Firm Entry and Market Interdependence*

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Abstract

Tariffs can reduce the targeted country's exports even to destinations that impose no new barriers. Using Chinese customs data, we find that anti-dumping investigations against Chinese products depress their exports to third markets, mainly through reduced firm entry. We explain this export contraction by extending the workhorse model of Melitz (2003) with interdependent pre-entry investment and variable-markup demand. Simple sufficient-statistics formulas characterize entry and exporter responses, revealing how entry interdependence transmits tariff shocks across markets. We calibrate the model to match tariff responses in both focal and third markets and show that entry interdependence substantially shapes tariff incidence across destinations.

Keywords: entry interdependence, export contraction, variable markup

JEL Classification. F12; F13; F14; L11; D21

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1 Introduction

Recent trade conflicts have renewed interest in how trade barriers reshape trade beyond the countries directly involved. When one country raises tariffs against a targeted country, do the targeted exporters redirect their sales to other countries, or do their sales shrink in those countries as well? What are the mechanisms of such spillovers? Resolving these questions is essential for third countries to identify domestic winners and losers, formulate policy responses, and define their positions in multilateral negotiations and trade agreements.

This paper shows that exports to third markets shrink rather than expand, and identifies firm entry as a central mechanism. Using anti-dumping investigations against Chinese products, we find that aggregate export values decline in third markets, which we call third-market *export contraction*. We find that it is primarily because fewer firms enter. To explain the facts, we extend the workhorse model of Melitz (2003) to incorporate interdependent pre-entry investment and demand that allows variable markups. We derive simple sufficient-statistics formulas for the responses of entry and exporter counts and confirm that third-market export contraction emerges as a robust model implication with unilateral tariffs. Our calibration further suggests that entry interdependence substantially shapes the distribution of tariff effects across destinations.

Our empirical analysis combines Chinese customs transactions with anti-dumping cases initiated against China during 2000–2011. These product-specific investigations provide persistent trade policy shocks, allowing us to trace their effects in both investigating destinations (focal markets) and destinations without investigations (third markets). Using an event-study design, we compare investigated products with other products in the same broad category and destination. After accounting for linear pre-trends, we estimate that third-market export values fall by approximately 27% six years after initiation.

Three decompositions clarify the sources of this decline. First, fewer exporters account for most of the fall in third-market export values, while average revenue per exporter changes little. Second, reduced entry explains almost all of the decline in exporter numbers, with exit contributing little. Third, the price–quantity decomposition reveals a rise in unit values. Together, these results indicate that a unilateral trade barrier reduces the number of Chinese suppliers serving third markets and raises average prices in those markets.

Several additional exercises support this interpretation. The third-market pattern persists when we exclude destinations that frequently initiate anti-dumping cases, use more distinct products as controls, vary the estimation of pre-trends, and use methods that account for staggered treatment. Firm-level estimates for continuing exporters align with the

market-level decomposition: revenue falls in focal markets but changes little in third markets. Chinese manufacturing data also show that foreign investigations reduce domestic firm entry in exposed industries. These findings suggest that the response extends beyond the reallocation of incumbent exporters across destinations.

All the evidence points to firm entry as an intuitive mechanism behind export contraction. Prospective firms invest in entering an industry based on expected profits across the markets they may serve. A tariff in one destination lowers the return to this investment and reduces overall entry. When entry decisions are interdependent across markets, this contraction also reduces the number of suppliers in third markets. Weaker competition restores profitability as surviving firms gain market share and charge higher markups. Yet fewer varieties and higher prices make the industry's goods less attractive to consumers, reducing aggregate exports even to destinations whose tariffs remain unchanged.

We operationalize this intuition through two extensions of the Melitz framework. First, a generalized Kimball demand system permits variable markups without prescribing a particular residual demand curve (Matsuyama and Ushchev, 2017). Second, and central to our contribution, a generalized entry technology makes destination-specific access an outcome of pre-entry investment. Entrants allocate managerial capacity across markets to maximize expected profits, with a parameter β governing the interdependence of market access. The technology nests independent entry at $\beta = 0$ and common, Melitz-style entry as β approaches one, while allowing intermediate degrees of interdependence. This flexibility lets entrants redirect investment toward more profitable destinations and makes the strength of cross-market entry linkages an object to be disciplined by the data.

With homogeneous firms, the equilibrium yields two simple sufficient-statistics formulas. The proportional response of prospective entry, $\mathrm{d}\log M$, is a weighted average of the adjustments that local tariff shocks would induce under independent entry. The response of active exporter counts in market i, $\mathrm{d}\log N_i$, combines this global entry response with the local tariff effect. The parameter β determines the relative weight of these two forces. With symmetric markets, a higher β shifts more of a unilateral tariff's incidence toward third markets and attenuates its effect in the focal market. This result highlights the economic importance of the entry technology: even holding the initial equilibrium fixed, assumptions about how entry investment is shared across destinations shape the international incidence of tariffs. Third-market export contraction nevertheless persists under interdependent entry even as entrants redirect investment toward those markets.

The sufficient-statistics formulas and the prediction of export contraction extend to en-

vironments with heterogeneous firms, uncertain tariffs, non-constant returns to scale in production, or endogenous foreign demand. Notably, the entry mechanism continues to generate export contraction despite countervailing forces from selection or intensive-margin reallocation. With heterogeneous firms, weaker selection can offset the decline in active exporter counts, but prospective entry and aggregate exports still fall. With decreasing returns to scale, continuing firms have an incentive to divert sales to third markets, yet this response does not offset the aggregate export contraction caused by reduced entry. These results underscore the role of entry in transmitting tariff shocks across markets.

The extensions yield two policy implications. First, the prospect of higher tariffs can deter entry before the tariffs take effect. Under tariff uncertainty, proportional upward shifts in firms' beliefs about future tariffs reduce entry through the same mechanism as deterministic tariff increases. Trade can thus contract in anticipation of higher barriers. Second, a unilateral tariff provides protection beyond the imposing country. Reduced entry weakens competition from the targeted country's exporters across destinations, allowing competing suppliers to gain market share in third markets that impose no new protection. Our results contrast with the conventional view that unilateral tariffs protect domestic producers while redirecting competitive pressure toward third countries.

Finally, we calibrate the model using the tariff responses from our event studies. With homogeneous firms and symmetric markets, the sufficient-statistics formulas allow us to recover model parameters from empirical moments without specifying a parametric demand system. We consider six responses: changes in log exporter counts, revenue per exporter, and unit values in focal and third markets. The calibration matches five of these moments exactly; the untargeted third-market unit value rises by 0.07 log points in the model against 0.13 in the data, within one standard error of the estimate. The calibrated entry-interdependence parameter, $\beta = 0.46$, lies between the independent-entry ($\beta = 0$) and Melitz-entry ($\beta \to 1$) cases. In the calibrated model, the average anti-dumping tariff of 84.5% lowers consumption of the targeted Chinese products by 6.54 log points in the focal market and by 1.46 log points in each third market; with seven third markets and one focal market, third markets account for 61% of the global decline.

Counterfactuals show that both interdependent entry and variable markups are quantitatively important for tariff spillovers. Under Melitz entry, exporter counts fall by the same amount in every market, overstating the third-market decline and understating the focal-market one, and the third markets' share of the global consumption loss rises from 61% to 84%. Under independent entry, spillovers disappear and the entire adjustment falls on the

focal market. Replacing flexible demand with CES eliminates price adjustment and forces revenue per exporter in third markets to rise rather than stay flat, so the model understates the global consumption decline (1.47 rather than 2.10 log points). Together, entry interdependence and variable markups shape both the magnitude of tariff effects and their distribution across destinations.

Related literature Our paper contributes to four strands of literature.

First, our paper relates to the literature on trade policy spillovers to bystander countries. Earlier studies examine responses to anti-dumping tariffs (Bown and Crowley, 2007, 2010), the removal of trade policy uncertainty (Mau, 2017; Breinlich et al., 2023), and US-China trade war tariffs (Fajgelbaum et al., 2023).[1] Our empirical contribution combines variation across a broad set of anti-dumping cases with comprehensive customs data that reveal the margins of adjustment. Specifically, we document an average decline in Chinese exports to third markets and establish reduced entry as its primary source. These findings motivate an entry-based mechanism of trade policy spillovers.

Second, our paper contributes to the literature on technological linkages across export markets. Existing work links sales across destinations through decreasing returns within firms (Almunia et al., 2021) or economies of scale within industries (Bartelme et al., 2021; Breinlich et al., 2023). In closely related work, Morales et al. (2019) and Alfaro-Ureña et al. (2024) estimate dynamic export participation models with cross-market cost complementarities under given market conditions. We complement their work by endogenizing industry entry and its industry-equilibrium feedback on market competition. Our framework generalizes common entry across destinations to allow for varying degrees of entry interdependence, nesting independent entry as the opposite extreme. We calibrate the parameter governing these linkages using tariff responses in focal and third markets and show that it is central to evaluating the incidence of tariffs across destinations.

Third, our paper builds upon the literature on variable markups and their implications for trade (Matsuyama and Ushchev, 2017; Mrázová and Neary, 2017; Arkolakis et al., 2019; Dhingra and Morrow, 2019). We embed the non-CES demand framework of Matsuyama and Ushchev (2017) in a multi-destination equilibrium with interdependent entry. This framework accommodates variable markups while preserving transparent sufficient-statistics formulas for tariff responses. This flexibility matters empirically: markup adjustment helps explain both the signs and magnitudes of the responses observed in focal and third markets.

[1] Related studies examine within-firm adjustments to tariff shocks (Eckel et al., 2023; Bao et al., 2026; Albornoz et al., 2026).

Finally, our findings have implications for trade agreements and multilateral negotiations. Bagwell and Staiger (1999) emphasize terms-of-trade externalities, while Venables (1987) and Ossa (2011) show how protection attracts production at other countries' expense, motivating agreements that internalize these effects. Our analysis highlights how entry interdependence transmits unilateral protection to third markets: reduced Chinese entry raises prices and reduces the variety available to consumers, while competing producers receive indirect protection. In our setting, these spillovers weaken the trade-deflection rationale for follow-up protection, since competitive pressure from Chinese exporters declines even in countries that impose no new barriers. These opposing effects on consumers and competing producers are important for understanding third countries' interests in trade negotiations.

Roadmap The rest of the paper is organized as follows. Section 2 presents the evidence of export contraction. Sections 3 and 4 develop the model and its main results, and Section 5 studies the extensions. Section 6 delivers the calibration results. Section 7 concludes.

2 Empirical Evidence

In this section, we show that unilateral tariffs can depress exports beyond the targeted destination: anti-dumping investigations against Chinese products in one country also reduce Chinese exports to third countries. We begin by describing the customs and anti-dumping data and the construction of our estimation sample. We then present the empirical specifications for the event-study and decomposition analyses. Next, we report the main findings on export contraction in third markets and the central role of the entry margin in driving it. Finally, we address robustness and interpretation concerns.

2.1 Data

Our empirical analysis relies on two data sources. First, we use Chinese customs data from 2000 to 2011, which cover the universe of Chinese exporters' transactions. The original data is at the firm-HS8 (Harmonized System)-country level, and we aggregate the data to the HS6-country or firm-HS6 levels. This dataset has been widely used in the literature to study exporter behaviors (Manova and Zhang, 2012).[2]

[2]In the appendix, we show that the aggregate exports in the Chinese customs data are almost identical to the data reported by UN Comtrade, and the market-level responses to AD are also similar if we use the Comtrade data instead.

Second, we use the Temporary Trade Barriers Database (TTBD) from Bown et al. (2020), which provides detailed information on anti-dumping (AD) cases, including the initiation country and date, the targeting country, and the affected products. Bown et al. (2020) classify products using the finest level of the HS codes available for each country, and we use the first six digits (HS6) because only the classification of the first six digits are consistent across countries.

Combining these two datasets, we focus on AD cases initiated between 2000 and 2011 against China. and present summary statistics in Appendix A.1. We show that anti-dumping investigations against Chinese products are both widespread and long-lasting. For example, 11% of Chinese exports to the U.S. are subject to AD investigations during the sample period.

Table A.2 summarizes the step-by-step construction of our final estimation sample. We treat the EU as a single "destination economy," since its member countries share a common AD policy. We then keep AD cases that satisfy three criteria. First, we require a *unique initiation year* within each HS6 product: all destination markets that investigate a given product must do so in the same year.[3] This restriction avoids contamination from staggered treatment: a destination investigated later may already have been affected by third-market spillovers from an earlier investigation of the same product in another destination. Second, we require that the measure remains in force for at least five years; and third, that it is revoked after 2011 or never revoked. These last two criteria focus the analysis on persistent tariff shocks. Our final sample contains 456 treated HS products and 472 HS6-country combinations.

Appendix Table A.3 reports the duration of AD measures. Because the TTBD was collected in 2020, cases still in force are right-censored. The first two rows consider two extreme treatments: assigning 2020 as the end year for unrevoked cases, which understates ongoing the duration of ongoing cases, and restricting the sample to revoked cases only, which may introduce selection bias. The revoked-only sample yields somewhat shorter durations, but both measures comfortably exceed the six-year event-study horizon, implying that AD measures remain in force throughout the period we analyze. Applying the 2020-truncated measure to our final estimation sample, the average duration is 12.3 years, and 75% of cases last at least ten years.

[3]In most cases an HS6 product is investigated by only one country. In the rare cases where several countries target the same HS6 product, this criterion keeps them only if the investigations are initiated in the same year, and drops products investigated in different years across markets.

2.2 Empirical specifications

We use an event-study framework to examine how AD investigations affect Chinese exports across markets and through which margins. We first define treatment and control groups for focal and third markets, and then present the regression specifications for the level and decomposition analyses.

In our analysis, a market is a country-HS6 pair. For a given HS6 product, focal markets are destination countries that initiate an AD investigation against that product, while third markets are destinations that do not. To estimate the AD effect in focal markets, we define the treated observations as investigated HS6 products and the control observations as other HS6 products within the same HS4 category and destination country. For third markets, treated observations are the same investigated HS6 products in non-initiating destinations, and controls are again other HS6 products within the same HS4 category and destination country. Thus, in both focal and third analyses, identification comes from within-country, within-HS4 comparisons across HS6 products.[4]

We estimate the AD effect in focal and third markets using the following dynamic specification:

$$y_{iht} = \sum_{k=-K}^{K} \beta_k \text{Treated}_{ih} \mathbb{1}\left\{t - t_{ih}^0 = k\right\} + \delta_{ih} + \delta_{is(h)t} + \varepsilon_{iht}. \tag{1}$$

In this equation, t_{ih}^0 is the investigation year. We set $K = 6$ as the maximum event-time horizon and bin all periods with $k \geq K$ and $k \leq -K$. Here, i indexes destination countries, h indexes HS6 products, and $s(h)$ denotes the HS4 category of product h. The δ terms are fixed effects, and standard errors are clustered at the HS6-product (h) level.

Our main dependent variable is log export value ($\ln R$). To decompose this response into price and quantity components, we also estimate specifications with log export quantity ($\ln \tilde{Q}$) and log unit value ($\ln p^m$). To decompose responses into extensive and intensive margins, we use log exporter counts ($\ln N$) and log average revenue per exporter ($\ln \bar{r}$).

As shown in the next section, estimates from (1) display strong linear pre-trends for treated products relative to controls. To address this concern, we estimate a treated-group linear pre-trend and assume that, absent treatment, it would have continued after the event, following Dobkin et al. (2018) and Khederlarian and Steinbach (2022). The modified speci-

[4]In Appendix A.1, we illustrate how we construct the treated and control groups for both focal and third markets using a specific AD case as an example.

fication is:

$$y_{iht} = \beta_{-K}\text{Treated}_{ih}\mathbb{1}\left\{t - t^0_{ih} = -K\right\} + \sum_{k=0}^{K}\beta_k\text{Treated}_{ih}\mathbb{1}\left\{t - t^0_{ih} = k\right\} + \gamma\text{Treated}_{ih} \times \left(t - t^0_{ih}\right) \times \mathbb{1}\left\{t < t^0_{ih}\right\} + \delta_{ih} + \delta_{is(h)t} + \varepsilon_{iht}. \quad (2)$$

In this specification, $\gamma\text{Treated}_{ih} \times (t - t^0_{ih}) \times \mathbb{1}\{t < t^0_{ih}\}$ captures the linear pre-trend for treated observations. Under this setup, the treatment effect at event time $k \geq 0$ is $\beta_k - \gamma k$, the post-treatment coefficient net of the pre-trend extrapolated to event time k; by construction, the effect is zero in every pre-treatment period. In Section A.6, we show that our results are robust to using fewer pre-periods to extrapolate the linear pre-trend.

Finally, we examine how AD investigations affect exporter entry and exit. We decompose changes in exporter counts into entry and exit components. To do so, we first estimate the following specification for the midpoint growth rate of the number of active exporters in country i, product h, from year $t-1$ to t::

$$\frac{N_{iht} - N_{iht-1}}{(N_{iht} + N_{iht-1})/2} = \beta_{-K}\text{Treated}_{ih}\Delta\mathbb{1}\left\{t - t^0_{ih} = -K\right\} + \sum_{k=0}^{K}\beta_k\text{Treated}_{ih}\Delta\mathbb{1}\left\{t - t^0_{ih} = k\right\} + \gamma\text{Treated}_{ih}\mathbb{1}\left\{t \leq t^0_{ih}\right\} + \delta_{is(h)t} + \Delta\varepsilon_{iht}, \quad (3)$$

where Δ denotes the year-on-year difference, so that $\Delta\mathbb{1}\{t - t^0_{ih} = k\} = \mathbb{1}\{t - t^0_{ih} = k\} - \mathbb{1}\{t - 1 - t^0_{ih} = k\}$. Note that the outcome variable, the midpoint growth rate, can be seen as an approximation of $\ln N_{iht} - \ln N_{iht-1}$. Consistent with this, the right hand side of regression (3) is effectively the first-difference version of the level regression with extrapolated pretrend, equation (2). Therefore, the first-difference version estimates coefficients that have the same interpretations as the level regressions (cumulative effects of the treatment), in which the treatment effect at time $k \geq 0$ is again $\beta_k - \gamma k$.

Because changes in exporter counts equal entrants minus exiters, we can decompose midpoint growth into entry and exit components:

$$\frac{N_{iht} - N_{iht-1}}{(N_{iht} + N_{iht-1})/2} = \frac{E_{iht}}{(N_{iht} + N_{iht-1})/2} + \frac{-X_{iht-1}}{(N_{iht} + N_{iht-1})/2},$$

where E_{iht} is the number of entrants (firms that do not export at $t-1$ but do export at t), and X_{iht-1} is the number of exiters (firms that export at $t-1$ but not at t). We therefore replace the outcome variable in regression (3) with the entry and exit components and obtain

an exact decomposition of the change in the midpoint growth rates of exporter counts.

2.3 Main results

This subsection presents two main findings. First, exports of investigated products decline in both focal and third markets. Second, in third markets, this decline is driven mainly by reduced firm entry and is accompanied by higher unit values. Taken together, these results point to entry adjustment as a key mechanism behind tariff spillovers.

2.3.1 Export contraction

Fact 1. With the initiation of anti-dumping, exports drop in both the focal and third markets.

Figure 1 presents the dynamic response of log export value, $\ln R$, in the focal and third markets. The top row reports the baseline event-study estimates in (1), while the bottom row reports the estimates after extrapolating linear pre-trends using (2). The event-study estimates show clear and approximately linear pre-trends in both focal and third markets. Table A.6 in the appendix reports the coefficient estimates underlying Figure 1: the pre-initiation coefficients are individually significant in both markets, as are the fitted linear pre-trend slopes.

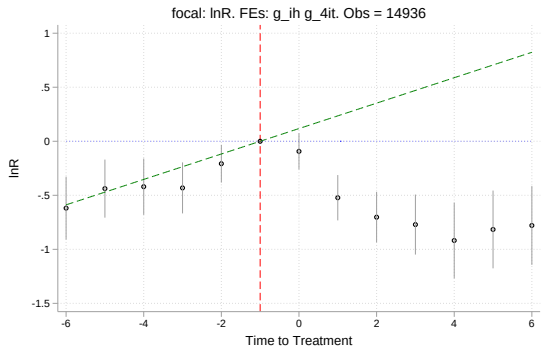
Accounting for these pre-trends is essential for interpreting the AD effect, especially in third markets. In the baseline event study, the post-treatment coefficients alone may suggest a limited effect in third markets. However, Figure 1b shows that post-treatment outcomes lie well below the pre-trend path after investigation starts, indicating substantial export contraction. The detrended estimates in the bottom row confirm this interpretation: the AD effect in third markets is statistically significant, with export value declining by about 27% after six years.

Contrary to the standard trade-diversion narrative, Chinese exports do not increase in unaffected destinations after unilateral trade barriers. Instead, export contraction emerges across markets: the treated product loses export revenue not only in focal destinations but also in destinations where no sanctions are imposed. To understand this pattern, we next investigate the underlying drivers of export contraction in third markets.

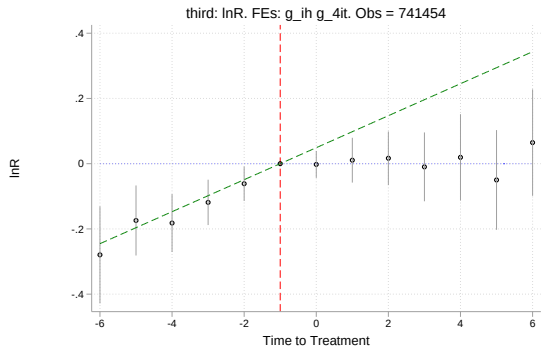
2.3.2 Decomposition

Fact 2. The export decline in the third markets is driven primarily by reduced firm entry and is accompanied by higher unit values.

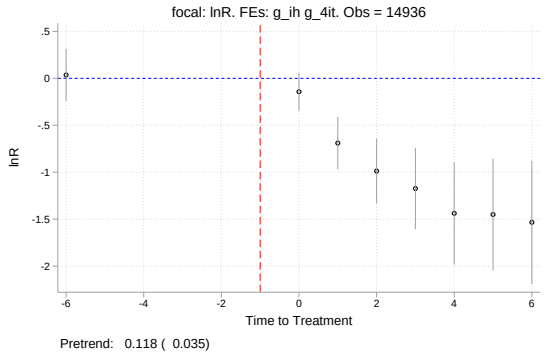
Figure 1: The AD effect in focal and third markets.



