's Customs Authority.

C.5 Changes in Countries' MS by End-Use Category

Table C11: PTAs and Global Value Chains: Changes in Countries' MS by End-Use Category

	All consumption goods (1)	All intermediate goods (2)	High-diff consumption goods (3)	Low-diff consumption goods (4)	High-diff intermediate goods (5)	Low-diff intermediate goods (6)
PTA_{odt}	0.16***	0.02	0.08	0.22***	0.11	0.01
	(0.046)	(0.038)	(0.062)	(0.067)	(0.104)	(0.041)
Tariff_{iodt}	-2.49***	-1.74***	-2.70***	-1.15*	-0.41	-1.95***
	(0.404)	(0.472)	(0.434)	(0.686)	(1.251)	(0.504)
Competitors' Avg $\text{PTA}_{i(-o)dt}$	0.84***	-0.21	0.99***	0.60***	-0.11	-0.13
	(0.111)	(0.142)	(0.128)	(0.188)	(0.529)	(0.144)
Competitors' Avg $\text{Tariff}_{i(-o)dt}$	7.72***	10.08***	9.43***	5.93***	24.30***	9.09***
	(1.240)	(2.812)	(1.507)	(2.012)	(6.642)	(2.810)
Observations	365,212	505,277	181,706	178,209	55,321	433,363
Fixed Effects						
Firm-origin-product-year	✓	✓	✓	✓	✓	✓
Product-destination-year	✓	✓	✓	✓	✓	✓
Origin-destination	✓	✓	✓	✓	✓	✓

Notes: The dependent variable is the log of a county's market share of a given product in a given destination in all columns. Significance: *** p<0.01, ** p<0.05, and * p<0.1 are based on standard errors clustered at the destination-product level, which are reported in parentheses. Data sources: eleven datasets of firms' exports from the World Bank Exporter Dynamics Database, China's Customs Authority, and Egypt's Customs Authority.

C.6 Changes in the Number of Firms by End-Use Category

Table C12: PTAs and Global Value Chains: Changes in the Number of Firms by End-Use Category

	All consumption goods (1)	All intermediate goods (2)	High-diff consumption goods (3)	Low-diff consumption goods (4)	High-diff intermediate goods (5)	Low-diff intermediate goods (6)
PTA_{odt}	-0.02	0.03***	-0.04	0.02	0.02	0.03**
	(0.018)	(0.012)	(0.024)	(0.023)	(0.025)	(0.013)
Tariff_{iodt}	-2.85***	-1.02***	-2.69***	-1.53***	-0.22	-1.13***
	(0.222)	(0.244)	(0.227)	(0.347)	(0.495)	(0.263)
Competitors' Avg $\text{PTA}_{i(-o)dt}$	0.39***	0.05	0.63***	0.09	-0.14	0.12*
	(0.065)	(0.059)	(0.065)	(0.105)	(0.155)	(0.063)
Competitors' Avg $\text{Tariff}_{i(-o)dt}$	2.82***	3.80***	4.99***	0.29	3.64	3.10**
	(0.658)	(1.200)	(0.746)	(0.990)	(2.316)	(1.249)
Observations	877,599	1,306,771	429,438	435,389	135,993	1,133,701
Fixed Effects						
Firm-origin-product-year	✓	✓	✓	✓	✓	✓
Product-destination-year	✓	✓	✓	✓	✓	✓
Origin-destination	✓	✓	✓	✓	✓	✓

Notes: The dependent variable is the the number of firms that sell a given product from a given origin to a given destination in all columns. Significance: *** p<0.01, ** p<0.05, and * p<0.1 are based on standard errors clustered at the destination-product level, which are reported in parentheses. Data sources: eleven datasets of firms' exports from the World Bank Exporter Dynamics Database, China's Customs Authority, and Egypt's Customs Authority.