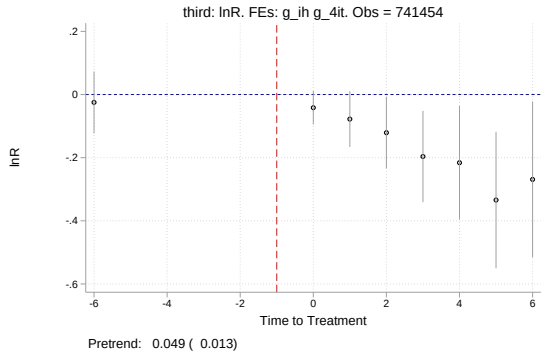
(a) Focal market: baseline event study



(b) Third market: baseline event study



(c) Focal market: detrended event study

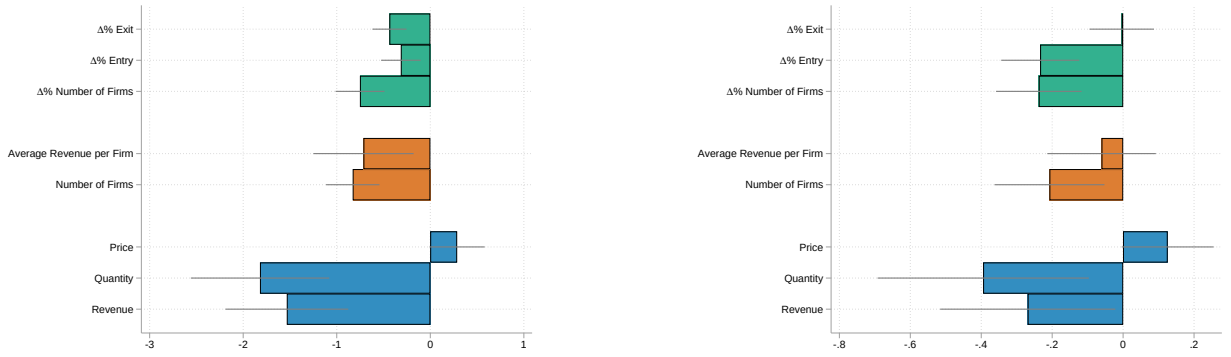


(d) Third market: detrended event study

Notes: The figure plots event-study coefficients for $\ln R$. The top row uses the baseline dynamic specification, while the bottom row extrapolates linear pre-trends using the restricted AD sample. All specifications include country-HS6-product and country-HS4-product-year fixed effects. Standard errors are clustered at the HS6 product level.

We document how quantity, unit values, the number of exporters, average per exporter, and entry and exit rates respond to the AD shock in focal and third markets. In Figure 2, we summarize the average log changes in these variables after six years of treatment and visualize the relative importance of different margins. We further report the corresponding point estimates in Table 1.

Figure 2: A decomposition of the AD effect in focal and third markets.



(a) Focal (b) Third

Notes: The bars summarize the log changes in the respective variables in the treatment group after AD investigations are in place for at least six years.

Figure 2 reports three decomposition exercises, organized into three blocks. The bottom block decomposes export declines into price and quantity components, $\ln R = \ln \tilde{Q} + \ln p^m$. Unit values rise in both focal and third markets. The middle block decomposes export declines into extensive and intensive margins, $\ln R = \ln N + \ln \bar{r}$. The intensive margin remains important in focal markets but changes little in third markets, implying that third-market export declines are driven mainly by the extensive margin. The top block further decomposes the extensive margin into entry and exit components. For the focal market, both entry and exit margins (i.e., fewer entries and more exits) contribute to the decline of the number of exporting firms. Reduced entry is the primary reason exporter counts decline in third markets, while exit plays a minor role. If anything, the positive but statistically insignificant estimate suggests that fewer exporters exit third markets after AD investigations.

Collectively, these results indicate that reduced entry is the main driver of export declines in third markets. The fact that a unilateral trade barrier in one destination lowers entry in other destinations suggests that firms' entry decisions across markets are interdependent. Put differently, a higher trade barrier in one market can reduce the profitability of entering *the entire export market*, leading to fewer exporting firms in every foreign market. The increase

Table 1: Decomposition of AD impacts in focal and third markets

	Level regressions					First differences		
	$\ln R$	$\ln \tilde{Q}$	$\ln p^m$	$\ln N$	$\ln \bar{r}$	$\frac{N_{iht}-N_{iht-1}}{(N_{iht}+N_{iht-1})/2}$	$\frac{E_{iht}}{(N_{iht}+N_{iht-1})/2}$	$\frac{-X_{iht-1}}{(N_{iht}+N_{iht-1})/2}$
focal	-1.533^a	-1.820^a	0.286^c	-0.829^a	-0.714^a	-0.751^a	-0.315^a	-0.437^a
	(0.335)	(0.378)	(0.150)	(0.146)	(0.273)	(0.133)	(0.108)	(0.093)
third	-0.269^b	-0.394^a	0.126^c	-0.208^a	-0.061	-0.238^a	-0.234^a	-0.004
	(0.126)	(0.152)	(0.066)	(0.079)	(0.078)	(0.062)	(0.056)	(0.046)

Notes: The table reports average impacts for periods at least six years after initiation, i.e., $t \geq t^0_{ih} + 6$.

in third-market prices is then a natural consequence of weaker competition on the supply side as entry declines. In later sections, we formalize this mechanism and show that entry interdependence can rationalize the full set of empirical patterns.

2.4 Robustness checks

We address in turn several concerns about the main results in the previous section: the institutional specifics of anti-dumping investigations, the composition of our control group, the extrapolation of pre-trends, the staggered timing of treatment, and the intensive-margin channels emphasized in the firm-level literature.

AD activists The third-market decline could reflect "tariff echoing": once one country imposes an AD duty on a product, other countries become more likely to initiate their own investigations against it (Crowley et al., 2018). If Chinese exporters anticipate follow-up protection in destinations known as AD activists, the resulting trade-policy uncertainty could curtail entry and shipments there before any duty is levied. Following Crowley et al. (2018), we treat the top 10 AD-investigating countries as those most prone to follow-up protection. We drop them from the set of third markets and re-estimate the impact of AD cases initiated by the focal markets. The summary decomposition in Figure A.5 and the event-study evidence in Figure A.6 reproduce the baseline pattern: export value and quantity fall while unit values rise in the remaining third markets. The third-market effect is therefore not driven by destinations prone to tariff echoing.

Cross-product reallocation Our baseline compares an investigated HS6 product with other, non-investigated HS6 products in the same HS4 category and destination country. If an AD duty induces Chinese exporters to reallocate sales toward substitutes within the same

HS4 (Eckel and Neary, 2010; Bao et al., 2026), the control products are themselves affected by the treatment, violating the stable-unit-treatment-value assumption (SUTVA) and mechanically magnifying the estimated decline. We therefore re-estimate our specifications using a more distant control group: never-investigated HS6 products in the same HS2 category and destination country but a different HS4 category, replacing HS4-country-year fixed effects with HS2-country-year fixed effects. Although these controls may be less comparable, the results are nearly identical to the baseline (Appendix A.5; Figure A.7; Table A.7), with the contraction again driven primarily by fewer exporters rather than lower revenue per exporter.

Pre-trend extrapolation Our preferred specification (2) fits the treated-group pre-trend over the full set of pre-investigation years other than the first period, and years far from the event may not be informative about the trend near it. We therefore re-estimate the pre-trend using progressively fewer pre-investigation years, dropping the earliest two or three pre-periods and letting them enter as free event-time coefficients rather than as part of the fitted trend, so that the extrapolated counterfactual is identified from the years closest to treatment. Appendix A.6 reports the results, which are very similar to our baseline (Table 1) under both alternative windows. The estimated effects are therefore not an artifact of the particular window used to extrapolate the pre-trend.

Staggered treatment AD investigations are initiated in different calendar years across product–country events, so our design involves staggered treatment timing. When treatment effects are heterogeneous, the conventional two-way fixed-effects (TWFE) estimand is a weighted average of cohort-specific effects with potentially negative weights, and the coefficients on individual event-time leads and lags can be contaminated by treatment effects from other periods, so that apparent pre-trends may arise purely from treatment-effect heterogeneity (de Chaisemartin and d'Haultfoeuille, 2020; Sun and Abraham, 2021; Borusyak et al., 2023).

None of the frontier estimators, however, has been adapted to our pre-trend extrapolation strategy, so we adopt two complementary strategies. First, we re-estimate the baseline event study using the interaction-weighted estimator of Sun and Abraham (2021), applied without the extrapolation because it operates directly on the dynamic coefficients. Figure A.9 shows that the Sun–Abraham coefficients track the corresponding OLS estimates closely, both in the pre-period and in the post-investigation dynamics. Second, we implement a stacked difference-in-differences design (Wing et al., 2024), which builds a separate sub-experiment

for each AD-initiation cohort, comprising of the HS6 product investigated in a particular year (cohort) and the never-investigated products in the same HS4 group (same cohort). We then control for HS6-country and HS4-country-year-cohort fixed effects in the regressions with pre-trend extrapolation. Table A.9 reports the resulting decomposition, and the estimates are similar to our main results in Table 1.

Firm-level evidence Our market-level decomposition attributes the third-market decline to the number of exporters. The firm-level literature instead emphasizes intensive-margin channels, in particular within-firm reallocation across destinations driven by decreasing returns in production (Almunia et al., 2021; Eckel et al., 2023). As a check on the intensive-margin side of our decomposition, we re-estimate the event study at the firm-product-country-year level with firm-product-country fixed effects, so that the estimates describe surviving exporters; Appendix A.8 reports the specification and the coefficient estimates. The firm-level responses are the counterpart of the response of average revenue per exporter, $\ln \bar{r}$, in Table 1, and the two agree in sign: export value per surviving firm falls in the focal market, while the third-market response is small and statistically indistinguishable from zero. The firm-level evidence therefore neither contradicts the market-level decomposition nor points to within-firm diversion strong enough to offset the fall in the number of exporters. Section 5.3 shows that the third-market decline survives when firm-level returns to scale are added to the model.

Domestic entry and exit Our evidence so far concerns the number of Chinese firms exporting a product to a given destination. If an AD duty lowers the value of serving the global market as a whole, the domestic producer population may contract as well. We examine this on the NBS above-scale manufacturing panel, collapsed to an industry-year panel over 1999–2009 and linked to the AD cases through the HS–CIC concordance of Brandt et al. (2017), with an industry treated from the first year its export-weighted AD coverage exceeds five percent. Appendix A.9 reports the results. We see similar pretrends in the treated industries as in the earlier analysis of exporters at the product-country-year level. Using the same detrending approach, we find that the number of active firms falls, and that the entry–exit decomposition assigns that decline to the entry margin. The NBS data also provides the founding year of the firms so we can measure entry precisely, and find that the number of domestic entrants measured in this way also drops after foreign AD investigations.

3 An Entry Model with Multiple Markets

We extend the canonical framework of Melitz (2003) along two dimensions: a generalized demand system that permits variable markups and a flexible entry technology that allows a varying degree of entry interdependence across destination markets. Sections 3.1 and 3.2 develop these two components, while Section 3.3 characterizes the resulting industry equilibrium. We consider a single home-country industry whose firms produce differentiated varieties and sell them in L destination markets, indexed by $i \in \mathscr{I} = \{1, 2, \ldots, L\}$.

3.1 Demand

Households In each destination, consumers' demand for home-country varieties follows a double-nest structure. They aggregate the set of available varieties sourced from the same origin into an origin-specific sectoral composite ("inner nest"), whose demand is determined externally ("outer nest"). Specifically, let Q_i denote the composite of varieties supplied by home exporters in destination i. Demand for this composite is summarized by the inverse-demand schedule D_i[5]:

$$P_i^I = D_i(Q_i), \qquad E_i(Q_i) = P_i^I Q_i, \tag{4}$$

where P_i^I is the ideal sectoral price index and E_i is foreign expenditure on the home-country composite. The outer-nest demand elasticity is $\eta_i \equiv -\mathrm{d}\log Q_i / \mathrm{d}\log P_i^I > 1$.

Among the set of available varieties $\omega \in \Omega_i$, consumers have a generalized Kimball preference that is homothetic and has directly implicit additivity (HDIA). Matsuyama and Ushchev (2017) show that its Marshallian demand has the following functional form:

$$\int_{\Omega_i} \Upsilon\left(\frac{q_\omega^i}{Q_i}\right) \mathrm{d}\omega = 1, \tag{5}$$

where q_ω^i is the quantity of variety ω in destination i, and the integrand $\Upsilon(\cdot)$ satisfies $\Upsilon(0) = 0$, $\Upsilon' > 0$, and $\Upsilon'' < 0$. In other words, Equation (5) aggregates consumption of firm varieties ω into the sectoral composite Q_i.

Let p_ω^i be the producer price. An ad valorem tariff factor t_i maps it into the consumer

[5]In Section 5.4, we present a micro-foundation of the outer-nest foreign demand schedule based on an oligopolistic competition between home and foreign producers à la Atkeson and Burstein (2008).

price $t_i p^i_\omega$. Expenditure minimization gives the residual demand curve facing firms:

$$\frac{t_i p^i_\omega}{P_i} = \Upsilon'\left(\frac{q^i_\omega}{Q_i}\right), \tag{6}$$

where the Kimball price aggregator P_i and aggregate demand index $\bar{\delta}_i$ satisfy

$$P_i Q_i = \bar{\delta}_i \int_{\Omega_i} t_i p^i_\omega q^i_\omega \mathrm{d}\omega = \bar{\delta}_i E_i, \tag{7}$$

$$\frac{1}{\bar{\delta}_i} = \int_{\Omega_i} \Upsilon'\left(\frac{q^i_\omega}{Q_i}\right) \frac{q^i_\omega}{Q_i} \mathrm{d}\omega. \tag{8}$$

Thus, the ideal price index satisfies $P_i = \bar{\delta}_i P^I_i$.

The double-nest demand system has two key advantages. First, aggregation into an origin-specific composite allows competition from foreign exports in the destination market to be summarized succinctly by the outer-nest demand elasticity η_i, without imposing a specific structure. Second, HDIA preferences naturally generalize CES demand, which is a special case with $\Upsilon(x) = x^{\frac{\sigma-1}{\sigma}}$. They are sufficiently flexible to generate a residual demand curve of any shape and avoid scale effects through homotheticity.[6] These properties conveniently simplify the theoretical analysis while retaining the generality of the model.

Firms Home firms use domestic labor as their only input, and its wage is the numeraire. A firm with productivity z produces zl units with l units of labor. Shipping to market i requires iceberg cost $\tau_i \geq 1$; the marginal cost of selling the good there is then τ_i/z. A firm with access to market i takes the residual demand curve in (6) and the tariff as given and chooses its producer price there according to

$$\max_p \left(p - \frac{\tau_i}{z}\right) q_i(t_i p). \tag{9}$$

Writing $x_i(z) \equiv q_i(z)/Q_i$, the optimal price, quantity, and variable profit satisfy

$$\begin{aligned} p_i(z) &= \mu_i(z)\frac{\tau_i}{z}, \qquad \frac{t_i p_i(z)}{P_i} = \Upsilon'\big(x_i(z)\big), \\ \pi_i(z) &= \left(p_i(z) - \frac{\tau_i}{z}\right) q_i(z) = p_i(z) q_i(z) \left(1 - \frac{1}{\mu_i(z)}\right), \end{aligned} \tag{10}$$

[6] Matsuyama and Ushchev (2017) also point out that another class of preferences—homothetic demand with a single aggregator (HSA)—exhibits similar properties in these respects. We show that all results extend to HSA preferences in Section 5.2.

where $\mu_i(z)$ is the markup. It is then without loss of generality to write firm-level variables as functions of $x = x_i(z)$. We compute standard local demand statistics as follows:

$$\sigma(x) = -\frac{\Upsilon'(x)}{x\Upsilon''(x)}, \qquad \mu(x) = \frac{\sigma(x)}{\sigma(x)-1}, \qquad \delta(x) = \frac{\Upsilon(x)}{x\Upsilon'(x)}, \tag{11}$$

where σ is the firm-level demand elasticity and δ is the infra-marginal surplus ratio. It is also useful to define the firm-level cost pass-through ρ and express it as a function of x:

$$\rho \equiv -\frac{\mathrm{d}\log p}{\mathrm{d}\log z} = 1 - \frac{\mathrm{d}\log \mu}{\mathrm{d}\log z} \Longrightarrow \rho(x) = \frac{1}{1+\frac{\mu'(x)x}{\mu(x)}\sigma(x)}. \tag{12}$$

We further assume that the Kimball aggregator ensures a unique interior solution.[7]

3.2 Entry

Timing Time is continuous. A prospective entrant pays f_e and makes a pre-entry investment to establish a business in the industry. The investment takes the form of a vector of destination-specific entry intensities and is described in detail below. Market-access opportunities then arrive according to those intensities, and the entrant draws productivity z from the distribution G. Conditional on receiving access, the firm chooses whether to enter and, if so, sets its price and quantity. An active firm in market i exits that market at a Poisson rate ν_i. Entry and fixed costs are denominated in home labor.

Pre-entry investment An entrant allocates a normalized stock of managerial capacity (e.g., time for market research) across destinations.[8] Given the expected value $\bar{\pi}_i$ of access to market i, it solves

$$\max_{\{J_i \geq 0\}_{i\in\mathscr{I}}} \sum_{i\in\mathscr{I}} J_i \bar{\pi}_i \qquad \text{s.t.} \qquad \left[\sum_{i\in\mathscr{I}} \left(\frac{J_i}{h_i}\right)^{\frac{1}{1-\beta}}\right]^{1-\beta} = 1, \tag{13}$$

[7] This requires that $\Upsilon'''(x)x + 2\Upsilon''(x) < 0$ is always satisfied. The existence of Υ''' ensures that the profit function π_i is continuous in z.

[8] This managerial allocation interpretation is common in span-of-control models such as Lucas (1978), Garicano (2000), and Chen (2017).

where $h_i > 0$ captures the ease of obtaining access to market i, and $\beta \in [0, 1)$.[9] For $0 < \beta < 1$, the optimal intensity is

$$J_i = h_i \left[\frac{(h_i \bar{\pi}_i)^{1/\beta}}{\sum_{k \in \mathscr{I}} (h_k \bar{\pi}_k)^{1/\beta}} \right]^{1-\beta}. \tag{14}$$

This entry technology nests two canonical entry assumptions as limiting cases of β. When $\beta = 0$, firms invest only in entering markets with the highest $h_i \bar{\pi}_i$. This case corresponds to the discrete-choice formulation commonly used in spatial models (Fajgelbaum et al., 2019), in which firms establish plants in the locations offering the highest expected profits. As $\beta \nearrow 1$, entry intensity converges to $J_i = h_i$ in every market, yielding the Melitz-style assumption of common entry across destinations: firms simultaneously enter each market at its destination-specific technological upper bound. Thus, as we show explicitly in the next section, β governs the degree of interdependence among firms' entry decisions across markets.

Entry and export decisions Conditional on access and productivity z, a firm exports to market i if its variable profit covers the per-period fixed cost f_i.[10] Conditional on exporting, it then sets the local price $p_i(z)$ as in (10). We assume an interior cutoff z_i^* defined by

$$\pi_i(z_i^*) = f_i, \qquad z \geq z_i^* \iff \text{the firm exports to market } i. \tag{15}$$

If firms discount at rate ϱ, the expected value of market access in market i is

$$\bar{\pi}_i = \frac{1}{\varrho + \nu_i} \int_{z_i^*}^{\infty} \left[\pi_i(z) - f_i \right] \mathrm{d}G(z). \tag{16}$$

Free entry into the industry requires the expected return to pre-entry investment to equal f_e:

$$\sum_{i \in \mathscr{I}} J_i \bar{\pi}_i = f_e \quad \iff \quad \left[\sum_{i \in \mathscr{I}} (h_i \bar{\pi}_i)^{1/\beta} \right]^{\beta} = f_e, \tag{17}$$

where the second expression follows from the optimal policy for J_i.

[9] Boehm and Oberfield (2020) use a similar functional form to model the allocation of firms across markets (Online Appendix G.5). In our framework, the constraint instead governs an individual firm's allocation of entry intensities across destinations, while the aggregate flow of prospective entrants, M, is endogenous and determined by free entry. Thus, entry responds through both destination-specific intensities and the aggregate flow of entrants.

[10] We slightly abuse the word "export" here because the home country can be a destination.

3.3 Equilibrium

We study a stationary perfect-foresight *industry equilibrium*. In particular, the home wage is the numeraire and normalized to one, and each foreign demand schedule $D_i(\cdot)$ is fixed. Tariffs t_i and iceberg costs τ_i are also taken as given. The model therefore neither imposes home labor-market clearing nor determines expenditure on foreign varieties.[11]

A stationary industry equilibrium consists of a flow of prospective entrants M and, for every $i \in \mathscr{I}$, an entry intensity J_i, export cutoff z_i^*, stock of home exporters N_i, demand aggregates $(Q_i, P_i^I, P_i, \bar{\delta}_i)$, expected market value $\bar{\pi}_i$, and firm policies $p_i(z)$ and $q_i(z)$ such that: (i) demand satisfies equations (4)–(8) in each market; (ii) firms' pricing, exporting, and pre-entry investment decisions are optimal; and (iii) entry and exit flows balance in every market:

$$J_i M\left[1 - G(z_i^*)\right] = \nu_i N_i. \tag{18}$$

4 Main Results

We present our main theoretical results for the case of homogeneous firms. We focus on this case for two reasons. First, the homogeneous-firm case maps directly to our empirical exercises conducted at the product-market level. Second, the mechanism through which entry interdependence transmits shocks across markets is most transparent in the homogeneous-firm equilibrium. We leave a thorough analysis of firm heterogeneity and other model extensions to Section 5. Detailed derivations and proofs are provided in Appendix B.

4.1 Solving the equilibrium

With homogeneous firms, it is without loss of generality to suppress firm-characteristic notation (ω or z) and index variables only by market. We further focus on equilibria in which every market has active exporters and solve for them in the following steps.

First, the HDIA aggregator implies that, in each market i,

$$N_i \Upsilon\left(x_i\right) = 1 \Longrightarrow x_i \equiv x_i(N_i) = \Upsilon^{-1}(1/N_i). \tag{19}$$

[11] This abstraction from general equilibrium effects, such as relative wage changes, suits well our empirical setting, in which the AD duties are imposed only on a refined category of products imported from China.

Since x_i is a function of N_i, it follows from (10) that firms' demand statistics $(\mu_i, \sigma_i, \delta_i, \rho_i)$, price p_i, quantity q_i, and profit π_i are all functions of N_i.

Next, substituting the free-entry condition (17) into the optimal entry intensity in (14) and combining it with the exporter flow-balance condition (18) yield

$$J_i = h_i \left(\frac{h_i \bar{\pi}_i}{f_e}\right)^{\frac{1-\beta}{\beta}} = \frac{\nu_i N_i}{M} \quad \Rightarrow \quad \pi_i(N_i) = (\varrho + \nu_i) \left(\frac{\nu_i N_i}{h_i M}\right)^{\frac{\beta}{1-\beta}} \frac{f_e}{h_i} + f_i, \tag{20}$$

where the second step uses (16). Since $\pi_i(N_i)$ is determined in the previous step, (20) defines N_i for a given M. We can then write $N_i = N_i(M)$.