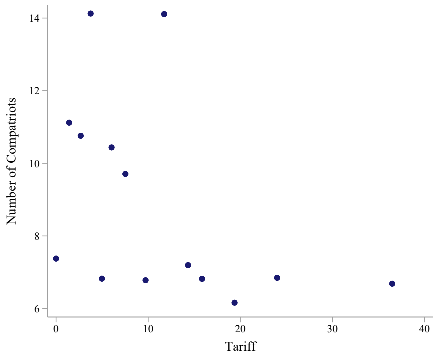
D Data Appendix

D.1 Correlations

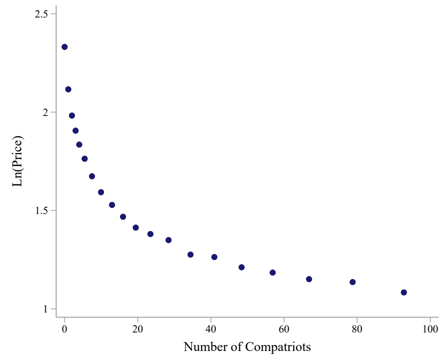
Figure D7: Correlations

(1) Number of Compatriots - Tariff | **(2) Ln(Price) - Number of Compatriots**

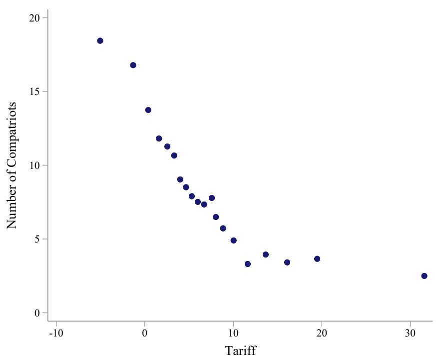
(a) No Fixed Effects



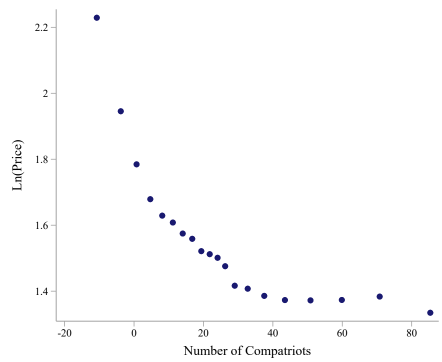
(b) No Fixed Effects



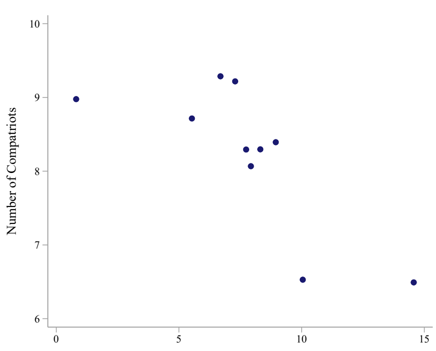
(c) Origin-Product-Time



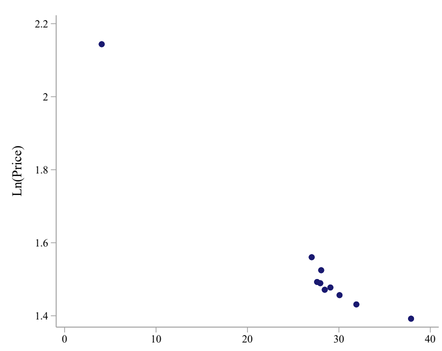
(d) Product Fixed Effects



(e) Origin-Destination-Product Fixed Effects



(f) Destination-Product-Time Fixed Effects



Notes: This figure plots the average number of compatriot firms, firms from the same origin o selling the same product i to the destination d at time t, by quantiles of the tariff distribution in column (1) and the average log trade unit value by quantiles of the number of compatriots in column (2). We consider tariffs between 0% and 100% in column (1) and numbers of compatriots between 0 and 100 in column (2), discarding the extreme right tail of these distributions in both cases. In panels (a) and (b), the figure shows this relationship without demeaning the data along any dimension. Panels (c) and (e) include origin-product-time and origin-destination-time fixed effects, and so effectively compare across destinations within origin-product-time and across years within an origin-destination-product, to account for the fact that our origin countries have vastly different sizes and the average number of compatriots will vary drastically by origin country. Panels (d) and (f) include product and destination-product-time fixed effects to account for the fact that trade unit values will vary substantially across products. In panel (f), the inclusion of destination-product-time fixed effects effectively means that we are holding the number of firms serving the destination d for product i at time t fixed and look at the average log trade unit value as the number of compatriot firms increases (and the number of firms from other origins decreases).

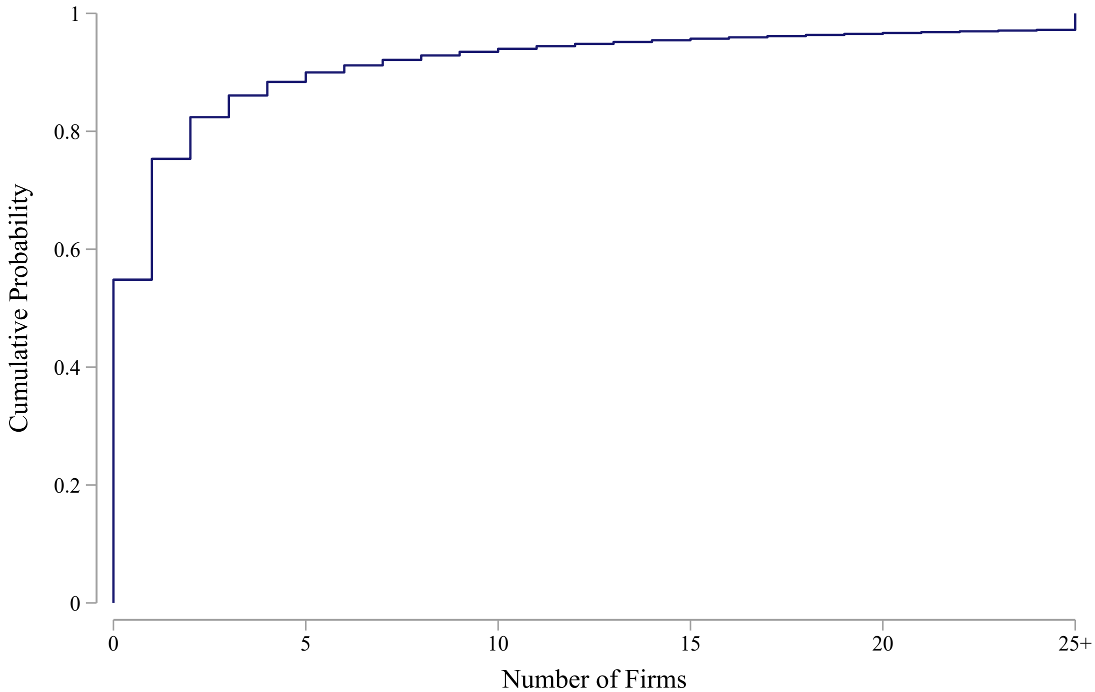
D.2 Number of Firms

Table D13: The Number of Exporters

	Mean	25th Percentile	Median	75th Percentile	Observations
Sample					
Number of Firms	8.89	1.00	2.00	5.00	2,956,796
Number of Entrants	5.10	0.00	1.00	3.00	2,956,796
Number of Exiters	3.61	0.00	0.00	2.00	2,956,796
Number of Incumbents	1.87	0.00	0.00	1.00	2,000,356
Augmented Sample					
Number of Firms	4.01	0.00	0.00	1.00	6,547,520
Number of Entrants	2.30	0.00	0.00	1.00	6,547,520
Number of Exiters	1.75	0.00	0.00	1.00	6,547,520
Number of Incumbents	0.78	0.00	0.00	0.00	4,820,554