Finally, plugging $N_i(M)$ into the free-entry condition (17) pins down the equilibrium mass of prospective entrants M:

$$\sum_{i \in \mathscr{I}} \left(h_i \bar{\pi}_i(N_i(M))\right)^{\frac{1}{\beta}} = f_e^{\frac{1}{\beta}}. \tag{21}$$

In this way, we have solved for the stationary equilibrium. We impose the following restrictions on the demand system to obtain a well-defined equilibrium.

Assumption 1. $0 < \rho_i \leq 1$, $\sigma_i > \eta_i$, *and* $\delta_i < \eta_i/(\eta_i - 1)$.

These conditions impose at most complete pass-through, stronger substitution within than across sectoral composites, and the requirement that $\pi_i(N_i)$ decline with N_i. Under nested CES demand, the second condition implies the third. Proposition 1 further establishes the existence and uniqueness of the equilibrium.

Proposition 1. *Suppose Assumption 1 holds for any* N_i *and* $\liminf_{N_i \to k} \frac{\eta_i}{\eta_i - 1} \frac{1}{\delta_i} > 1$ *for* $k \in \{0, +\infty\}$. *Then, there exists a unique stationary equilibrium.*

4.2 Tariff responses

We now analyze equilibrium changes in response to market-specific tariff shocks. In each market i, R_i and $\tilde{Q}_i$ denote, respectively, the total value and physical quantity imported from the home country. We use the superscript m to denote market-level averages. In particular, the average price, quantity, and revenue are $p_i^m \equiv R_i/\tilde{Q}_i$, $q_i^m \equiv \tilde{Q}_i/N_i$, and $r_i^m \equiv R_i/N_i$. They coincide with the firm-level variables p_i, q_i, and r_i in the case of homogeneous firms.[12] The total quantity $\tilde{Q}_i$ differs from the sectoral composite Q_i, which is a utility index.

[12] With the specified demand system, four distinct variables are related to prices: the firm producer price p_i, the market-level average price p_i^m, the Kimball price aggregator P_i, and the ideal price index P_i^I.

It follows from the previous section that equilibrium variables in each market are fully characterized by the number of exporters N_i, which is in turn determined by the number of prospective entrants M through the free-entry condition. Hence, the change in M alone determines every equilibrium change. Let $\mathrm{d}\log t_i$ denote the log tariff change in market i. The following proposition establishes the equilibrium change in M in response to tariff changes.

Proposition 2. *Suppose that Assumption 1 holds in the initial equilibrium. Given a set of tariff changes* $\{\mathrm{d}\log t_i\}_{i\in\mathscr{I}}$*, the change in the number of prospective entrants satisfies*

$$\mathrm{d}\log M = \sum_i \tilde{s}_i \cdot \frac{-\mathrm{d}\log t_i}{\theta_i}, \tag{22}$$

in which

$$\tilde{s}_i = \frac{s_i\xi_i}{\sum_i' s_{i'}\xi_{i'}}, \quad s_i = \frac{J_i\bar{\pi}_i}{\sum_k J_k\bar{\pi}_k}, \quad \xi_i = \frac{\frac{\pi_i}{\pi_i - f_i}\eta_i\theta_i}{\frac{\beta}{1-\beta} + \frac{\pi_i}{\pi_i - f_i}\eta_i\theta_i} \in (0,1], \tag{23}$$

and

$$\theta_i = \underbrace{\left(\frac{1}{\eta_i} - \frac{1}{\sigma_i}\right)\left(\frac{1}{\rho_i} - 1\right)\delta_i}_{\geq 0} + \underbrace{1 - \frac{\eta_i - 1}{\eta_i}\delta_i}_{>0} > 0. \tag{24}$$

Equation (22) shows that the response of prospective entrants to tariff changes can be written in a shift-share form: $\mathrm{d}\log M$ is the average of the local adjustments $-\mathrm{d}\log t_i/\theta_i$, weighted by $\tilde{s}_i$. Both the shift and share terms are intuitive. First, the shift term $-\mathrm{d}\log t_i/\theta_i$ describes the reduction in the number of firms when market i is independent of other markets. With free entry, equilibrium expected profit must equal the entry cost. The number of active exporters N_i has to decline to maintain profitability in response to a tariff increase. θ_i captures the sensitivity of this extensive-margin adjustment: it governs the elasticity of the equilibrium number of active exporters with respect to the tariff. It further shows that the extensive margin restores profitability through two channels: a market-size effect governed by $1 - \frac{\eta_i - 1}{\eta_i}\delta_i$ and a markup effect governed by $\left(\frac{1}{\eta_i} - \frac{1}{\sigma_i}\right)\left(\frac{1}{\rho_i} - 1\right)\delta_i$. Namely, with fewer firms in the market, each firm increases its profit by serving a larger share of the market and charging a higher markup.

Next, the share term $\tilde{s}_i$ aggregates the local adjustments across markets in the presence of interdependent entry. It is proportional to the product of two components: s_i is the share of expected profit in market i, and ξ_i is an influence weight that captures the degree of entry

interdependence across markets. A local tariff has a larger global impact when it hits a more profitable market (higher s_i) or when the local adjustment is more elastic (higher ξ_i) . It should be emphasized that the entry parameter β affects the equilibrium change only through ξ_i, a property that significantly sharpens the subsequent analysis.

The global entry response and local tariff changes jointly determine the changes in every equilibrium outcome. In the following proposition, we highlight two variables of key interest, N_i and Q_i, while leaving the others to the appendix.

Proposition 3. *Suppose that Assumption 1 holds in the initial equilibrium. Given a set of tariff changes* $\{\mathrm{d}\log t_i\}_{i\in\mathscr{I}}$*, the change in the number of active exporters is given by*

$$\mathrm{d}\log N_i = (1-\xi_i)\mathrm{d}\log M + \xi_i \frac{-\mathrm{d}\log t_i}{\theta_i}, \tag{25}$$

and the change in the sectoral composite Q_i *is given by*

$$\mathrm{d}\log Q_i = \underbrace{\left(\frac{\delta_i}{\rho_i} - \eta_i\theta_i\right)}_{>0} \mathrm{d}\log N_i - \eta_i \mathrm{d}\log t_i. \tag{26}$$

Proposition A.1 contains the expressions for the equilibrium changes in other variables.

Equation (25) explains how entry interdependence transmits local shocks across markets. It shows that, in each market, the decline in the number of active exporters can be driven by either the decline in global entry ($\mathrm{d}\log M$) or the increase in the local tariff ($-\mathrm{d}\log t_i/\theta_i$), with influence weight ξ_i. From (23), ξ_i decreases with β, $\xi_i \to 1$ if $\beta = 0$, and $\xi_i \to 0$ if $\beta \to 1$. Intuitively, as entry becomes more interdependent across markets, the local extensive margin depends more heavily on the global entry condition and less on local economic conditions. This further suggests that the incidence of a local tariff is diverted beyond the border and that the extent of tariff spillovers hinges crucially on the entry parameter β.

Q_i measures local consumption of home-country exports in utility terms. Given the demand structure, it is the only welfare-relevant variable among these outcomes. Equation (26) then implies that $\mathrm{d}\log Q_i$ comoves with $\mathrm{d}\log N_i$ in addition to responding to tariff changes. Intuitively, if there are fewer active exporters, consumption of home-country exports falls because fewer varieties and higher markups make the composite more expensive.

We now adapt Proposition 3 to the empirical setting in Section 2 and confront the model's implications directly with our empirical results.

Corollary 1. *Suppose that Assumption 1 holds in the initial equilibrium. Moreover, only country j ("the focal market") raises its tariff:* $\mathrm{d}\log t_j > 0$, *and* $\mathrm{d}\log t_i = 0$ *for* $i \neq j$. *The model makes the following predictions for equilibrium variables across markets:*

(i) In the focal market j, $N_j, \tilde{Q}_j, R_j, Q_j \downarrow$, $p_j \uparrow$, and $\pi_j, q_j, r_j \downarrow$;

(ii) In a third market $i \neq j$, $N_i, \tilde{Q}_i, R_i, Q_i \downarrow$, $p_i, \pi_i \uparrow$ and

$$q_i \uparrow \quad \textit{iff } \frac{\eta_i}{\eta_i - 1} > \frac{\delta_i}{1 - \frac{\delta_i}{\sigma_i}\left(\frac{1}{\rho_i} - 1\right)}, \qquad r_i \uparrow \quad \textit{iff } \frac{\eta_i}{\eta_i - 1} > \delta_i \left[1 + \left(\frac{1}{\rho_i} - 1\right)\frac{1}{\sigma_i}\right].$$

Corollary 1 reports the predicted signs of variable changes in response to a unilateral tariff increase. The results are consistent with our event-study findings in both the third and focal markets. Specifically, market-level export value, quantity, and the number of active exporters decrease in both places, while prices increase. Despite an unambiguous increase in profit, whether firms' sales or quantities also increase in third markets remains uncertain because firms can now charge higher markups.

Finally, two observations deserve additional attention. First, the model rationalizes the puzzling increase in unit value in the focal market documented in Table 1. Although firms' price setting features incomplete pass-through, the extensive-margin adjustment generates more-than-complete tariff pass-through in the industry equilibrium. Second, export contraction in third markets can be a robust feature of the entry mechanism. Relative to the Melitz entry case ($\beta = 1$), generalized entry with $\beta < 1$ introduces an additional force that diverts trade to third markets, since entry intensity now increases with expected profit. Despite our efforts to relax assumptions on both demand and entry, export contraction in third markets persists without special parameter restrictions, supporting the empirical relevance of the entry mechanism.

4.3 Special cases

In this section, we revisit the model's implications under three special cases: nested CES demand, independent entry, and Melitz entry. Examining these special cases helps us better understand the limitations of standard assumptions in explaining the rich cross-market patterns in the data while illustrating the importance of our generalization.

Nested CES demand Suppose the inner aggregator is CES and the outer inverse demand has a constant elasticity:

$$\Upsilon_i(x) = x^{\frac{\sigma_i - 1}{\sigma_i}}, \qquad P_i^I = D_i Q_i^{-\frac{1}{\eta_i}},$$

where $D_i > 0$ is a market-specific demand shifter. Assumption 1 then reduces to $\sigma_i > \eta_i$, and

$$\mu_i = \delta_i = \frac{\sigma_i}{\sigma_i - 1}, \quad \eta_i \theta_i = \frac{\sigma_i - \eta_i}{\sigma_i - 1}, \quad \rho_i = 1.$$

Corollary 2. *Suppose the demand system in each market is nested CES with $\sigma_i > \eta_i > 1$. Given a set of tariff changes $\{\mathrm{d}\log t_i\}_{i \in \mathscr{I}}$, the following equations characterize changes in the equilibrium:*

(i) At the market level,

$$\mathrm{d}\log R_i = \mathrm{d}\log \tilde{Q}_i = \frac{\eta_i - 1}{\sigma_i - 1}\mathrm{d}\log N_i - \eta_i \mathrm{d}\log t_i, \quad \mathrm{d}\log Q_i = \frac{\eta_i}{\sigma_i - 1}\mathrm{d}\log N_i - \eta_i \mathrm{d}\log t_i;$$

(ii) At the firm level,

$$\mathrm{d}\log p_i = 0, \quad \mathrm{d}\log \pi_i = \mathrm{d}\log r_i = \mathrm{d}\log q_i = -\frac{\sigma_i - \eta_i}{\sigma_i - 1}\mathrm{d}\log N_i - \eta_i \mathrm{d}\log t_i;$$

CES demand eliminates variable markups: prices are fixed, so firm profit, revenue, and quantity move together. Contrary to our empirical findings, a model with nested CES demand predicts that tariff shocks have no price effects and that average firm revenue and quantity always increase in third markets.

Independent entry ($\beta = 0$) At $\beta = 0$, the pre-entry investment problem is linear. Entrants allocate capacity only to markets that maximize $h_i \bar{\pi}_i$. Hence, in an equilibrium with positive entry in every market, the equilibrium J_i and M ensure that $h_i \bar{\pi}_i = f_e$ for every $i \in \mathscr{I}$. Since $\xi_i = 1$ from (23), we obtain

$$\mathrm{d}\log M = \sum_i s_i \cdot \frac{-\mathrm{d}\log t_i}{\theta_i}, \quad \mathrm{d}\log N_i = -\frac{\mathrm{d}\log t_i}{\theta_i}, \qquad \text{for } i \in \mathscr{I}.$$

The extensive-margin adjustment now depends only on local conditions, so there is no third-market effect.

Melitz entry ($\beta \to 1$) As $\beta \to 1$, exporters enter all markets at the exogenous rates $J_i \to h_i$, as in Melitz (2003). The number of active exporters is then proportional to the total number of entrants M. Therefore,

$$\mathrm{d}\log N_i = \mathrm{d}\log M = \sum_i \tilde{s}_i \cdot \frac{-\mathrm{d}\log t_i}{\theta_i}, \qquad \text{for } i \in \mathscr{I},$$

in which $\tilde{s}_i = \frac{s_i \xi_i}{\sum_i s_i \xi_i}$, and $\xi_i = \frac{\pi_i \eta_i \theta_i}{\pi_i - f_i}$. With Melitz entry, the model predicts the same percentage drop in the number of active exporters in the focal and third markets, whereas the drop in the focal market is much larger in the data.

4.4 Entry interdependence

We conclude this section by discussing the role of entry interdependence in generating tariff spillovers across markets. As before, we focus on the case in which only country j raises its tariff. The elasticity of the number of active exporters in market i with respect to the tariff in market j measures the degree of tariff spillovers. The preceding discussion implies that

$$\frac{\mathrm{d}\log N_i}{\mathrm{d}\log t_j} = -\left[(1-\xi_i)\tilde{s}_j + \xi_i \mathbb{1}\{i=j\}\right]\frac{1}{\theta_j}. \tag{27}$$

We can rewrite $\xi_i = \frac{v_i}{v_i + \tilde{\beta}}$ with $v_i = \frac{\pi_i}{\pi_i - f_i}\eta_i\theta_i$ and $\tilde{\beta} = \beta/(1-\beta)$. $\tilde{\beta}$ increases with β, while ξ_i decreases with β.

We are interested in the following thought experiment. Suppose there are two global economies that are identical in all respects except for their entry technologies and that share the same initial equilibrium. We can then index them by the entry-interdependence parameter β.[13] The question is: how does the global impact of the same local tariff shock differ between the high-β and low-β worlds?

It then suffices to compare how the elasticity $\mathrm{d}\log N_i/\mathrm{d}\log t_j$ changes with β. With the same equilibrium allocation, Equation (27) shows that β affects tariff responses only through

[13] Let J_i and $\bar{\pi}_i$ denote the entry intensities and expected profits in the initial equilibrium. Free entry then implies that the entry cost f_e must be the same in both worlds. From Equation (20), the entry efficiency h_i can be recovered as a function of β: $h_i \equiv h_i(\beta) = J_i^{\beta}\left(\frac{f_e}{\bar{\pi}_i}\right)^{1-\beta}$. Hence, the worlds can differ only in β.

$\{\xi_i\}$. Holding $\tilde{s}_j$ constant, a larger β reduces ξ_i in every market, which increases the weight on global entry and reduces the weight on the local tariff. Consequently, the focal market loses fewer exporters in the high-β world, while third markets lose more. The incidence of a local tariff is diverted toward third markets and distributed more evenly across markets.

The above argument does not generally capture the overall effect because $\tilde{s}_j$ also changes with β through $\{\xi_i\}$. An increase in β may either reduce or increase the importance of the focal market in shock transmission. A notable exception, however, occurs when markets are symmetric. Suppose all markets are identical in the initial equilibrium, so $\xi_i = \xi$, $v_i = v$, $\theta_i = \theta$, and $\tilde{s}_j = 1/L$, where $L = |\mathscr{I}|$. Then

$$\frac{\mathrm{d}\log N_j}{\mathrm{d}\log N_i} = 1 + \frac{\xi}{1-\xi}L,$$

and

$$\frac{\partial}{\partial\tilde{\beta}}\frac{\mathrm{d}\log N_i}{\mathrm{d}\log t_j} = \frac{\xi^2}{v}\left(\mathbb{1}\{i=j\} - \frac{1}{L}\right)\frac{1}{\theta} \quad \begin{cases} < 0, & \text{if } i \neq j, \\ > 0, & \text{if } i = j, \end{cases},$$

With symmetry, β has no net impact on $\tilde{s}_j$, and the above logic goes through. The focal market always loses fewer exporters, while third markets always lose more, when β is higher. The ratio of the changes in the number of active exporters in the focal and third markets then decreases with β. Since both changes are observable in the data, this ratio helps identify β in the subsequent estimation.

5 Extensions

The central result in Section 4 is that a local tariff shock depresses home exports in all destinations. It builds upon four major assumptions: (i) homogeneous firms, (ii) deterministic tariffs, (iii) constant returns-to-scale (CRS) production functions, and (iv) exogenous foreign demand. We extend the model to incorporate these relaxations in this section. We show that in each case, the sufficient-statistics formulas continue to hold, and the export contraction in third markets remains a robust feature of the entry mechanism.

5.1 Heterogeneous firms

We reintroduce firm heterogeneity into the baseline model. The central entry mechanism remains unchanged: a tariff in the focal market reduces the total entrant pool M and the

number of potential entrants $M_i^p = J_i M$ in every market. Productivity selection adds a second margin, however, because the number of active exporters also depends on the market-specific survival cutoff z_i^*. We summarize below how the comparative statics are modified in the presence of productivity selection. Detailed analysis could be found in Appendix C.

We focus on initial equilibria that satisfy the following conditions. First, we introduce Assumption 1′ that presents the heterogeneous-firm version of conditions in Assumption 1. Second, we identify additional conditions in Assumption 2 under which the baseline comparative statics results still hold.

Assumption 1′. *For every market i,*

$$0 < \rho_i(z) \leq 1, \quad \forall z; \qquad \sigma_i(z_i^*) > \eta_i; \qquad \bar{\delta}_i < \frac{\eta_i}{\eta_i - 1}.$$

Assumption 2. *For every market i:*

(i) cost pass-through satisfies $\rho_i'(z) \leq 0$ for every $z \geq z_i^*$;

(ii) entry is excessive, $\bar{\delta}_i \leq \mathbb{E}_{\lambda_i}^i[\mu_i^{-1}]^{-1}$;

(iii) selection is insufficient, $\bar{\delta}_i \geq \delta_i^*$; and

(iv) expected profit decreases with the survival cutoff, $\mathrm{d}\log \bar{\pi}_i / \mathrm{d}\log z_i^* < 0$.

The conditions in Assumption 2 have transparent economic interpretations. First, Condition (i) presents a strong version of *Marshall's second law of demand*: cost pass-through is incomplete and weakly decreases with productivity. This restriction is consistent with the firm-size gradient in pass-through estimated by Amiti et al. (2019). Second, entry and selection are two central sources of inefficiency in imperfectly competitive markets (Baqaee et al., 2023). Behrens et al. (2020) find insufficient selection and excessive entry are pervasive across French and UK sectors, providing empirical support for Conditions (ii) and (iii). Third, Condition (iv) is a regularity condition that ensures a pro-competitive effect from more selection. All four conditions are satisfied when the inner nest has CES demand.

We then present the equilibrium changes in the presence of heterogeneous firms. As before, we first derive the changes in the global entrant pool $\mathrm{d}\log M$ and the market-specific changes in potential entrants and cutoffs, $\mathrm{d}\log M_i^p$ and $\mathrm{d}\log z_i^*$. We now write other market-specific variable changes in terms of $\mathrm{d}\log z_i^*$ instead of $\mathrm{d}\log N_i$. Such changes better align with the heterogeneous-firm models convention and help highlight the role of firm selection.

Proposition 4. *Suppose that Assumptions 1′ and 2 hold in the initial equilibrium. Given tariff changes* $\{\mathrm{d}\log t_i\}_{i\in\mathscr{I}}$*, equilibrium changes in the entrant pool, market-specific potential entrants, cutoffs, and sectoral composite satisfy*

$$\mathrm{d}\log M = -\frac{\sum_{i\in\mathscr{I}} s_i \xi_i^t \mathrm{d}\log t_i}{\sum_{i\in\mathscr{I}} s_i \xi_i^M}, \qquad \mathrm{d}\log M_i^p = \Big(1 - \underset{\in(0,1)}{\xi_i^M}\Big)\mathrm{d}\log M - \underset{(+)}{\xi_i^t}\,\mathrm{d}\log t_i, \tag{28}$$

$$\mathrm{d}\log z_i^* = \underset{(+)}{z_i^M}\mathrm{d}\log M + z_i^t \mathrm{d}\log t_i, \qquad \mathrm{d}\log Q_i = \underset{(+)}{Q_i^z}\mathrm{d}\log z_i^* + \underset{(-)}{Q_i^t}\mathrm{d}\log t_i,$$

where s_i *is the expected profit share as in* (23)*. The expressions for* ξ_i^M*,* ξ_i^t*,* z_i^M*,* z_i^t*,* Q_i^z*, and* Q_i^t *are defined in Appendix C.3.*

Proposition 4 parallels Propositions 2–3. The response of global entry is again a weighted average of local tariff shocks, but the transmission weights, $\xi_i^M \in (0,1)$, now account for movements in the productivity cutoffs. Holding local tariffs, a decline in the global entry reduces local market competition and causes both the number of potential entrants and entry cutoff to decrease. The consumption of sectoral composite falls as well since it is now more expensive: firms charge higher markups, and there are more low-productivity firms.

Proposition 5. *Suppose Assumptions 1′ and 2 hold in the initial equilibrium. If the focal market* j *raises its tariff,* $\mathrm{d}\log t_j > 0$*, while* $\mathrm{d}\log t_i = 0$ *for every third market* $i \neq j$*, then:*

(i) $\mathrm{d}\log M < 0$*. In every market,* $\mathrm{d}\log M_i^p < 0$*,* $\mathrm{d}\log Q_i < 0$*,* $\mathrm{d}\log \tilde{Q}_i < 0$*, and* $\mathrm{d}\log R_i < 0$*. For every continuing firm,* $\mathrm{d}\log p_i(z) = \mathrm{d}\log \mu_i(z) \geq 0$*.*

(ii) In every third market $i \neq j$*,* $\mathrm{d}\log z_i^* < 0$ *and* $\mathrm{d}\log p_i^m \geq 0$*. Whereas, the sign of* $\mathrm{d}\log z_j^*$ *in the focal market* j *is ambiguous.*

Proposition 5 demonstrates that the model responses to unilateral tariff changes in Corollary 1 remain robust to heterogeneous firms: the market-level export value, physical quantity, and sectoral composite decline in both focal and third markets, while third-market unit values weakly rise. Despite definite decline in potential entrants (M_i^p) in all markets, what no longer follows unconditionally is the decline in active exporters (N_i) since weaker selection may offset the entry decline. This is true even in the focal market: Part (ii) shows that $\mathrm{d}\log z_j^*$ can be either positive or negative. This ambiguity arises because while elevated tariffs increase the entry cutoff by lowering local profitability, reduced global entry decreases it by alleviating local competition. Only the latter force operates in the third markets, and that's why the entry cutoff decreases there unambiguously.