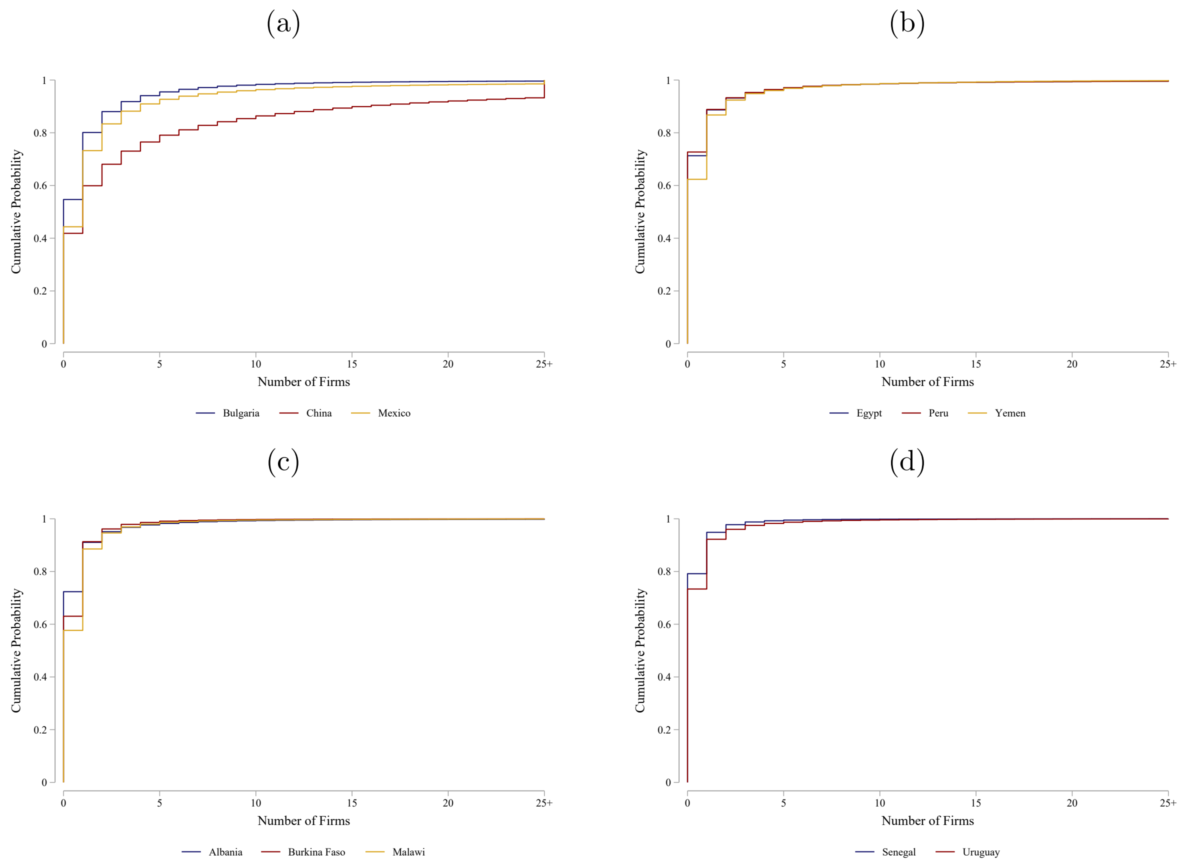
Notes: This tables presents summary statistics for i) the number of firms from an origin o selling product i to destination d at time t, ii) the number of firms that did not sell this product to that destination in period $t-1$ but do so in period t, iii) the number of firms that sell this product to that destination in period t but do not do so in period $t+1$ and iv) the number of firms that sell this product to that destination in periods $t-1$, t and $t+1$. We create a zero trade flow for year t whenever we see a firm f 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. The first panel presents statsitcs calculated for the sample excluding zero trade flows, the second for the sample including zero trade flows.

Figure D8: Cumulative Number of Firms



Notes: This figure plots the cumulative distribution function of the number of firms from an origin o selling product i to destination d at time t. We create a zero trade flow for year t whenever we see a firm f 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. To make the figure more legible, we truncate the distribution at 100.

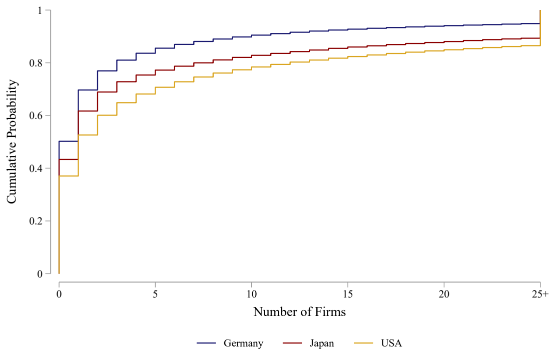
Figure D9: Cumulative Number of Firms by Origins



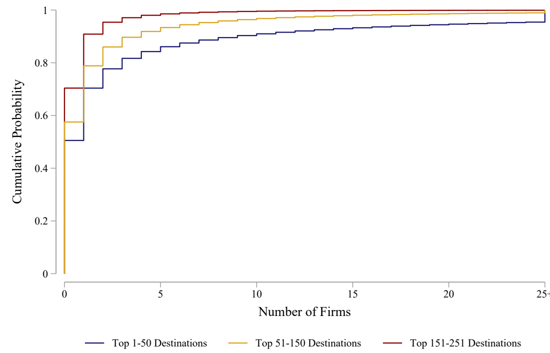
Notes: This figure plots the cumulative distribution function of the number of firms from an origin o selling product i to destination d at time t for the eleven origin countries in our sample. We create a zero trade flow for year t whenever we see a firm f exporting a product i from an origin o to a destination d in any year for which we observe o's exports but not in year t. To make the figure more legible, we truncate the distribution at 100.