To better illustrate the role of selection in entry tranmission, we further restrict ourselves to the special case of nested CES demand. Recall from Section 4.3 that θ_i defined in (24) satisfies $\theta_i^{\text{CES}} = \frac{\sigma_i - \eta_i}{\eta_i(\sigma_i - 1)}$ in the CES case. Moreover, we define $\lambda_i^* \equiv r_i(z_i^*)/r_i^m < 1$, the ratio between the marginal firms' revenue and the average revenue, and $\varphi_i^* \equiv \frac{z_i^* g(z_i^*)}{1-G(z_i^*)} \geq 0$, the elasticity of survival rate with respect to the cutoff. A lower λ_i^* or higher φ_i^* implies more severe firm heterogeneity and then stronger selection force. π_i^m denotes the average profit as before. The following corollary reports equilibrium changes with CES demand.

Corollary 3. *Suppose the demand system in each market is nested CES with $\sigma_i > \eta_i > 1$, and let $\theta_i^{\text{CES}} \equiv \frac{\sigma_i - \eta_i}{\eta_i(\sigma_i - 1)}$. Given a set of tariff changes $\{\mathrm{d}\log t_i\}_{i \in \mathscr{I}}$, the changes in the entrant pool and market-specific active exporters satisfy*

$$\mathrm{d}\log M = \sum_i \tilde{s}_i^M \cdot \frac{-\mathrm{d}\log t_i}{\theta_i^{\text{CES}}}, \qquad \mathrm{d}\log N_i = (1 - \widetilde{\xi}_i)\mathrm{d}\log M + \widetilde{\xi}_i \frac{-\mathrm{d}\log t_i}{\theta_i^{\text{CES}}},$$

where $\tilde{s}_i^M = \frac{s_i \xi_i^M}{\sum_i' s_{i'} \xi_{i'}^M}$, $s_i = \frac{J_i \bar{\pi}_i}{\sum_k J_k \bar{\pi}_k}$, $\xi_i^M = \frac{\frac{\pi_i^m}{\pi_i^m - f_i}\eta_i \theta_i^{\text{CES}}}{\frac{\pi_i^m}{\pi_i^m - f_i}\eta_i \theta_i^{\text{CES}} + \frac{\beta}{1-\beta}\left(1 + \frac{\eta_i \theta_i^{\text{CES}}}{\sigma_i - 1}\lambda_i^* \varphi_i^*\right)} \in (0,1)$, *and*

$$\widetilde{\xi}_i = \frac{\frac{\pi_i^m}{\pi_i^m - f_i}\eta_i \theta_i^{\text{CES}} + \frac{\beta}{1-\beta}\frac{\eta_i \theta_i^{\text{CES}}}{\sigma_i - 1}\varphi_i^*}{\frac{\pi_i^m}{\pi_i^m - f_i}\eta_i \theta_i^{\text{CES}} + \frac{\beta}{1-\beta}\left(1 + \frac{\eta_i \theta_i^{\text{CES}}}{\sigma_i - 1}\lambda_i^* \varphi_i^*\right)} \in (0, \frac{1}{\lambda_i^*}).$$

Corollary A.1 contains the expressions for the equilibrium changes in other variables.

Selection weakens the extensive margin adjustment in the third markets. With CES demand, both $\mathrm{d}\log M$ and $\mathrm{d}\log N_i$ have the same form as in the homogeneous-firm case and become identical when $\varphi_i^* = 0$. $\widetilde{\xi}_i$ is the heterogeneous-firm counterpart of ξ_i in (23), capturing the transmission from global entry to local active exporters. Holding others constant, $\widetilde{\xi}_i \geq \xi_i$, and $\widetilde{\xi}_i$ decreases on λ_i^* but increases on φ_i^*. Moreover, $\widetilde{\xi}_i$ can be above one with $\lambda_i^* < 1$. Despite that the market-level revenue always decreases, the selection could be so strong that the number of active exporters increases in the third markets.

Finally, we revisit the role of β in the incidence of tariffs. We repeat the thought experiment in Section 4.4 and focus again on the case of symmetric markets for better illustration. We show in Appendix C.3 that $\mathrm{d}\log Q_i$ decreases with β in the third market but decreases on β in the focal market. That is, stronger entry interdependence shifts more of the consumption loss toward third markets and attenuates it in the focal market. This is the same incidence pattern as in the homogeneous-firm case.

5.2 Tariff uncertainty

In this section, we consider an alternative class of generalized CES demand systems introduced by Matsuyama and Ushchev (2017), namely homothetic demand with a single aggregator (HSA). We extend the model to incorporate tariff uncertainty and show that the sufficient-statistics formulas derived in Section 4 continue to hold in this environment. The detailed analysis is presented in Appendix D.

We modify the demand system in the baseline model as follows: the inner nest is replaced by HSA preferences, and the outer-nest demand is fully CES. Let $t_i p_\omega^i$ denote the consumer price of variety ω. Variety demand is characterized by a linearly homogeneous price aggregator A_i and a non-negative and decreasing market share function $s(\cdot)$ that satisfy

$$\int_{\Omega_i} s\left(\frac{t_i p_\omega^i}{A_i}\right) \mathrm{d}\omega = 1, \tag{29}$$

where $s(t_i p_\omega^i / A_i)$ delivers the expenditure share of variety ω among all home varieties exported to destination i. We use $\tilde{P}_i^I \equiv t_i P_i^I$ to denote the associated (consumer) ideal price index.[14] Next, the CES outer nest implies that expenditure on home varieties in market i is $E_i(\tilde{P}_i^I) = D_i^{\eta_i}(\tilde{P}_i^I)^{1-\eta_i}$, where η_i is the constant elasticity of substitution. The resulting quantity of the sectoral composite is $Q_i = E_i/\tilde{P}_i^I$. We also carry over the notations δ_i, σ_i, and ρ_i to the HSA case, although their expressions differ from those in the HDIA case.

We now incorporate tariff uncertainty into the baseline model. Homogeneous firms share the same beliefs about tariffs and make pre-entry investment accordingly. Tariffs are realized with market access, firms then decide on production and exporting. We denote the expected tariff in market i by t_i^e and the realized tariff by t_i. The former is a random variable and collapses to the latter in the absence of tariff uncertainty. To characterize comparative statics with respect to tariff expectations, we consider proportional shifts in beliefs of the form $t_i^e \to (1+\varepsilon_i)t_i^e$, or $\mathrm{d}\log t_i^e = \varepsilon_i$, if we slightly abuse the notation. We call ε_i the expected tariff change. We continue to denote the realized tariff change by $\mathrm{d}\log t_i$.

We solve the equilibrium backwardly in two steps. We first solve for firms' profit in market i conditional on the realized tariffs and the number of active firms. Firms take as given the

[14] Matsuyama and Ushchev (2020) show that the (consumer) ideal price index satisfies

$$\log\left(\tilde{P}_i^I\right) = C + \log(A_i) - \int_{\omega\in\Omega_i}\int_{\frac{t_i p_\omega^i}{A_i}}^{\infty} \frac{s(\zeta)}{\zeta}\mathrm{d}\zeta\mathrm{d}\omega,$$

where C is some normalization constant.

ideal price index $t_i P_i^I$ and the price aggregator A_i in each market. Their profits in market i are given by

$$\pi_i(t_i P_i^I, A_i) = \max_p \; E_i(t_i P_i^I) s\left(\frac{t_i p}{A_i}\right) \frac{p - \frac{\tau_i}{z}}{t_i p}.$$

Let $P_i \equiv A_i/t_i$ denote the ex-tariff price aggregator. The optimal pricing is then given by the markup rule, i.e., $p_i = \frac{\sigma(\upsilon_i)}{\sigma(\upsilon_i)-1}\frac{\tau_i}{z}$, where $\upsilon_i = \frac{p_i}{P_i}$. Meanwhile, the HSA demand in market i implies that

$$N_i s\left(\frac{t_i p_i}{A_i}\right) = N_i s\left(\upsilon_i\right) = 1 \Rightarrow \upsilon_i = \upsilon(N_i) = s^{-1}\left(\frac{1}{N_i}\right),$$

in which N_i is the number of active exporters in market i. Hence, the equilibrium υ_i, is only determined by N_i, and we could write

$$\pi_i(t_i P_i^I, A_i) = \pi_i(N_i, t_i) = \frac{E_i(t_i P_i^I(N_i))}{N_i t_i \; \sigma(\upsilon(N_i))}, \tag{30}$$

where the producer ideal price index $P_i^I(N_i)$ is implied by the HSA demand system.

We then follow the strategy in Section 4.1 to solve N_i and M. Let the expected variable profits be $\pi_i^e(N_i) = \mathbb{E}_{t_i^e}[\pi_i(N_i, t_i^e)]$, and the expected present value $\bar{\pi}_i = \frac{\pi_i^e - f_i}{\varrho + \nu_i}$. Combining optimal entry intensity in (14), the exporter flow-balance condition (18) and the free entry condition, N_i and M are determined by

$$\pi_i^e(N_i) = (\varrho + \nu_i)\left(\frac{\nu_i N_i}{h_i M}\right)^{\frac{\beta}{1-\beta}} \frac{f_e}{h_i} + f_i, \qquad \text{and} \qquad \sum_{i \in \mathscr{I}} (h_i \bar{\pi}_i(N_i))^{\frac{1}{\beta}} = f_e^{\frac{1}{\beta}},$$

which parallels equations (20) and (21).

An immediate implication of the foregoing analysis is that M and N_i are determined at the entry stage and only depend on tariff expectations. Although firms choose prices p_i ex post, they depend only on N_i and are then independent of realized tariffs. To summarize, uncertain tariff affects firms' entry decisions in the same way as deterministic tariffs, while realized tariffs only shift firms' residual demand. It is then straightforward to verify that the baseline comparative statics hold in the presence of tariff uncertainty. We present below the counterpart of Proposition 2 and 3 and leave the comparative statics of other variables to the appendix.

Proposition 6. *Suppose that Assumption 1 holds in the initial equilibrium. Given a set of shifts in tariff expectations* $\mathrm{d}\log t_i^e = \varepsilon_i$*, the changes in the entrant pool and market-specific active exporters satisfy*

$$\mathrm{d}\log M = \sum_i \widetilde{s}_i \cdot \frac{-\varepsilon_i}{\theta_i^{\mathrm{HSA}}}, \qquad \mathrm{d}\log N_i = (1-\xi_i)\mathrm{d}\log M - \xi_i \frac{\varepsilon_i}{\theta_i^{\mathrm{HSA}}},$$

where $\widetilde{s}_i$ *and* ξ_i *follow* (23)*, while the expression of* θ_i^{HSA} *is given in the appendix.*

5.3 Non-CRS production function

The baseline CRS assumption rules out within-firm production-cost linkages across destinations. Under decreasing returns, however, a tariff-induced contraction in output lowers marginal cost, encouraging continuing firms to expand sales in third markets. This raises a natural question: can the contraction in entry still generate export contraction when firms have this incentive to divert sales? We relax CRS and show that the entry response outweighs this offsetting adjustment, so aggregate exports still fall in third markets.

To sharpen the analysis, we consider a static version of the model à la Krugman (1980), in which homogeneous firms pay to enter and obtain access to all markets, with no exit or discounting.[15] Full details are provided in Appendix E. We focus on an interior equilibrium in which every entrant serves every destination, so $N_i = M$. A common inner-nest aggregator Υ then implies that the demand statistics σ, δ, and ρ are common across markets, while market sizes, outer-nest elasticities η_i, and iceberg costs τ_i may still differ.

Production is given by $q^f = l^\alpha$, where $\alpha > 0$ and $q^f = \sum_i \tau_i q_i$ includes shipments lost in transit. Let $c = c(q^f)$ denote marginal cost and define its negative output elasticity as

$$\psi \equiv -\frac{\mathrm{d}\log c}{\mathrm{d}\log q^f} = 1 - \frac{1}{\alpha}.$$

Thus, $\psi < 0$, $\psi = 0$, and $\psi > 0$ correspond to decreasing, constant, and increasing returns, respectively. We impose $\psi < 1/\sigma$ to ensure positive firm-level operating profits. The following proposition extends Proposition 2 to this production technology.

[15] This setup imposes stronger restrictions than the earlier special case of Melitz entry ($\beta \to 1$). With non-CRS production, firms with identical productivity can have different marginal costs if they gain access to different markets. Deterministic access to all markets simplifies the analysis by ensuring that firms remain homogeneous after entry.

Proposition 7. *Suppose that Assumption 1 holds in the initial equilibrium. Given a set of tariff changes* $\{\mathrm{d}\log t_i\}_{i\in\mathscr{I}}$*, the changes in the entrant pool and firms' marginal cost satisfy*

$$\mathrm{d}\log M = \sum_i \tilde{s}_i \cdot \frac{-\mathrm{d}\log t_i}{\theta_i^{\mathrm{NC}}}, \qquad \mathrm{d}\log c = -\frac{\psi\delta}{1-\psi\sigma}\left(\frac{1}{\rho}-1\right)\mathrm{d}\log M,$$

where $\tilde{s}_i$ *has the same expression as in the Melitz-entry limit* ($\beta \to 1$) *of* (23)*, and*

$$\theta_i^{\mathrm{NC}} \equiv \left(\frac{1}{\eta_i}-\frac{1}{\sigma}\right)\left(\frac{1}{\rho}-1\right)\frac{\delta}{1-\psi\sigma}+1-\frac{\eta_i-1}{\eta_i}\delta > 0.$$

The entry response retains the same form, with the market-specific extensive-margin adjustment θ_i^{NC} now incorporating marginal-cost adjustment through ψ. When $\psi = 0$, the expressions reduce to the baseline Melitz-entry special case. A unilateral tariff increase therefore reduces entry and the number of exporters in every market. When $\rho < 1$, marginal cost falls under decreasing returns and rises under increasing returns; it is unchanged under constant returns or complete pass-through.

Finally, the change in aggregate export revenue satisfies

$$\mathrm{d}\log R_i = (\eta_i - 1)\underbrace{\left[\delta - 1 + \frac{\delta}{\sigma(1-\psi\sigma)}\left(\frac{1}{\rho}-1\right)\right]}_{>0}\mathrm{d}\log M - \eta_i \mathrm{d}\log t_i.$$

Thus, aggregate exports fall in both focal and third markets. Holding the entry response fixed, decreasing returns ($\psi < 0$) attenuate its effect on revenue, while increasing returns ($\psi > 0$) amplify it. The cost reduction under decreasing returns supports continuing firms' third-market sales, but never outweighs the aggregate contraction from fewer exporters. The entry-based explanation for export contraction therefore remains valid with production-cost linkages across markets.

5.4 Endogenous foreign demand

Foreign demand for home exports is exogenous in the baseline model. In this section, we endogenize foreign demand by introducing oligopolistic competition in destination markets. The extension shows how tariffs affect foreign producers in both focal and third markets and how the outer-nest parameter η_i captures the effective demand elasticity of home exports, accounting for competitors' pricing and adjustments in sectoral expenditure. Appendix F contains the derivations.

In each market i, consumers substitute between the home composite, priced at P_i^I, and a foreign composite supplied by other producers, priced at P_i^f, with constant elasticity $\bar{\eta}_i > 1$. Let E_i^S denote total expenditure on both composites ("sectoral expenditure") and $\alpha_i^S \equiv P_i^I Q_i / E_i^S \in (0,1)$ the home expenditure share. Demand for the home composite is then $Q_i = E_i^S (P_i^I)^{-\bar{\eta}_i} (P_i^S)^{\bar{\eta}_i - 1}$, where the sectoral price index is $P_i^S = [(P_i^I)^{1-\bar{\eta}_i} + (P_i^f)^{1-\bar{\eta}_i}]^{1/(1-\bar{\eta}_i)}$. Demand therefore responds to both competitors' prices and sectoral expenditure. We assume a sectoral demand elasticity of $\phi_i \in [1, \bar{\eta}_i]$: substitution across sectors is no stronger than substitution between the composites. Sectoral expenditure then satisfies

$$\mathrm{d} \log E_i^S = (1 - \phi_i) \mathrm{d} \log P_i^S.$$

On the production side, home firms retain their baseline pricing and entry decisions. A representative foreign composite producer sets P_i^f to maximize profit, taking P_i^I and E_i^S as given. The resulting price response to changes in P_i^I and E_i^S is

$$\mathrm{d} \log P_i^f = \eta_i^c \mathrm{d} \log P_i^I + \eta_i^e \mathrm{d} \log E_i^S,$$

where $\eta_i^c < 1$ measures the response to home prices and η_i^e measures the response to sectoral expenditure. Foreign production can exhibit increasing, constant, or decreasing returns.

Combining competitors' pricing responses with expenditure adjustment gives

$$\mathrm{d} \log P_i^S = \kappa_i \mathrm{d} \log P_i^I, \qquad \text{where } \kappa_i \equiv \frac{\alpha_i^S + (1 - \alpha_i^S)\eta_i^c}{1 + \eta_i^e (\phi_i - 1)(1 - \alpha_i^S)} \in (0,1).$$

Thus, an increase in the home composite price raises the sectoral price less than proportionally. Finally, we obtain the effective demand elasticity of home exports:

$$\mathrm{d} \log Q_i = -\eta_i \mathrm{d} \log P_i^I, \qquad \text{where } \eta_i \equiv \phi_i \kappa_i + \bar{\eta}_i (1 - \kappa_i) \in (\phi_i, \bar{\eta}_i).$$

Thus, η_i incorporates competitors' strategic responses and substitution across sectors; it is a weighted average of the sectoral demand elasticity and the elasticity of substitution between the home and foreign composites. Provided Assumption 1 holds with this effective elasticity, the comparative statics in Section 4 continue to apply: a unilateral tariff reduces entry and aggregate home exports in every destination and raises the home composite price P_i^I.

The extension also clarifies the protection afforded to competing suppliers. The foreign

expenditure share rises as the home share falls:

$$\mathrm{d}\log \alpha_i^S = -(\bar{\eta}_i - 1)(1 - \kappa_i)\mathrm{d}\log P_i^I < 0.$$

Home exporters therefore lose market share in both focal and third markets. Through entry interdependence, the protective effects of a unilateral tariff extend beyond the imposing country: reduced global entry weakens competition from home exporters even in destinations that leave their tariffs unchanged.

6 Quantitative Analysis

In this section, we confront the model with data. We first show that a calibrated model accounts well for the observed tariff responses and then highlight the role of β in transmitting tariff shocks across countries using counterfactual exercises.

6.1 Parameter Identification

We calibrate a version of the model with homogeneous firms and symmetric markets to account for the tariff responses documented in Section 2. This approach has two advantages. First, the assumptions align the model with our empirical moments: market symmetry is consistent with our estimates of the average effects of AD investigations across markets, while firm homogeneity provides a direct mapping between the model's entry and per-firm export responses and the empirical extensive and intensive margins. Second, the sufficient-statistics formulas in Section 4.2 allow us to recover the model parameters directly by inverting the estimated tariff responses, without imposing a parametric functional form on the Kimball aggregator Υ. We detail this identification strategy below.

Identifying η and β. From Proposition 3, the difference in the change in export revenue (normalized by the change in the number of exporters) between the focal market j and a typical third market i satisfies

$$\frac{\mathrm{d}\log \bar{r}_j}{\mathrm{d}\log N_j} - \frac{\mathrm{d}\log \bar{r}_i}{\mathrm{d}\log N_i} = -\eta \frac{\mathrm{d}\log t_j}{\mathrm{d}\log N_j}. \tag{31}$$

Intuitively, the focal market has a larger response than the third market because exporters face an actual tariff there, and the impact of the tariff is governed by the demand elasticity

in the upper nest. The four log changes on the left-hand side all correspond to regression coefficients. Since the response of the third market average revenue (see Table 1), as well as the firm-level revenue in Appendix A.8, is insignificantly different from zero, we set $\mathrm{d}\log \bar{r}_i = 0$ and use the estimated $\mathrm{d}\log \bar{r}_j$, $\mathrm{d}\log N_j$, and $\mathrm{d}\log N_i$ directly. In our data, the average AD duty, weighted by the share of each country as a focal market across all export destinations, is 84.5% (Appendix Table A.5), and then $\mathrm{d}\log t_j = 0.61$. Substituting these estimates from Table 1 into (31), we obtain $\eta = 1.17$.

The entry interdependence parameter β governs how much of the entry response spills over across markets. Under symmetry, equation (25) implies that

$$\mathrm{d}\log N_i = -\left(\frac{1-\xi}{L} + \xi \times 1\{i=j\}\right)\frac{\mathrm{d}\log t_j}{\theta},$$

where θ is the extensive-margin adjustment defined in equation (24). Let $\hat{n} \equiv \mathrm{d}\log N_i / \mathrm{d}\log N_j$ denote the ratio of the third-market to the focal-market entry response. Solving for θ and the influence ξ gives

$$\xi = \frac{1-\hat{n}}{1+(L-1)\hat{n}}, \qquad \theta = -\frac{\mathrm{d}\log t_j}{\mathrm{d}\log N_j}\frac{1}{1+(L-1)\hat{n}}.$$

To compute ξ and θ, we set the total number of markets to 8 ($L = 8$) to approximate the 11.8% average focal share of global exports (Appendix Table A.5).[16]

Given η, θ and ξ, we obtain the following expression for β using the definition of ξ in (23):

$$\frac{1}{1-f/\pi}\frac{1-\beta}{\beta} = \frac{1}{\eta\theta}\frac{\xi}{1-\xi}.$$

Two observations follow. First, a higher $\hat{n}$ (more transmission) implies a lower ξ and a higher β, which is the key for us to identify β. Second, when targeting $\mathrm{d}\log N_i$ and $\mathrm{d}\log N_j$ and recovering ξ and θ, we can only identify the composite $\frac{1}{1-f/\pi}\frac{1-\beta}{\beta}$; separately identifying β requires an additional restriction on the fixed-cost-to-profit ratio f/π. We assume that $f/\pi = 0$ for the baseline calibration since estimates from the exporter dynamics literature

[16] We obtain the tariff response moments from the Chinese customs data, so we see our model best as a description of how firms enter the foreign markets. If we interpret our model as firm entry to all markets, including the domestic one, we need to use the focal share of global sales rather than global exports, which is likely smaller than 11.8%. In Appendix G.4 (Tables A.12 and A.13), we conduct robustness checks using alternative L to match different focal market shares.

suggest that f/π is small. We show in Appendix G.3 that, over the literature-implied range of f/π, β remains close to the baseline value.[17] Because the targeted moments pin down ξ and θ regardless of f/π, a positive f/π raises the calibrated β but leaves all other parameters and the model-implied tariff responses unchanged.

Identifying the local demand statistics. Given η and β, three additional moments exactly identify the local demand statistics σ, δ, and ρ. We target: (i) the θ calibrated above, which ensures that we can match $\mathrm{d}\log N_j$ and $\mathrm{d}\log N_i$; (ii) the change in third market per-exporter revenue, $\mathrm{d}\log \bar{r}_i = 0$, which together with the calibrated η also matches $\mathrm{d}\log \bar{r}_j$, as in equation (31); and (iii) the change in focal market unit value $\mathrm{d}\log p_j^m$. For example, the last moment can be expressed as

$$\mathrm{d}\log p_j^m = -\left(\frac{1}{\rho} - 1\right)\frac{\delta}{\sigma}\mathrm{d}\log N_j.$$

Exporters charge higher prices because there is less competition (lower N_j). The strength of the response depends on ρ, the cost pass-through. In the CES special case, $\rho = 1$, and the model would predict no price change even when the number of exporters drops. The same relation holds in the third market, with $\mathrm{d}\log p_i^m$ proportional to $\mathrm{d}\log N_i$ by the same coefficient. Because the coefficient $\left(\frac{1}{\rho} - 1\right)\frac{\delta}{\sigma}$ is common across markets under symmetry, the model can match only one of the two normalized price responses, $\mathrm{d}\log p_j^m/\mathrm{d}\log N_j$ or $\mathrm{d}\log p_i^m/\mathrm{d}\log N_i$. Matching the third-market response would imply a larger focal price change than the data. To be conservative, we match $\mathrm{d}\log p_j^m$.

6.2 Calibration Results

Table 2a reports the calibrated values of the model parameters and equilibrium variables. First, the calibrated parameter values satisfy the conditions outlined in Assumption 1. Second, the calibrated value of the entry-dependence parameter, β, lies neither near zero nor close to one. This supports the importance of allowing for a general form of the entry technology, as specified in equation (13). Finally, the calibrated value of ρ implies incomplete but high cost pass-through, and the value is close to the range estimated by Corsetti et al.

[17] Das et al. (2007) and Alessandria and Choi (2007) estimate fixed export costs of about 1% to 2% of annual export revenue, and Ruhl and Willis (2017) estimate 1% to 7.7% of a new entrant's first-year export revenue. With our calibrated σ, these imply f/π between 1.9% and 14.7%. In Table A.11, we report the calibrated value of β for alternative values of f/π. Under symmetric markets, the value of f/π also does not affect the model counterfactuals at $\beta = 0$ or $\beta \to 1$.

(2023) for the Chinese exporters (0.93-0.95).

Table 2: Calibration Targets and Results

(a) Calibrated parameters

	Parameter	Rough Targets	Value
η	upper-nest demand elas.	response diff in $\bar{r}$, eq (31)	1.17
β	entry interdependence	$\mathrm{d}\log N_i/\mathrm{d}\log N_j$	0.46
σ		$\mathrm{d}\log \bar{r}_j$ (equivalently, $\mathrm{d}\log \bar{r}_i$)	1.91
δ	local elasticities (joint)	$\mathrm{d}\log N_j$ (equivalently, $\mathrm{d}\log N_i$)	6.69
ρ		$\mathrm{d}\log p_j^m$	0.91

(b) Data and model moments

	Focal market (j)			Third markets (i)		
	$\mathrm{d}\log \bar{r}_j$	$\mathrm{d}\log N_j$	$\mathrm{d}\log p_j^m$	$\mathrm{d}\log \bar{r}_i$	$\mathrm{d}\log N_i$	$\mathrm{d}\log p_i^m$
Data	-0.714	-0.829	0.286	-0.061	-0.208	0.126
	(0.273)	(0.146)	(0.150)	(0.078)	(0.079)	(0.066)
Targeted	-0.714	-0.829	0.286	0.000	-0.208	0.126
Model	-0.714	-0.829	0.286	0.000	-0.208	0.072

Notes. Standard errors of the estimated coefficients in parentheses. The calibration targets $\mathrm{d}\log \bar{r}_i = 0$, the estimated $\mathrm{d}\log \bar{r}_j$, $\mathrm{d}\log N_j$, and $\mathrm{d}\log N_i$, and the focal unit-value response $\mathrm{d}\log p_j^m$; the third-market unit-value response is untargeted. The "Model" row reports the model-implied equilibrium responses under the calibrated parameters in panel (a).

The first row in Table 3 reports the model implied changes in the focal and third markets under the calibrated β. As shown in Table 2b, the calibration exactly matches the targeted moments; the only untargeted moment, the third-market unit value, is underpredicted by the model (0.072 versus 0.126 in the data), though the gap is within one standard error of the empirical estimate.

Consistent with Assumption 1, our calibration yields $\sigma > \eta$, and the moderate gap between the two demand elasticities is natural in this setting: within the same product category, Chinese varieties should remain substitutable both with one another and with foreign varieties. The magnitude of η is closely related to the trade elasticity, which can differ substantially between the short run and the long run because the two are identified from different variation: long-run elasticities are often disciplined by cross-sectional variation in bilateral trade costs, whereas short-run elasticities are estimated from time-series responses of trade flows to changes in relative prices or trade costs (Ruhl, 2008; Boehm et al., 2023).[18] Because

[18]The former approach is best illustrated by Simonovska and Waugh (2014). For the latter approach, see

Table 3: Model-implied responses to 84.5% tariff

			Focal market (j)					Third markets (i)				
β	$\mathrm{d}\log M$	$\mathrm{d}\log Q_{\mathrm{agg}}$	$\mathrm{d}\log N_j$	$\mathrm{d}\log \bar{r}_j$	$\mathrm{d}\log p_j$	$\mathrm{d}\log Q_j$	Share	$\mathrm{d}\log N_i$	$\mathrm{d}\log \bar{r}_i$	$\mathrm{d}\log p_i$	$\mathrm{d}\log Q_i$	Share
Panel A: baseline calibration												
0.46	-28.6	-209.8	-82.9	-71.4	28.6	-654.4	39.0	-20.8	0.0	7.2	-146.3	61.0
Panel B: varying β												
1.00	-28.6	-209.8	-28.6	-71.4	9.9	-272.3	16.2	-28.6	0.0	9.9	-200.9	83.8
0.00	-28.6	-209.8	-228.5	-71.4	78.8	-1678.5	100.0	0.0	0.0	0.0	0.0	0.0
Panel C: CES version												
0.46	-28.6	-147.0	-82.9	-45.5	0.0	-472.3	40.1	-20.8	6.5	0.0	-100.6	59.9

Notes. All entries except Share are log changes multiplied by 100; Share is in percent. M: mass of active firms. $\bar{r}$: revenue per exporter. $\mathrm{d}\log Q_{\mathrm{agg}} = \sum_i \mathrm{d}\log Q_i/L$. Share: market's contribution to $\mathrm{d}\log Q_{\mathrm{agg}}$. Symmetric equilibrium with $L = 8$ markets. 84.5% tariff ($\mathrm{d}\log t_j = \ln(1.845) \approx 0.61$) on focal market only. Calibrated parameters are reported in Table 2a.

the moments identifying η are the over-time intensive- and extensive-margin responses to tariff shocks in a relatively short horizon, our calibration is closest to the latter approach—in particular to Boehm et al. (2023), whose horizon-specific tariff elasticities range from about -0.75 in 1 year to -2.12 in 10 years. Our calibrated η lies within this range.

In the first row of Table 3, we also predict the impact on sectoral consumption of Chinese goods, for which we do not have direct empirical counterparts. The decline in aggregate consumption—driven by both the reduction in the number of exporters and the increase in prices—is far larger in the focal market (6.54 log points) than in a typical third market (1.46 log points); but because there are seven third markets and only one focal market, the third markets jointly account for 61.0% of the reduction in global aggregate consumption, $\mathrm{d}\log Q_{\mathrm{agg}} \equiv \sum_i \mathrm{d}\log Q_i/L$.

Panel B of Table 3 examines how the entry-interdependence parameter β affects the transmission of tariff shocks across markets. We conduct the thought experiment in Section 4.4 at two polar cases: the independent entry case $\beta = 0$, and the Melitz-style common entry case $\beta \to 1$. With $\beta \to 1$, the model substantially overpredicts the spillover effect to the third market and underpredicts it for the focal market, a discrepancy primarily driven by changes in the number of exporting firms; with $\beta = 0$, the spillover effect disappears.[19] We

Hooper et al. (2000), Fitzgerald and Haller (2018), Fontagné et al. (2018), and Boehm et al. (2023).

[19]Note from Table 3 that $\mathrm{d}\log M$ and $\mathrm{d}\log Q_{\mathrm{agg}}$ are independent of β. In a symmetric equilibrium, β governs how firm entry is distributed across markets but not the total entry. Appendix G.1 provides the derivation.

then verify that entry interdependence is quantitatively important in shaping the incidence of tariffs across destinations.

Panel C of Table 3 examines the role of the variable markups by replacing the benchmark HDIA demand with CES demand. The demand structure does not affect the calibration strategy of η and β, but it does change the local demand statistics: under CES demand, $\delta = \sigma/(\sigma - 1)$ and $\rho = 1$, so only σ needs to be recalibrated. We choose σ to match the change in the number of exporters in focal and third markets, and obtain $\sigma = 1.24$ (Appendix G.2 provides the details). With $\rho = 1$, the model predicts no responses in the unit values in either the focal or the third markets and cannot match these data moments. As a result, the changes in export quantities in the focal and third markets are much smaller than those in the benchmark case. The global aggregate consumption loss, $\mathrm{d}\log Q_{\text{agg}}$, is 1.47 log points, about 30% smaller than the loss in the benchmark case.

Another observation of Panel C is that under CES demand, our calibrated version predicts a 6.5% increase in per-exporter sales ($\mathrm{d}\log \bar{r}_i = 0.065$) in third markets, which cannot match our target of zero, and even further away from the observed (insignificant) -6.1% ($\mathrm{d}\log \bar{r}_i = -0.061$). This is because profits are proportional to sales in each market. Due to free entry, the expected global profits do not change, and the per-exporter profits and sales in the third markets must rise. Therefore, the CES demand will not only underpredict the price responses, but also miss the intensive margin of per-exporter sales.

7 Conclusion

A tariff need not divert the targeted country's exports toward unrestricted destinations. Anti-dumping investigations against Chinese products instead reduce exports in those third markets by about 27% after six years, driven mainly by reduced entry. We explain these findings in an industry equilibrium model with interdependent pre-entry investment and variable-markup demand. A tariff lowers the return to entering the industry, reducing entry across interdependent markets. Weakened competition then makes home exports more expensive, causing aggregate export values to fall even in destinations where no new barriers are imposed. A calibration of the model suggests that this entry mechanism explains well the observed tariff responses in both focal and third markets.

These results show that the incidence of unilateral trade policy extends beyond the countries directly involved. Reduced entry by the targeted country's firms provides indirect protection to producers in third countries, while consumers there face higher prices and fewer

varieties. These spillovers can be substantial: in our calibration, third markets account for 61% of the global decline in consumption of Chinese exports. Focusing only on the imposing and targeted countries therefore misses a large share of the tariff's effects and may mischaracterize third countries' incentives in trade negotiations. Our analysis provides a first step toward understanding how entry interdependence shapes these incentives. A natural next step is to embed the entry mechanism in a multi-country general equilibrium framework with endogenous wages and expenditure. Such a framework would allow us to evaluate entry responses and terms-of-trade effects jointly and assess how entry interdependence changes optimal unilateral tariffs and the gains from international policy coordination.

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Supplementary Appendix to

"Firm Entry and Market Interdependence"

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September 2026

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A Additional Empirical Results

A.1 Sample construction and descriptive statistics

Table A.1: AD duties and focal market shares by investigating country

Country	Obs	Duty (%)	Focal Share
United States	224	157.4	0.228
India	209		0.088
Turkey	147	60.8	0.036
European Union	138	41.8	0.221
Argentina	118	521.5	0.036
Canada	68	43.2	0.276
Brazil	58	31.1	0.057
Peru	45		0.005
Colombia	45		0.114
Indonesia	31		0.059
Australia	28		0.032
Korea	27	27.5	0.124
Russian Federation (the)	24		0.050
Mexico	19	149.6	0.023
South Africa	16	55.5	
Taiwan (Province of China)	15	91.6	0.058
Ukraine	13		0.009
Pakistan	12	25.3	0.042
Israel	10	100.7	0.004
Trinidad and Tobago	6		
New Zealand	4	81.3	0.024
Morocco	3		
Egypt	2		0.005
Jamaica	2	89.8	
Kazakhstan	1		
Japan	1		0.456
Uruguay	1	35.0	0.004
Global	1267	84.5	0.118

Notes. Cases initiated between 2000 and 2011 in the estimation sample. Obs: number of passed cases. Duty: the average AD duty the country imposes on China across its cases, in percent; blank where no duty rate is recorded. Focal Share: the share of China's exports to the investigating country in its total exports of the investigated product in the year before initiation, averaged across the country's cases. In the Global row, duties are weighted by focal share and focal shares by the number of cases.

Table A.2: Sampling restrictions for AD cases

Steps	Add requirement	# of HS6	# of HS6-Country	# of HS6-Country (EU as one)
1	Initiation year in 2000-11	783	4738	1147
2	Drop outliers: final - initiation year >5	778	4733	1142
3	Unique initiation year	560	2475	585
4	Last more than 5 years	523	2327	545
5	Revoked later than 2011+1	456	1795	472

Notes: The table reports how the sample changes as we impose the restrictions used in the main text. The final row corresponds to the restricted AD sample used in the detrended specifications.

Table A.3: Duration of AD cases against China, initiated 2000-2011

			Duration (years)				
Sample	# cases	% censored	Mean	p25	Median	p75	Max
All passed cases (truncated at 2020)	510	57.8	11.3	7	11	14	20
Revoked cases only	215	–	7.9	6	7	11	18
Final estimation sample (truncated at 2020)	472	66.3	12.3	10	12	15	20

Notes: The table describes the duration of anti-dumping cases (passed cases only) that China faced, initiated between 2000 and 2011, using the GAD2020 (TTBD 2020 vintage) data. Duration is measured in years as the end year minus the initiation (investigation) year. In the first row (truncated), all passed cases are kept and a case not yet revoked by 2020 is right-censored at 2020 (the data vintage); "% censored" reports the share of such cases. In the second row, only cases that were revoked are kept and the duration uses the revocation year as the end year. The first two rows are at the case level. The third row reports the truncated duration for the final estimation sample used in the event studies (HS6-by-country units, with the EU treated as one entity, that survive all sampling restrictions in Table A.2).

Example of defining control groups Table A.4 presents an actual case to illustrate our definitions of treated and control groups. In Jan 2004, the U.S. initiated an AD case on "certain frozen and canned warm water shrimp and prawns" (HS6 code 160520). The case received preliminary and final determinations in July 2004 and Feb 2005, respectively. We define the focal treated market as frozen and canned shrimps and prawns (160520) sold in the U.S. Within the HS4 code of 1605, there are two other six-digit products, preserved crabs (160510) and lobsters (160530). We define the focal control market as those two products sold in the U.S. Other countries that do not initiate AD investigations against Chinese preserved shrimps and prawns belong to "third markets", such as Japan. A typical third treated market is frozen and canned shrimps and prawns (160520) sold in Japan, while a typical third control markets are preserved crabs (160510) and lobsters (160530) sold in Japan.

Table A.4: Defining focal (third) markets and control groups: an example

Market	Country, i	HS6, h	HS6 Description
Focal treated	United States	160520	shrimps and prawns
Focal control	United States	160510	crab
		160530	lobster
Third treated	Japan	160520	shrimps and prawns
Third control	Japan	160510	crab
		160530	lobster

Notes: focal/third treated and control markets in the example of the U.S. AD case on shrimps and prawns.

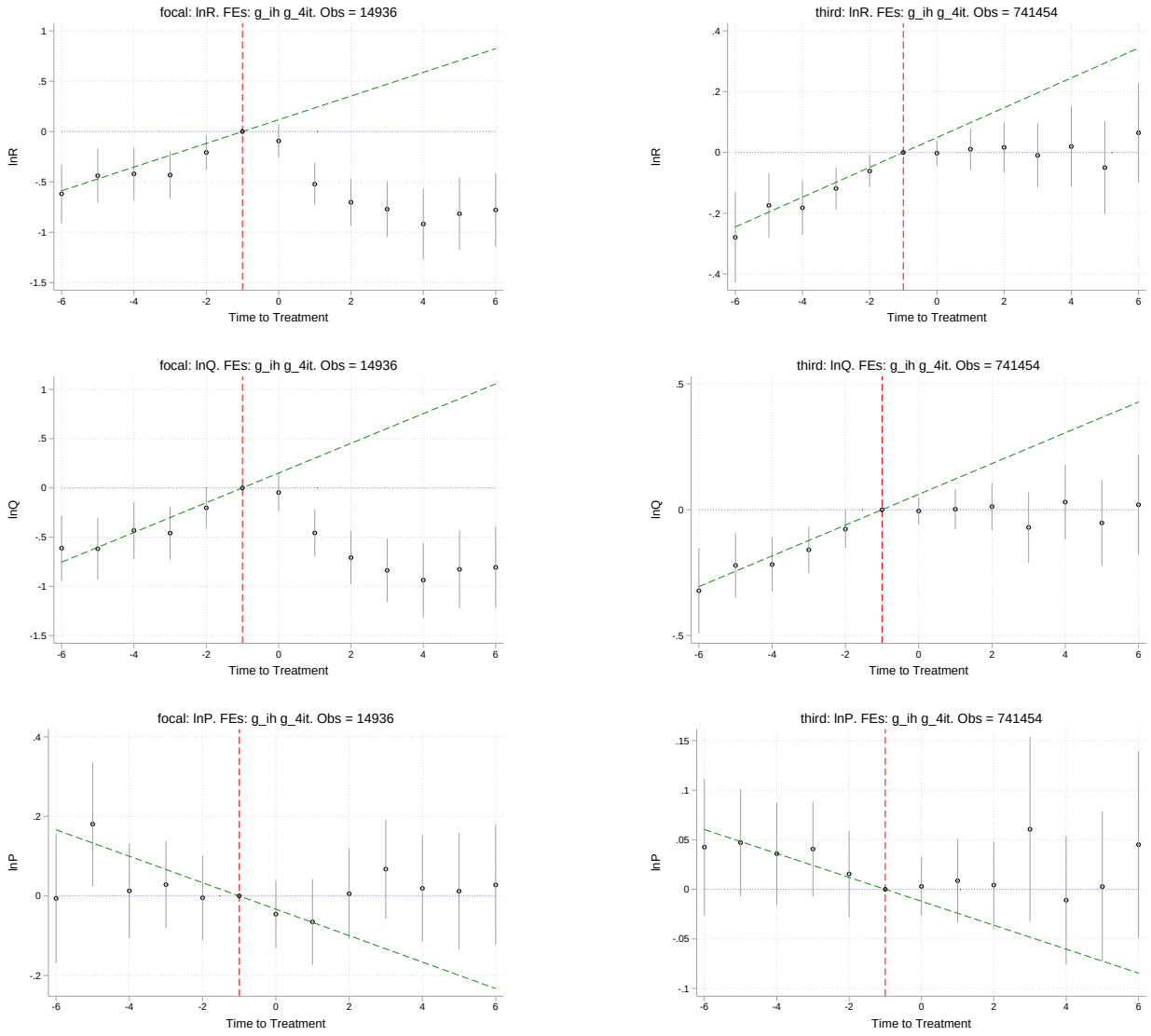
Table A.5: AD duties and focal market shares by investigating country

Country	Obs	Duty (%)	Focal Share
United States	224	157.4	0.228
India	209		0.088
Turkey	147	60.8	0.036
European Union	138	41.8	0.221
Argentina	118	521.5	0.036
Canada	68	43.2	0.276
Brazil	58	31.1	0.057
Peru	45		0.005
Colombia	45		0.114
Indonesia	31		0.059
Australia	28		0.032
Korea	27	27.5	0.124
Russian Federation (the)	24		0.050
Mexico	19	149.6	0.023
South Africa	16	55.5	
Taiwan (Province of China)	15	91.6	0.058
Ukraine	13		0.009
Pakistan	12	25.3	0.042
Israel	10	100.7	0.004
Trinidad and Tobago	6		
New Zealand	4	81.3	0.024
Morocco	3		
Egypt	2		0.005
Jamaica	2	89.8	
Kazakhstan	1		
Japan	1		0.456
Uruguay	1	35.0	0.004
Global	1267	84.5	0.118

Notes. Cases initiated between 2000 and 2011 in the estimation sample; countries with no passed case are omitted. Obs: number of passed cases. Duty: the average AD duty the country imposes on China across its cases, in percent; blank where no duty rate is recorded. Focal Share: the share of China's exports to the investigating country in its total exports of the investigated product in the year before initiation, averaged across the country's cases. In the Global row, duties are weighted by focal share and focal shares by the number of cases.