Figure D10: Cumulative Number of Firms by Destinations

(a) Top 3 Destinations



(b) All Destinations



Notes: This figure plots the cumulative distribution function of the number of firms from an origin o selling product i to destination d at time t for different destination countries. We create a zero trade flow for year t whenever we see a firm f 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. To make the figure more legible, we truncate the distribution at 100.

D.3 Export Participation

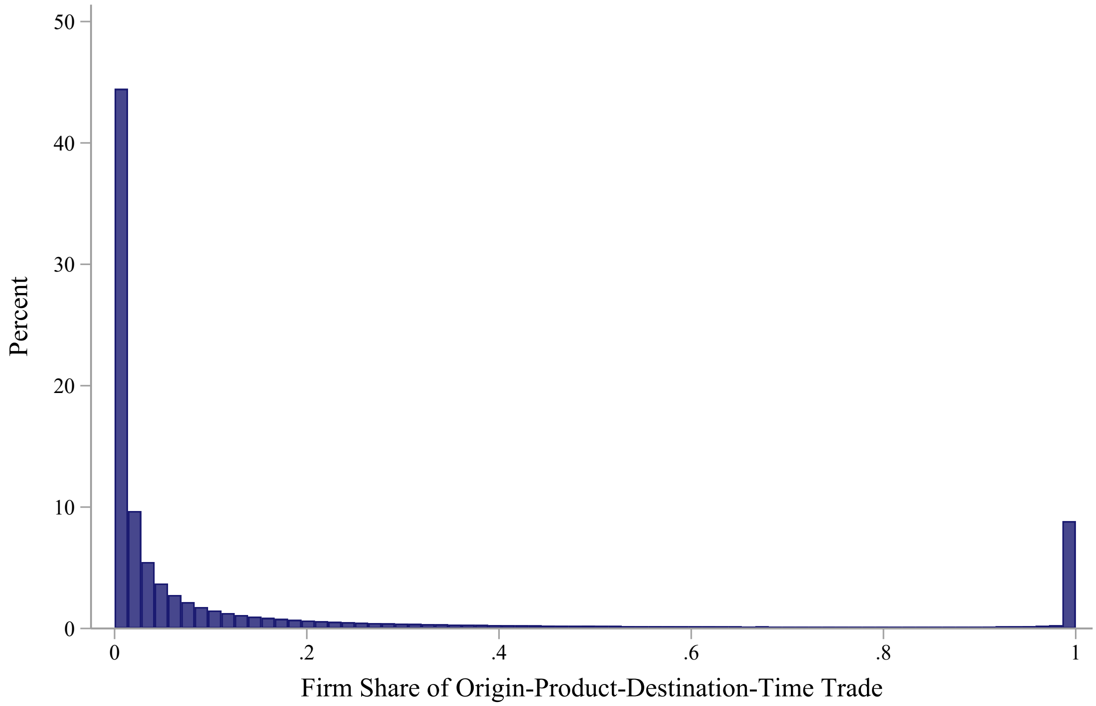
Table D14: Export Participation

Country	Year	Export Participation
Albania	2007	13.4
Bulgaria	2007	10.5
Burkina Faso	2009	4.5
China	2012	10.8
Egypt	2008	22.4
Malawi	2009	4.8
Mexico	2006	2.1
Peru	2006	19.0
Senegal	2007	10.6
Uruguay	2006	16.9
Yemen	2010	1.2

Notes: This tables presents data on the share of firms which export for each of the eleven countries in our sample. It is based on data for the indicator "percent of firms exporting directly at least 1% of sales" form the World Bank Group Enterprise Surveys.

D.4 Firm Market Share

Figure D11: Firm Share of Product-Origin-Destination-Time Trade ms_{fiodt}



Notes: This figure plots the distribution of ms_{fiodt} for the eleven countries in our sample and cases with up to 100 firms selling product i from an origin o to destination d at time t.