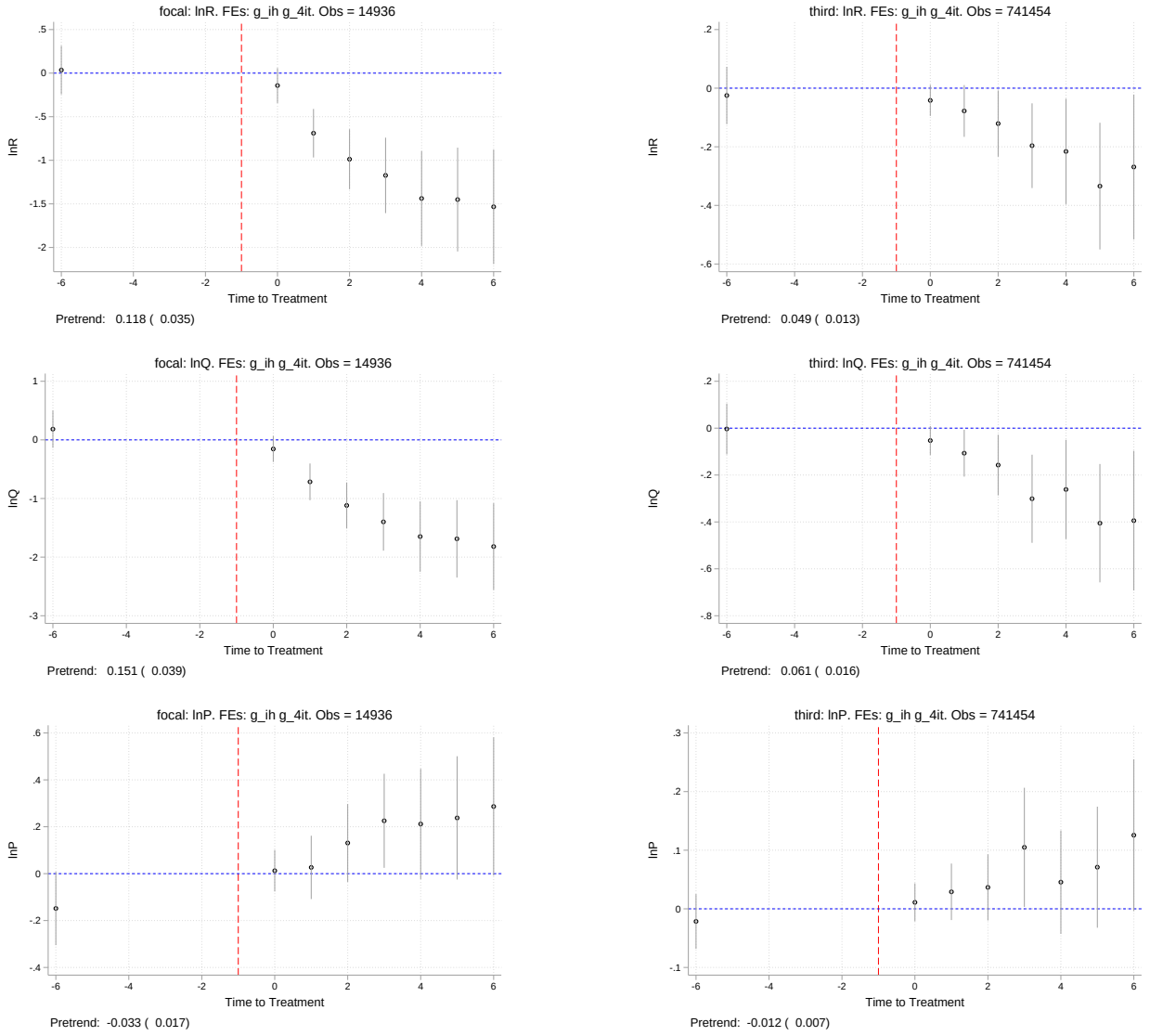
A.2 Main-result Event Studies

Figure A.1: Market-level event studies for export value, quantity, and unit value: baseline specification.



Notes: All specifications include country-HS6-product and country-HS4-product-year fixed effects. Standard errors are clustered at the HS6 product level.

Figure A.2: Market-level event studies for export value, quantity, and unit value: detrended specification.



Notes: All specifications include country-HS6-product and country-HS4-product-year fixed effects. Standard errors are clustered at the HS6 product level.

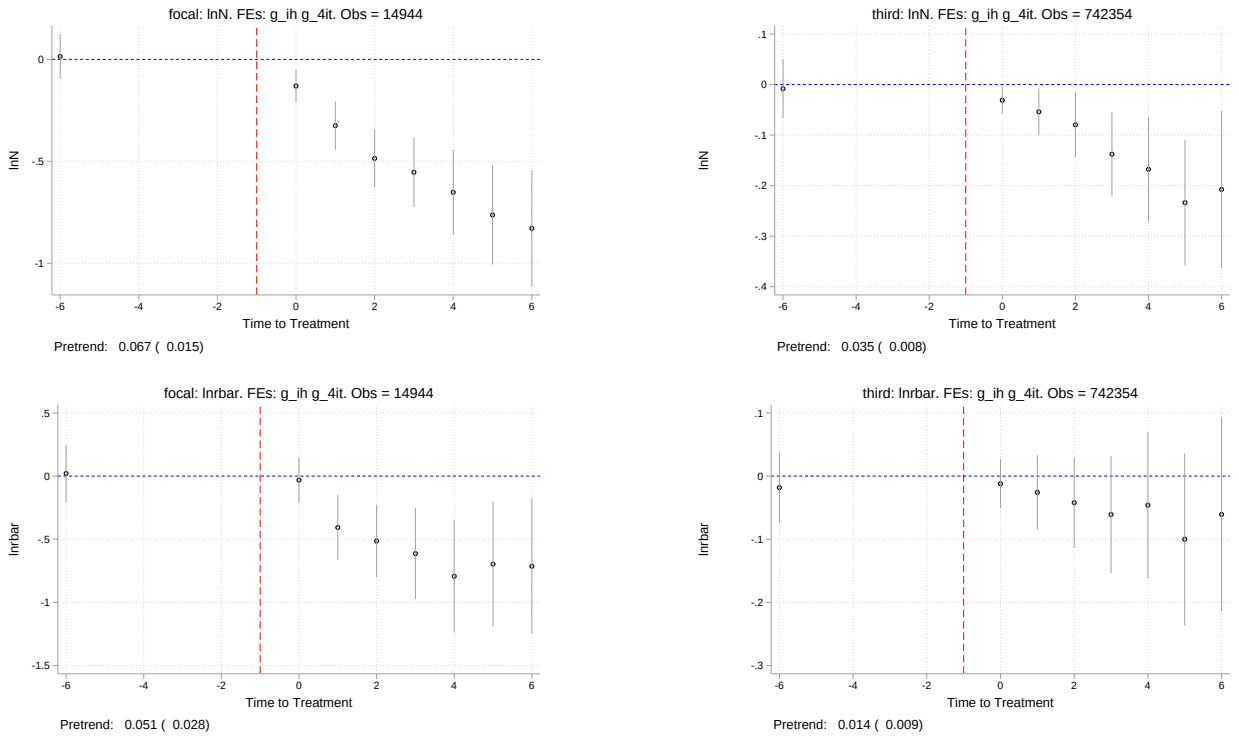
Table A.6: Event-study coefficients behind Figure 1: export value $\ln R$.

	Focal market			Third market		
	Event study	Detrended (raw)	Detrended (net of trend)	Event study	Detrended (raw)	Detrended (net of trend)
$t=-6$	-0.619^a	0.035	0.035	-0.279^a	-0.025	-0.025
	(0.148)	(0.142)	(0.142)	(0.076)	(0.050)	(0.050)
$t=-5$	-0.438^a			-0.174^a		
	(0.137)			(0.055)		
$t=-4$	-0.420^a			-0.182^a		
	(0.133)			(0.045)		
$t=-3$	-0.432^a			-0.119^a		
	(0.120)			(0.035)		
$t=-2$	-0.207^b			-0.061^b		
	(0.089)			(0.027)		
$t=0$	-0.093	-0.143	-0.143	-0.002	-0.042	-0.042
	(0.086)	(0.103)	(0.103)	(0.021)	(0.027)	(0.027)
$t=1$	-0.522^a	-0.572^a	-0.689^a	0.011	-0.029	-0.078^c
	(0.107)	(0.119)	(0.142)	(0.035)	(0.039)	(0.045)
$t=2$	-0.703^a	-0.752^a	-0.988^a	0.017	-0.023	-0.121^b
	(0.119)	(0.129)	(0.176)	(0.042)	(0.045)	(0.058)
$t=3$	-0.771^a	-0.820^a	-1.173^a	-0.010	-0.049	-0.196^a
	(0.142)	(0.150)	(0.221)	(0.054)	(0.056)	(0.074)
$t=4$	-0.918^a	-0.967^a	-1.438^a	0.019	-0.020	-0.216^b
	(0.179)	(0.186)	(0.278)	(0.067)	(0.069)	(0.092)
$t=5$	-0.816^a	-0.862^a	-1.450^a	-0.050	-0.089	-0.334^a
	(0.183)	(0.190)	(0.304)	(0.078)	(0.080)	(0.110)
$t=6$	-0.779^a	-0.827^a	-1.533^a	0.065	0.025	-0.269^b
	(0.186)	(0.191)	(0.335)	(0.083)	(0.085)	(0.126)
Linear pre-trend		0.118^a			0.049^a	
		(0.035)			(0.013)	
Observations	14,936	14,936	14,936	741,454	741,454	741,454
# of HS6	1,305	1,305	1,305	1,384	1,384	1,384
R^2	0.869	0.869		0.862	0.862	

Notes: The dependent variable is $\ln R$ and t denotes years since the initiation of the AD investigation. For each market, the first column reports the baseline event-study coefficients β_k from (1), with $t=-1$ as the omitted reference period. The second column reports the estimates of the detrended specification (2): the post-initiation coefficients β_k, the coefficient on the earliest event-time bin β_{-K}, and the linear pre-trend slope γ. The third column reports the treatment effects net of the extrapolated pre-trend, $\beta_k - \gamma k$, which are the estimates plotted in the bottom row of Figure 1; effects in the pre-initiation periods are zero by construction and are left blank. All specifications include country-HS6-product and country-HS4-product-year fixed effects. Standard errors clustered at the HS6 product level are in parentheses. Superscripts a, b, and c denote significance at the 1, 5, and 10 percent levels.

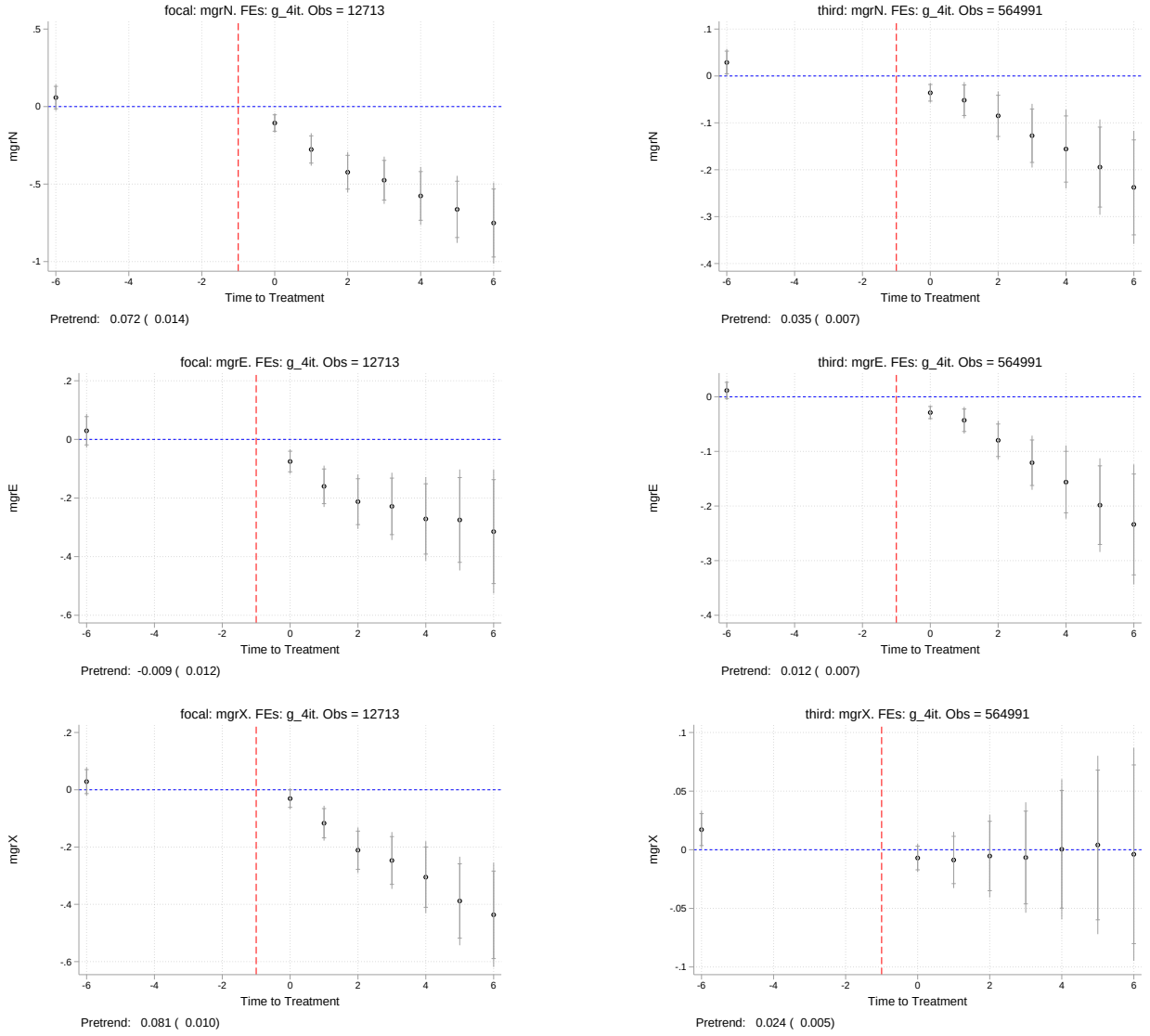
A.3 Decomposition Details

Figure A.3: Extensive-intensive decomposition at the market level.



Notes: The top row plots the response of the number of exporters, $\ln N$, and the bottom row plots average revenue per firm, $\ln \bar{r}$.

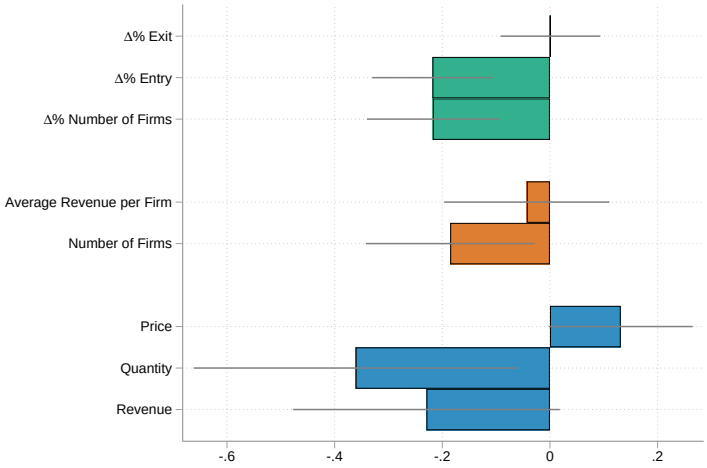
Figure A.4: Entry-exit decomposition using first-difference regressions.



Notes: The first row reports midpoint growth in the number of exporters, the second row the entry component, and the third row the exit component. All specifications include country-HS4-product-year fixed effects, and standard errors are clustered at the HS6 product level.

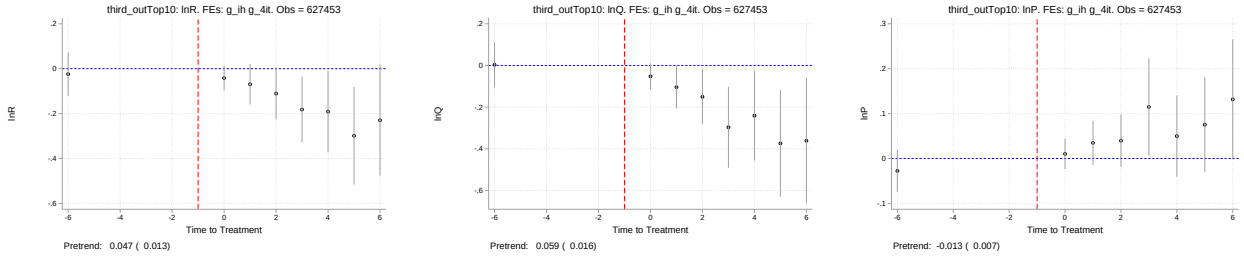
A.4 AD activists

Figure A.5: Robustness to excluding the top 10 AD investigators from third markets: summary decomposition.



Notes: The figure repeats the decomposition summary after excluding the top 10 AD investigators from the set of third markets.

Figure A.6: Robustness to excluding the top 10 AD investigators from third markets: detailed third-market responses.



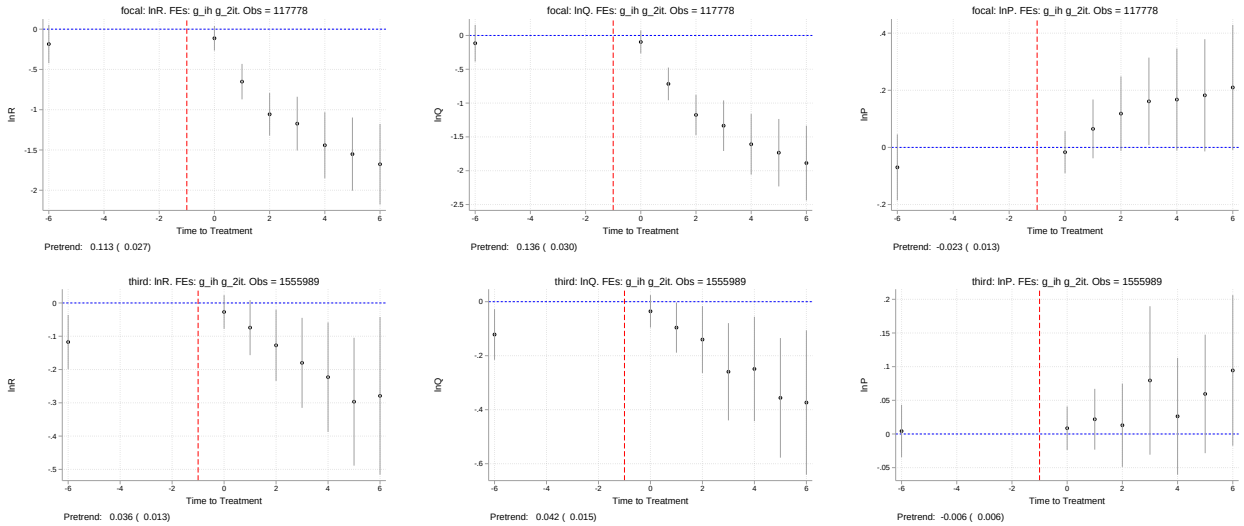
Notes: These figures report the third-market responses in $\ln R$, $\ln \tilde{Q}$, and $\ln p^m$ after excluding the top 10 AD investigators from the set of third markets.

A.5 Cross-product Reallocation (SUTVA)

This subsection addresses the concern that an AD duty may induce reallocation across HS6 products within the same HS4 category, contaminating our within-HS4 control group. We re-estimate the specifications using never-investigated HS6 products in a different HS4 but the same HS2 category as the control group, replacing the HS4-country-year fixed effects

with HS2-country-year fixed effects. Figure A.7 reports the event-study responses of revenue, quantity, and unit values, and Table A.7 reports the corresponding decomposition.

Figure A.7: Effect of AD investigation on revenue, quantities and prices, using never-treated HS4 products within the same HS2 as controls.



Notes: The top row reports focal-market responses and the bottom row third-market responses in $\ln R$, $\ln \tilde{Q}$, and $\ln p^m$. The control group consists of never-investigated HS6 products in a different HS4 but the same HS2 as the treated product. All specifications include country-HS6-product and country-HS2-product-year fixed effects. Standard errors are clustered at the HS6 product level.

Table A.7: Decomposition of AD impacts, within-HS2 control group

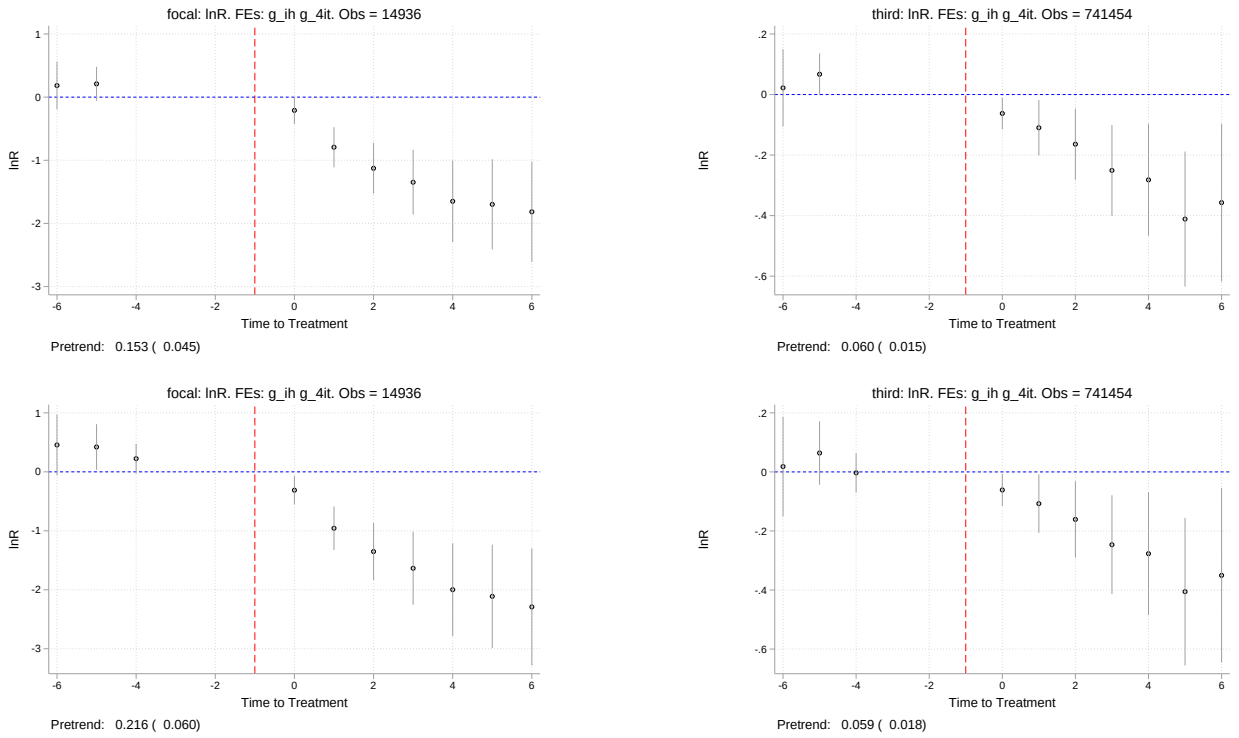
	Level regressions					First differences		
	$\ln R$	$\ln \tilde{Q}$	$\ln p^m$	$\ln N$	$\ln \bar{r}$	$\frac{N_{iht}-N_{iht-1}}{(N_{iht}+N_{iht-1})/2}$	$\frac{E_{iht}}{(N_{iht}+N_{iht-1})/2}$	$\frac{-X_{iht-1}}{(N_{iht}+N_{iht-1})/2}$
focal	-1.677^a	-1.887^a	0.210^c	-0.956^a	-0.729^a	-0.669^a	-0.191^b	-0.478^a
	(0.255)	(0.282)	(0.112)	(0.128)	(0.210)	(0.110)	(0.089)	(0.075)
third	-0.279^b	-0.374^a	0.094^c	-0.214^a	-0.067	-0.195^a	-0.183^a	-0.012
	(0.121)	(0.136)	(0.057)	(0.079)	(0.076)	(0.056)	(0.053)	(0.039)

Notes: The control group consists of never-investigated HS6 products in a different HS4 but the same HS2 as the treated product. The table reports average impacts for periods at least six years after initiation, i.e., $t \geq t^0_{ih} + 6$.

A.6 Pre-trend Extrapolation Window

Our main specification fits the treated-group linear pre-trend in (2) using all pre-investigation periods except the earliest one, i.e., from $-(T-1)$ to -1. Here we shorten the estimation window further, fitting the trend over $-(T-2)$ to -1 and over $-(T-3)$ to -1; the additional excluded early pre-periods enter as free event-time coefficients rather than being constrained to the fitted line. Figure A.8 plots the event-study responses of log export value $\ln R$ under the two windows for both markets, and Table A.8 reports the corresponding decomposition. The estimates are very similar to the baseline in Table 1.

Figure A.8: Effect of AD investigation on log export value $\ln R$, under shorter pre-trend estimation windows.



Notes: The left column reports focal-market responses and the right column third-market responses in $\ln R$. The top row estimates the linear pre-trend over $-(T-2)$ to -1, and the bottom row over $-(T-3)$ to -1; the remaining early pre-periods enter as free event-time coefficients. All specifications include country-HS6-product and country-HS4-product-year fixed effects. Standard errors are clustered at the HS6 product level.

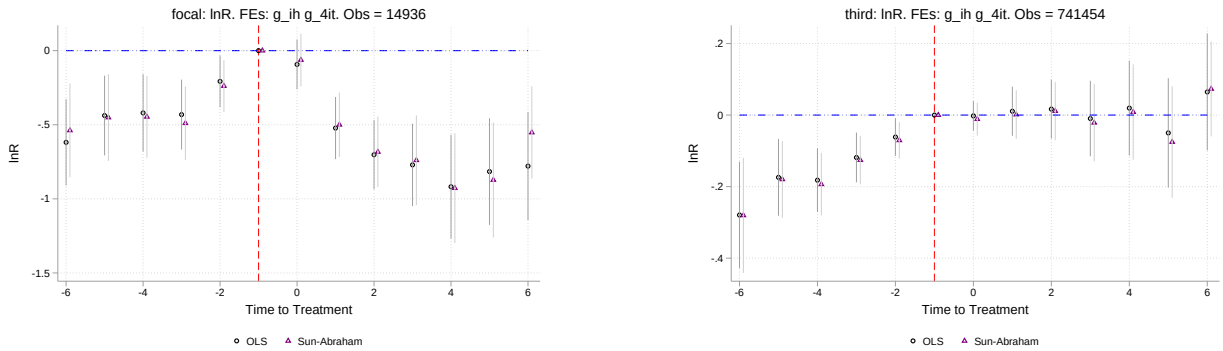
Table A.8: Decomposition of AD impacts, alternative pre-trend estimation windows

	Level regressions					First differences		
	$\ln R$	$\ln \tilde{Q}$	$\ln p^m$	$\ln N$	$\ln \bar{r}$	$\frac{N_{iht}-N_{iht-1}}{(N_{iht}+N_{iht-1})/2}$	$\frac{E_{iht}}{(N_{iht}+N_{iht-1})/2}$	$\frac{-X_{iht-1}}{(N_{iht}+N_{iht-1})/2}$
Pretrend estimated using -(T-2) to -1								
focal	-1.816^a	-1.897^a	0.081	-0.802^a	-1.007^a	-0.748^a	-0.293^a	-0.454^a
	(0.405)	(0.443)	(0.165)	(0.158)	(0.329)	(0.143)	(0.113)	(0.099)
third	-0.357^a	-0.496^a	0.139^c	-0.210^b	-0.149^c	-0.256^a	-0.231^a	-0.025
	(0.133)	(0.166)	(0.079)	(0.083)	(0.084)	(0.064)	(0.057)	(0.046)
Pretrend estimated using -(T-3) to -1								
focal	-2.290^a	-2.420^a	0.129	-0.841^a	-1.439^a	-0.764^a	-0.275^b	-0.488^a
	(0.506)	(0.580)	(0.227)	(0.196)	(0.415)	(0.168)	(0.121)	(0.111)
third	-0.350^b	-0.538^a	0.187^c	-0.220^b	-0.141	-0.240^a	-0.225^a	-0.015
	(0.151)	(0.200)	(0.101)	(0.093)	(0.098)	(0.072)	(0.060)	(0.048)

Notes: The table reports average impacts for periods at least six years after initiation, i.e., $t \geq t^0_{ih} + 6$. The top panel estimates the linear pre-trend over $-(T-2)$ to -1 and the bottom panel over $-(T-3)$ to -1. In each panel, the first row reports focal-market and the second row third-market estimates.

A.7 Staggered-treatment Approaches

Figure A.9: Effect of AD investigation on revenue, quantities and prices. Event-study dynamic specifications, OLS vs Sun and Abraham (2021)



Notes: All specifications include country-HS6-product and country-HS4-product-year fixed effects. Standard errors are clustered at the HS6 product level.

Table A.9: Decomposition of AD impacts, stacked DiD

	Level regressions					First differences		
	$\ln R$	$\ln \tilde{Q}$	$\ln p^m$	$\ln N$	$\ln \bar{r}$	$\frac{N_{iht}-N_{iht-1}}{(N_{iht}+N_{iht-1})/2}$	$\frac{E_{iht}}{(N_{iht}+N_{iht-1})/2}$	$\frac{-X_{iht-1}}{(N_{iht}+N_{iht-1})/2}$
focal	-1.567^a	-1.841^a	0.274^c	-0.836^a	-0.742^a	-0.762^a	-0.312^a	-0.450^a
	(0.333)	(0.374)	(0.151)	(0.146)	(0.274)	(0.132)	(0.104)	(0.094)
third	-0.273^b	-0.390^b	0.116^c	-0.166^b	-0.106	-0.223^a	-0.221^a	-0.001
	(0.128)	(0.154)	(0.068)	(0.083)	(0.079)	(0.065)	(0.057)	(0.046)

Notes: The table reports average impacts for periods at least six years after initiation, i.e., $t \geq t^0_{ih} + 6$.

A.8 Firm-level Evidence

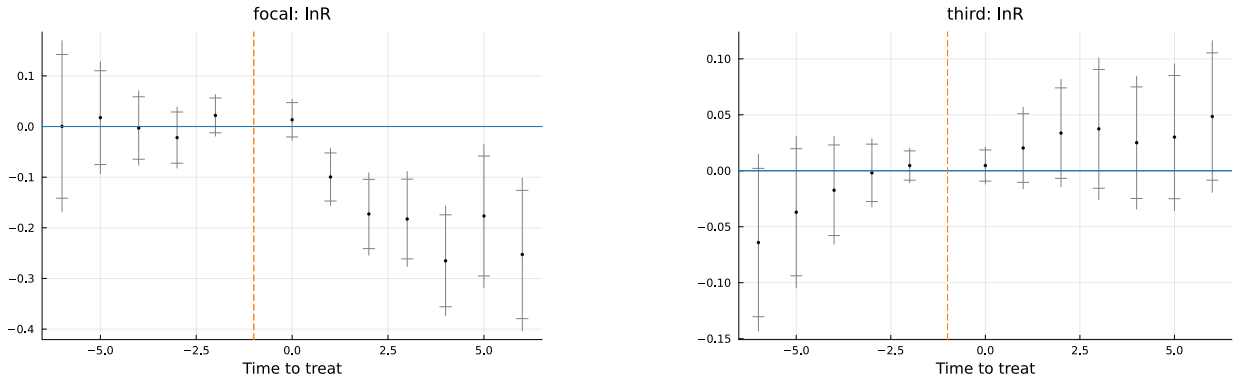
When analyzing the impact of AD at the firm level, we estimate a dynamic event-study specification at the firm-country-product-year level, analogous to (1):

$$\ln R_{fhit} = \sum_{k=-K}^{K} \beta_k \text{Treated}_{ih} \mathbb{1}\left\{t - t^0_{ih} = k\right\} + \delta_{fih} + \delta_{s(h)t} + \delta_{it} + \varepsilon_{fhit}, \tag{32}$$

where f, h, i, and t index the firm, HS6 product, destination country, and year, respectively. The dependent variable is the firm's export to a product-country cell in a particular year. The fixed effects are firm-HS6-country (δ_{fih}), HS4-year ($\delta_{s(h)t}$), and country-year (δ_{it}), and we estimate the specification separately for focal and third markets. For third market regressions, the treatment is at the product level rather than the product-country level. Since treatment varies at the product(-country) level, we cluster standard errors at the HS6 product level. We also estimate the firm-level counterpart of the detrended specification (2) with the same fixed effects.

Figure A.10 plots the event-study coefficients in the focal and third markets, and Table A.10 reports the coefficient estimates behind the figure next to the estimates of the detrended specification. Because the specification includes firm-HS6-country fixed effects, the estimates describe surviving firm-product-destination triplets; they are the firm-level counterpart of the response of average revenue per exporter, $\ln \bar{r}$, in Table 1. The two agree in sign: export value per surviving firm falls in the focal market, while the third-market response is small and not statistically distinguishable from zero.

Figure A.10: Firm-level event studies for log export value $\ln R$.



(a) Focal market

(b) Third market

Notes: Event-study estimates of (32) at the firm-country-product-year level, with firm-HS6-country, HS4-year, and country-year fixed effects; $t = -1$ is the omitted reference period. Standard errors are clustered at the HS6 product level.

Table A.10: Firm-level event-study coefficients behind Figure A.10: export value $\ln R$.

	Focal market		Third market	
	Event study	Detrended (raw)	Event study	Detrended (raw)
$t = -6$	0.000	-0.003	-0.064	-0.027^{c}
	(0.086)	(0.057)	(0.040)	(0.016)
$t = -5$	0.018		-0.037	
	(0.056)		(0.035)	
$t = -4$	-0.003		-0.017	
	(0.037)		(0.025)	
$t = -3$	-0.022		-0.002	
	(0.031)		(0.016)	
$t = -2$	0.022		0.005	
	(0.021)		(0.008)	
$t = 0$	0.013	0.010	0.005	-0.009
	(0.021)	(0.027)	(0.008)	(0.015)
$t = 1$	-0.100^{a}	-0.103^{a}	0.020	0.007
	(0.029)	(0.033)	(0.019)	(0.017)
$t = 2$	-0.173^{a}	-0.176^{a}	0.034	0.020
	(0.042)	(0.046)	(0.025)	(0.019)
$t = 3$	-0.183^{a}	-0.186^{a}	0.037	0.023
	(0.048)	(0.051)	(0.032)	(0.026)
$t = 4$	-0.265^{a}	-0.269^{a}	0.025	0.011
	(0.055)	(0.058)	(0.030)	(0.026)
$t = 5$	-0.177^{b}	-0.180^{b}	0.030	0.016
	(0.072)	(0.073)	(0.033)	(0.029)
$t = 6$	-0.253^{a}	-0.256^{a}	0.048	0.035
	(0.077)	(0.078)	(0.035)	(0.030)
Linear pre-trend		0.000		0.008
		(0.013)		(0.008)
Observations	589,715	589,715	9,046,901	9,046,901
# of HS6 products	1,246	1,246	1,396	1,396
R^2	0.785	0.785	0.791	0.791

Notes: The dependent variable is $\ln R$ at the firm-country-product-year level and t denotes years since the initiation of the AD investigation. For each market, the first column reports the baseline event-study coefficients β_k from (32), with $t = -1$ as the omitted reference period. The second column reports the estimates of the firm-level counterpart of the detrended specification (2): the post-initiation coefficients β_k, the coefficient on the earliest event-time bin β_{-K}, and the linear pre-trend slope γ. All specifications include firm-HS6-country, HS4-year, and country-year fixed effects. Standard errors clustered at the HS6 product level are in parentheses. Superscripts a, b, and c denote significance at the 1, 5, and 10 percent levels.

A.9 Industry-level Entry and Exit in China

The trade results concern the number of Chinese firms exporting a product to a given destination. This subsection asks the domestic counterpart: when foreign AD actions hit an industry's products, does the number of firms operating in that industry in China change, and through which margin? For this question, we turn to the Annual Surveys of Industrial Production (ASIP) conducted by the National Bureau of Statistics (the NBS firm-level data). We construct an industry-year panel from 1999 to 2009, and collapse the firm-year level panel to industry-year level.[20]

AD cases are recorded at the HS6 level while the NBS data is at the four-digit industry level (Chinese Industry Classification). For each industry c and year t, we calculate its coverage by AD cases as

$$\text{AD_cov}_{ct} = \frac{\sum_h w_{hc} v_h \mathbb{1}\left\{t_h^0 \leq t\right\}}{\sum_h w_{hc} v_h},$$

where w_{hc} is the inverse of the number of industries HS6 line h maps into and v_h is China's 1996–1999 export value of that line, a period before any of the AD cases in our sample were initiated.[21] An industry is treated from the first year AD_cov_{ct} exceeds 0.05. We drop industries that are exposed but never cross the cutoff. This leaves us 148 treated and 244 never-exposed control industries.

Our first outcome is the midpoint growth rate of the number of active firms in industry c from year $t-1$ to t, $\text{mgrN}_{ct} = (N_{ct} - N_{ct-1})/\bar{N}_{ct}$ with $\bar{N}_{ct} = (N_{ct} + N_{ct-1})/2$, which approximates $\ln N_{ct} - \ln N_{ct-1}$. We therefore estimate the industry-level analogues of (1) and (2) in first differences, following the same logic as (3). The first-differenced event study is

$$\text{mgrN}_{ct} = \sum_{\substack{k=-K \\ k\neq -1}}^{K} \beta_k \text{Treated}_c \Delta \mathbb{1}\left\{t - t_c^0 = k\right\} + \delta_{s(c)t} + \Delta\varepsilon_{ct}, \tag{33}$$

and the pre-trend-extrapolation specification is

$$\begin{aligned}\text{mgrN}_{ct} = \beta_{-K} \text{Treated}_c \Delta \mathbb{1}\left\{t - t_c^0 = -K\right\} + \sum_{k=0}^{K} \beta_k \text{Treated}_c \Delta \mathbb{1}\left\{t - t_c^0 = k\right\} \\ + \gamma \text{Treated}_c \mathbb{1}\left\{t \leq t_c^0\right\} + \delta_{s(c)t} + \Delta\varepsilon_{ct}.\end{aligned} \tag{34}$$

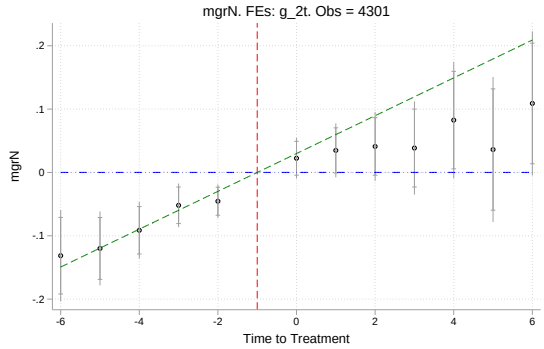
[20] The data starts in 1998, so the growth rate in number of firms can only be constructed from 1999. We dropped the firm-level data after 2009 due to known quality issues (Chen et al., 2019).

[21] We use the concordance map created by Brandt et al. (2017) to map an HS6 code to four-digit industries.

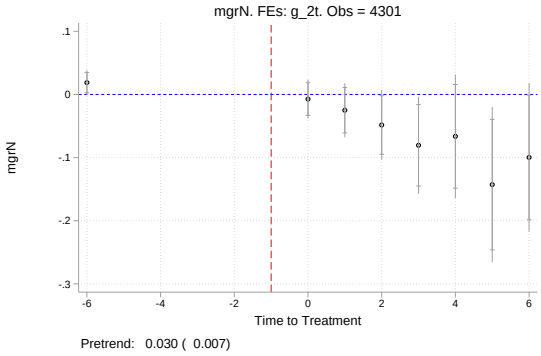
Here t_c^0 is the first year in which AD_cov$_{ct}$ exceeds the cutoff, $K = 6$ with event times beyond $\pm K$ binned at the endpoints, $\Delta\mathbb{1}\{t - t_c^0 = k\} = \mathbb{1}\{t - t_c^0 = k\} - \mathbb{1}\{t - 1 - t_c^0 = k\}$, and Treated$_c\mathbb{1}\{t \leq t_c^0\}$ is the first difference of the treated-group linear pre-trend Treated$_c\,(t - t_c^0)\,\mathbb{1}\{t < t_c^0\}$ in (2). Because the outcome is already a first difference, the industry fixed effect is differenced out; $\delta_{s(c)t}$ is a two-digit-industry-by-year fixed effect, the counterpart of the HS4-by-country-by-year effect $\delta_{is(h)t}$ in the trade regressions, and $s(c)$ denotes the two-digit industry of c. Never-treated industries have all-zero event-time indicators and identify the year effects. As in (3), the coefficients retain the interpretation of the level regressions: β_k is the cumulative effect on $\ln N$ at event time k relative to $k = -1$, and in (34) the detrended effect at $k \geq 0$ is $\beta_k - \gamma k$. Standard errors are clustered at the four-digit industry level. For the entry and exit margins we replace mgrN$_{ct}$ with its entry and exit components, mgrE$_{ct} = E_{ct}/\bar{N}_{ct}$ and mgrX$_{ct} = -X_{ct-1}/\bar{N}_{ct}$, where E_{ct} is the number of firms present in t but not $t-1$ and X_{ct-1} the number present in $t-1$ but not t, so that mgrN$_{ct}$ = mgrE$_{ct}$ + mgrX$_{ct}$ holds industry by industry.

The left and right columns in Figure A.11 report the event study and the pretrend extrapolation results, respectively. Panel (a) shows the first difference results for the number of firms. The treated industries have a stronger pretrend than the control industries, but the trend is weakened after the shock. Using the extrapolation approach, we find that AD reduced the number of firms in the treated industries (panel (b)). Decomposing them into the entry and exit margins (panels (d) and (f)), we find that the decline in the number of firms is mainly driven by the reduction in entry.

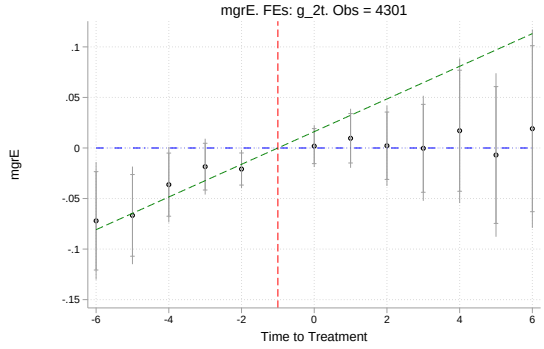
Figure A.11: Entry and exit decomposition of firm count, midpoint growth rates



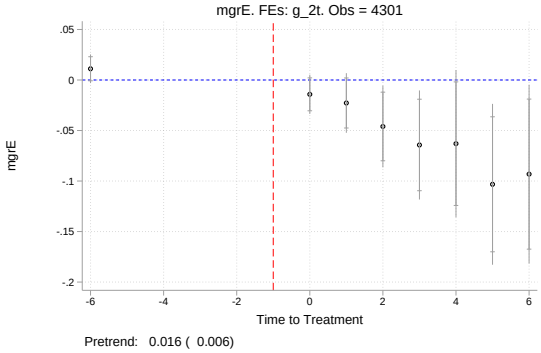
(a) Net, mgrN



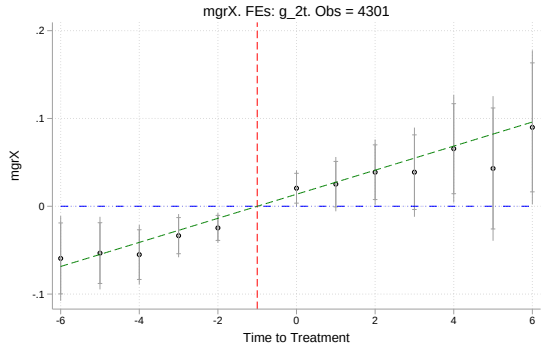
(b) Net, mgrN



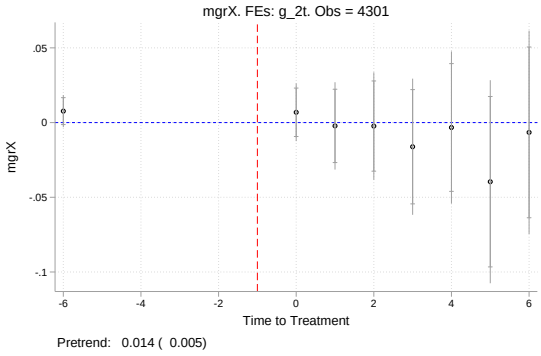
(c) Entry, mgrE



(d) Entry, mgrE



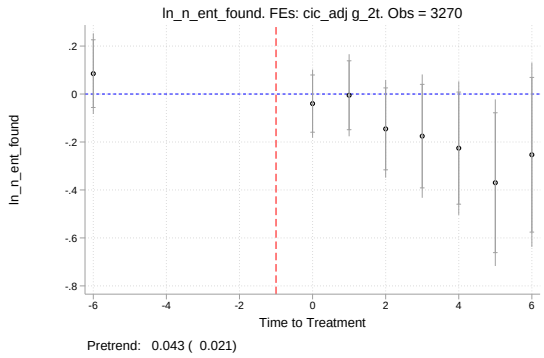
(e) Exit, mgrX



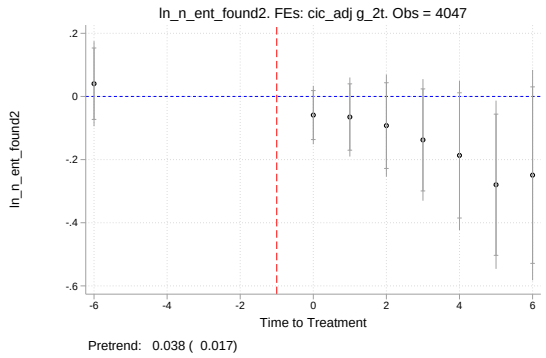
(f) Exit, mgrX

Notes: Estimated first-differenced specifications, so the industry fixed effect is absorbed by the differencing. In each regression, we control for two-digit-industry-by-year fixed effects and standard errors clustered at the industry level.

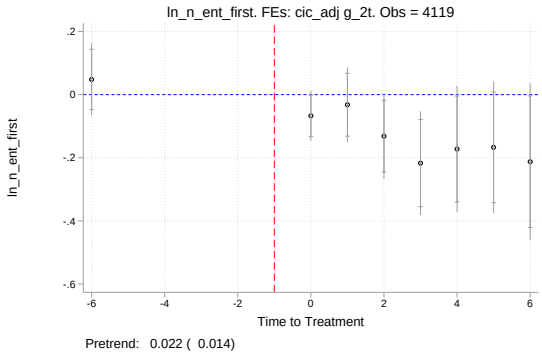
Figure A.12: The impact of AD shock on the number of entrants



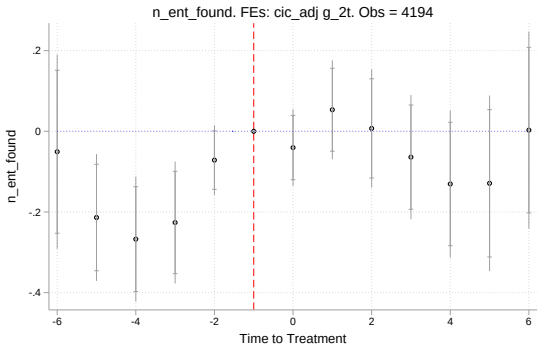
(a) Founding year reported, OLS



(b) Founding year, two-year window, OLS



(c) First appearance in the panel, OLS



(d) Founding-year reported, Poisson (count)

Notes: Panels (a)–(c) estimate the pre-trend-extrapolation specification (35) with the log number of entrants as the outcome, which drops industry-years with no entrant. Panel (d) estimates the undetrended event study on the entrant count by Poisson, which keeps those industry-years. All regressions include industry and two-digit-industry-by-year fixed effects, and standard errors are clustered at the industry level.

In the above decomposition, we define entry as a firm being active in year t but not in $t-1$. The NBS data allow two alternative definitions. First, the ASIF asks firms for their founding year, so we can count as entrants in year t the firms that report being founded in t. Because a firm founded in t may only be covered by the survey from $t+1$, we also use a two-year window that counts a firm as an entrant in year t if its reported founding year is t or $t-1$. Second, we can define entrants in t as firms that first appear in the data in year t, starting in 1999, the second year the data covers. In panels (a)–(c) of Figure A.12, we estimate the following specification with the log number of entrants under each definition as the outcome:

$$\ln E_{ct} = \beta_{-K}\text{Treated}_c \mathbb{1}\left\{t - t_c^0 = -K\right\} + \sum_{k=0}^{K} \text{Treated}_c \mathbb{1}\left\{t - t_c^0 = k\right\}$$
$$+ \gamma \text{Treated}_c \times \left(t - t_c^0\right) \times \mathbb{1}\left\{t < t_c^0\right\} + \delta_{s(c)t} + \varepsilon_{ct}, \tag{35}$$

where E_{ct} is the number of entrants in industry c in year t under various definitions, δ_c is an industry fixed effect, $\delta_{s(c)t}$ a two-digit-industry-by-year fixed effect, and the remaining terms are as in (34). This is the level counterpart of that specification, i.e. the industry analogue of (2); the effect at event time $k \geq 0$ is again $\beta_k - \gamma k$, and standard errors are clustered at the four-digit industry level.

After removing the pretrends, we find the impact of the AD shock is in generally negative on the number of entrants. The patterns are quite consistent across different definitions of entrants. Finally, since we lose observations with zero number of entrants with the log transformation, we perform a Poisson regression on the number of entrants (using the founding year, one year window definition) in panel (d). We do not perform a detrending exercise here due to the non-linearity, and only report the event study results. We again find positive growth in the treated industries before the AD shock, but the growth was muted after the event, and the coefficients even become negative in some periods, consistent with the OLS results.

B Additional Results with Homogeneous Firms

B.1 Proof of proposition 1

Totally differentiating the system, we have shown that

$$\frac{\mathrm{d}\log \pi_i}{\mathrm{d}\log N_i} = -\eta_i \theta_i < 0 \quad \text{and} \quad \frac{\mathrm{d}\log N_i}{\mathrm{d}\log M} = 1 - \xi_i \geq 0,$$

where that assumption 1 holds for all N_i ensures $\theta_i > 0$.

Therefore, $\pi_i(M)$ is decreasing in M, and so is $\frac{N_i(M)}{M}$. The left hand side of equation (21) is also decreasing in M. In that sense, the equilibrium will be unique if it exists. From equation (20), we must have $N_i(M) \to \infty$ if $M \to \infty$ and $N_i(M) \to 0$ if $M \to 0$. It suffices

to have $\pi_i(N_i)$ satisfy the Inada condition that

$$\lim_{N_i \to 0} \pi_i(N_i) = \infty, \quad \lim_{N_i \to \infty} \pi_i(N_i) = 0.$$

Note that for any $N_1 > N_0 > 0$,

$$\frac{\pi_i(N_1)}{\pi_i(N_0)} = \exp\left(- \int_{N_0}^{N_1} \frac{\eta_i(x)\theta_i(x)}{x} \mathrm{d}x \right).$$

The integral diverges at $N_1 = \infty$ or $N_0 = 0$ since the limit conditions ensures that

$$\min \left[\liminf_{N_i \to 0} \eta_i \theta_i, \liminf_{N_i \to \infty} \eta_i \theta_i \right] > 0.$$

Hence, we have verified the Inada condition and established the existence of the equilibrium.

B.2 Equilibrium conditions

We expand the equilibrium equations presented in Section 4.1 to the first order in the shocks.

Welfare

$$\delta_i \mathrm{d} \log N_i + \mathrm{d} \log \frac{q_i}{Q_i} = 0 \tag{36}$$

Budget balance

$$\begin{aligned} \mathrm{d} \log P_i^I =& \mathrm{d} \log N_i + \mathrm{d} \log t_i + \mathrm{d} \log \mu_i + \mathrm{d} \log \frac{\tau_i}{z} + \mathrm{d} \log \frac{q_i}{Q_i} \\ \Rightarrow \quad -\frac{1}{\eta_i} \mathrm{d} \log Q_i =& \mathrm{d} \log N_i + \mathrm{d} \log t_i + \mathrm{d} \log \frac{\tau_i}{z} + \left[\left(\frac{1}{\rho_i} - 1 \right) \frac{1}{\sigma_i} + 1 \right] \mathrm{d} \log \frac{q_i}{Q_i} \end{aligned} \tag{37}$$

Markup

$$\mathrm{d} \log \mu = \left(\frac{1}{\rho_i} - 1 \right) \frac{1}{\sigma_i} \mathrm{d} \log \frac{q_i}{Q_i}, \tag{38}$$

in which

$$\rho_i = -\frac{\partial \log p_i}{\partial \log z} = \frac{1}{1 + \frac{\mu'\left(\frac{q_i}{Q_i}\right)\frac{q_i}{Q_i}}{\mu\left(\frac{q_i}{Q_i}\right)}\sigma_i}.$$

Variable profit

$$\mathrm{d}\log \pi_i = \frac{1}{\mu_i - 1}\mathrm{d}\log \mu_i + \mathrm{d}\log P_i^I + \mathrm{d}\log Q_i - \mathrm{d}\log N_i - \mathrm{d}\log t_i \tag{39}$$

Balanced flow

$$\frac{\pi_i \mathrm{d}\log \pi_i - f_i \mathrm{d}\log f_i}{\pi_i - f_i} = \mathrm{d}\log(\varrho + \nu_i) + \frac{\beta}{1-\beta}\left[\mathrm{d}\log \nu_i + \mathrm{d}\log N_i - \mathrm{d}\log h_i - \mathrm{d}\log M\right] + \mathrm{d}\log f_e - \mathrm{d}\log h_i \tag{40}$$

Free entry

$$\begin{aligned} &\frac{1}{1-\beta}\sum_{i\in\mathscr{I}} \frac{\left(\frac{\nu_i N_i}{h_i M}\right)^{\frac{1}{1-\beta}}}{\sum_k \left(\frac{\nu_k N_k}{h_k M}\right)^{\frac{1}{1-\beta}}}\left[\mathrm{d}\log N_i + \mathrm{d}\log \nu_i - \mathrm{d}\log h_i - \mathrm{d}\log M\right] = 0 \\ \Rightarrow \quad &\sum_{i\in\mathscr{I}} s_i \left[\mathrm{d}\log N_i + \mathrm{d}\log \nu_i - \mathrm{d}\log h_i\right] = \mathrm{d}\log M, \end{aligned} \tag{41}$$

in which $s_i = \frac{J_i \bar{\pi}_i}{\sum_k J_k \bar{\pi}_k} = \frac{\left(\frac{\nu_i N_i}{h_i M}\right)^{\frac{1}{1-\beta}}}{\sum_k \left(\frac{\nu_k N_k}{h_k M}\right)^{\frac{1}{1-\beta}}}$.

B.3 Proof of Proposition 2, 3 and Corollary 1

A full description of equilibrium changes We present below the equilibrium change of every endogenous variables in the extended version of Proposition 3.

Proposition A.1. *Suppose that Assumption 1 holds in the initial equilibrium. Given a set of tariff changes* $\{\mathrm{d}\log t_i\}_{i\in\mathscr{I}}$,, *the following equations characterize changes of endogenous variables in equilibrium:*

i) At the market level,

$$
\begin{aligned}
\mathrm{d}\log N_i &= (1-\xi_i)\mathrm{d}\log M + \xi_i \frac{-\mathrm{d}\log t_i}{\theta_i} \\
\mathrm{d}\log \tilde{Q}_i &= \underbrace{\left(\delta_i\left(\frac{1}{\rho_i}-1\right)-\eta_i\theta_i+1\right)}_{>0}\mathrm{d}\log N_i - \eta_i \mathrm{d}\log t_i, \\
\mathrm{d}\log R_i &= \underbrace{\left[\left(\frac{1}{\rho_i}-1\right)\left(1-\frac{1}{\sigma_i}\right)\delta_i-\eta_i\theta_i+1\right]}_{>0}\mathrm{d}\log N_i - \eta_i \mathrm{d}\log t_i, \\
\mathrm{d}\log Q_i &= \underbrace{\left(\frac{\delta_i}{\rho_i}-\eta_i\theta_i\right)}_{>0}\mathrm{d}\log N_i - \eta_i \mathrm{d}\log t_i;
\end{aligned}
$$

ii) At the firm level,

$$
\begin{aligned}
\mathrm{d}\log \pi_i &= -\eta_i\theta_i \mathrm{d}\log N_i - \eta_i \mathrm{d}\log t_i, \\
\mathrm{d}\log p_i &= -\left(\frac{1}{\rho_i}-1\right)\frac{\delta_i}{\sigma_i}\mathrm{d}\log N_i, \\
\mathrm{d}\log q_i &= \left(\delta_i\left(\frac{1}{\rho_i}-1\right)-\eta_i\theta_i\right)\mathrm{d}\log N_i - \eta_i \mathrm{d}\log t_i, \\
\mathrm{d}\log r_i &= \left[\left(\frac{1}{\rho_i}-1\right)\left(1-\frac{1}{\sigma_i}\right)\delta_i-\eta_i\theta_i\right]\mathrm{d}\log N_i - \eta_i \mathrm{d}\log t_i.
\end{aligned}
$$

In the following, we present the detailed derivation that give rise to the above proposition. We introduce the following notations for convenience:

$$
\mathbb{E}_x[y] = \frac{\int x(v)y(v)\mathrm{d}v}{\int x(v)\mathrm{d}v},
$$

in which x and y are measurable on v, and v could be either discrete or continuous.

Changes in M and N_i We consider only $\mathrm{d}\log t_i$ and set $\mathrm{d}\log\frac{\tau_i}{z} = \mathrm{d}\log\nu_i = \mathrm{d}\log h_i = \mathrm{d}\log f_i = \mathrm{d}\log f_e = 0$. Then, we obtain the following system of equations

$$\begin{aligned}
\delta_i \mathrm{d}\log N_i + \mathrm{d}\log\frac{q_i}{Q_i} &= 0 \\
-\frac{1}{\eta_i}\mathrm{d}\log Q_i = \mathrm{d}\log N_i + \mathrm{d}\log t_i + \left[\left(\frac{1}{\rho_i}-1\right)\frac{1}{\sigma_i}+1\right]\mathrm{d}\log\frac{q_i}{Q_i} \\
\mathrm{d}\log\pi_i = \frac{1}{\rho_i}\mathrm{d}\log\frac{q_i}{Q_i} + \mathrm{d}\log Q_i \\
\frac{\pi_i}{\pi_i - f_i}\mathrm{d}\log\pi_i = \frac{\beta}{1-\beta}\left[\mathrm{d}\log N_i - \mathrm{d}\log M\right] \\
\sum_{i\in\mathscr{I}} s_i \mathrm{d}\log N_i = \mathrm{d}\log M
\end{aligned}$$

Combining the first three equations, we obtain that

$$\mathrm{d}\log\pi_i = -\eta_i\theta_i \mathrm{d}\log N_i - \eta_i \mathrm{d}\log t_i,$$

in which

$$\theta_i = \underbrace{\left(\frac{1}{\eta_i}-\frac{1}{\sigma_i}\right)\left(\frac{1}{\rho_i}-1\right)\delta_i}_{\geq 0} + \underbrace{1-\frac{\eta_i-1}{\eta_i}\delta_i}_{>0} > 0.$$

The first bracket is non-negative since $\sigma_i > \eta_i$ and $\rho_i \leq 1$. The second bracket is positive since $\delta_i < \frac{\eta_i}{\eta_i - 1}$.

Then, we obtain that

$$\begin{aligned}
&\frac{\pi_i}{\pi_i - f_i}\left[-\eta_i\theta_i \mathrm{d}\log N_i - \eta_i \log t_i\right] = \frac{\beta}{1-\beta}\left[\mathrm{d}\log N_i - \mathrm{d}\log M\right] \\
&\Rightarrow \mathrm{d}\log N_i = \frac{\frac{\beta}{1-\beta}}{\frac{\beta}{1-\beta}+\frac{\pi_i}{\pi_i - f_i}\eta_i\theta_i}\mathrm{d}\log M - \frac{\eta_i\frac{\pi_i}{\pi_i-f_i}}{\frac{\beta}{1-\beta}+\frac{\pi_i}{\pi_i-f_i}\eta_i\theta_i}\mathrm{d}\log t_i
\end{aligned}$$

Using the free entry condition,

$$\mathrm{d}\log N_i - \mathrm{d}\log M = -\xi_i \mathrm{d}\log M - \xi_i\frac{\mathrm{d}\log t_i}{\theta_i},$$

where

$$\xi_i = \frac{\frac{\pi_i}{\pi_i-f_i}\eta_i\theta_i}{\frac{\beta}{1-\beta}+\frac{\pi_i}{\pi_i-f_i}\eta_i\theta_i} \leq 1,$$

then

$$\sum_{i\in\mathscr{I}} s_i \mathrm{d}\log N_i = \mathrm{d}\log M \Rightarrow \mathrm{d}\log M = -\frac{\sum_{i\in\mathscr{I}} s_i\xi_i \frac{\mathrm{d}\log t_i}{\theta_i}}{\sum_{i\in\mathscr{I}} s_i\xi_i} = -\mathbb{E}_{s\xi}\left[\frac{\mathrm{d}\log t}{\theta}\right].$$

Hence, we can re-write $\mathrm{d}\log N_i$ as

$$\mathrm{d}\log N_i = (1-\xi_i)\mathrm{d}\log M - \xi_i\frac{\mathrm{d}\log t_i}{\theta_i} = -\left[(1-\xi_i)\,\mathbb{E}_{s\xi}\left[\frac{\mathrm{d}\log t}{\theta}\right] + \xi_i\frac{\mathrm{d}\log t_i}{\theta_i}\right]$$

Changes in other variables Similarly,

$$\begin{aligned}
\mathrm{d}\log \pi_i &= -\eta_i\theta_i \mathrm{d}\log N_i - \eta_i \mathrm{d}\log t_i \\
&= \eta_i\theta_i\left[(1-\xi_i)\,\mathbb{E}_{s\xi}\left[\frac{\mathrm{d}\log t}{\theta}\right] + \xi_i\frac{\mathrm{d}\log t_i}{\theta_i}\right] - \eta_i \mathrm{d}\log t_i \\
&= \eta_i(1-\xi_i)\theta_i\left\{\mathbb{E}_{s\xi}\left[\frac{\mathrm{d}\log t}{\theta}\right] - \frac{\mathrm{d}\log t_i}{\theta_i}\right\}
\end{aligned}$$

The relative quantity has the following expression:

$$\mathrm{d}\log\frac{q_i}{Q_i} = -\delta_i \mathrm{d}\log N_i = \delta_i\left[(1-\xi_i)\,\mathbb{E}_{s\xi}\left[\frac{\mathrm{d}\log t}{\theta}\right] + \xi_i\frac{\mathrm{d}\log t_i}{\theta_i}\right]$$

The utility change:

$$\begin{aligned}
\mathrm{d}\log Q_i &= -\eta_i\left(\mathrm{d}\log N_i + \mathrm{d}\log t_i + \left[\left(\frac{1}{\rho_i}-1\right)\frac{1}{\sigma_i}+1\right]\mathrm{d}\log\frac{q_i}{Q_i}\right) \\
&= -\eta_i\left\{1 - \left[\left(\frac{1}{\rho_i}-1\right)\frac{1}{\sigma_i}+1\right]\delta_i\right\}\mathrm{d}\log N_i - \eta_i \mathrm{d}\log t_i \\
&= -\eta_i\left[\underbrace{(1-\delta_i)}_{<0} - \underbrace{\delta_i\left(\frac{1}{\rho_i}-1\right)\frac{1}{\sigma_i}}_{>0}\right]\mathrm{d}\log N_i - \eta_i \mathrm{d}\log t_i
\end{aligned}$$

Notice that

$$\begin{aligned}
\eta_i\theta_i &= \left(1-\frac{\eta_i}{\sigma_i}\right)\left(\frac{1}{\rho_i}-1\right)\delta_i + \eta_i - (\eta_i-1)\delta_i \\
&= -\frac{\eta_i}{\sigma_i}\left(\frac{1}{\rho_i}-1\right)\delta_i + \eta_i(1-\delta_i) + \frac{\delta_i}{\rho_i},
\end{aligned}$$

then $\eta_i\theta_i - \frac{\delta_i}{\rho_i} < 0$. Plugging it into the formula for $\mathrm{d}\log Q_i$ and using the expression for $\mathrm{d}\log N_i$,

$$\begin{aligned}\mathrm{d}\log Q_i &= \left(\eta_i\theta_i - \frac{\delta_i}{\rho_i}\right)\left[(1-\xi_i)\,\mathbb{E}_{s\xi}\left[\frac{\mathrm{d}\log t}{\theta}\right] + \xi_i\frac{\mathrm{d}\log t_i}{\theta_i}\right] - \eta_i\theta_i\frac{\mathrm{d}\log t_i}{\theta_i} \\ &= \underbrace{-\left(\frac{\delta_i}{\rho_i} - \eta_i\theta_i\right)(1-\xi_i)}_{<0}\,\mathbb{E}_{s\xi}\left[\frac{\mathrm{d}\log t}{\theta}\right] \underbrace{-\left[\xi_i\frac{\delta_i}{\rho_i} + (1-\xi_i)\,\eta_i\theta_i\right]}_{<0}\frac{\mathrm{d}\log t_i}{\theta_i}\end{aligned}$$

To obtain the individual quantity change, we have

$$\begin{aligned}\mathrm{d}\log q_i =& \mathrm{d}\log\frac{q_i}{Q_i} + \mathrm{d}\log Q_i \\ =& \delta_i\left[(1-\xi_i)\,\mathbb{E}_{s\xi}\left[\frac{\mathrm{d}\log t}{\theta}\right] + \xi_i\frac{\mathrm{d}\log t_i}{\theta_i}\right] - \left(\frac{\delta_i}{\rho_i} - \eta_i\theta_i\right)(1-\xi_i)\,\mathbb{E}_{s\xi}\left[\frac{\mathrm{d}\log t}{\theta}\right] \\ & - \left[\xi_i\frac{\delta_i}{\rho_i} + (1-\xi_i)\,\eta_i\theta_i\right]\frac{\mathrm{d}\log t_i}{\theta_i} \\ =& \left(\delta_i\left(1-\frac{1}{\rho_i}\right) + \eta_i\theta_i\right)(1-\xi_i)\,\mathbb{E}_{s\xi}\left[\frac{\mathrm{d}\log t}{\theta}\right] + \left[\xi_i\delta_i\left(1-\frac{1}{\rho_i}\right) - (1-\xi_i)\eta_i\theta_i\right]\frac{\mathrm{d}\log t_i}{\theta_i} \\ =& \left(\delta_i\left(1-\frac{1}{\rho_i}\right) + \eta_i\theta_i\right)(1-\xi_i)\left(\mathbb{E}_{s\xi}\left[\frac{\mathrm{d}\log t}{\theta}\right] - \frac{\mathrm{d}\log t_i}{\theta_i}\right) \underbrace{- \delta_i\left(\frac{1}{\rho_i} - 1\right)}_{>0}\frac{\mathrm{d}\log t_i}{\theta_i}.\end{aligned}$$

Observe that

$$\begin{aligned}\delta_i\left(1-\frac{1}{\rho_i}\right) + \eta_i\theta_i &= \delta_i\left(1-\frac{1}{\rho_i}\right) + \left(1-\frac{\eta_i}{\sigma_i}\right)\left(\frac{1}{\rho_i} - 1\right)\delta_i + \eta_i - (\eta_i - 1)\delta_i \\ &= -\frac{\eta_i}{\sigma_i}\left(\frac{1}{\rho_i} - 1\right)\delta_i + \eta_i - (\eta_i - 1)\delta_i \\ &= \eta_i\delta_i\Bigg[\underbrace{-\frac{1}{\sigma_i}\left(\frac{1}{\rho_i} - 1\right)}_{<0} + \underbrace{\frac{1}{\delta_i} - \frac{\eta_i - 1}{\eta_i}}_{>0}.\Bigg]\end{aligned}$$

Hence, it is negative with ρ_i is small[22] and $\delta_i \approx \frac{\eta_i}{\eta_i - 1}$ It becomes positive when passthrough rate is close to complete. For example, with CES demand, $\rho = 1$, and this term is always

[22] If the strong version of Marshall's second law of demand in Baqaee et al. (2023) holds, passthrough is decreasing with productivity. Hence, a lower ρ is associated with a lower σ (higher markup μ), making this term more negative.

positive. The following condition gives the precise signing condition:

$$\delta_i\left(1-\frac{1}{\rho_i}\right)+\eta_i\theta_i>0 \iff \frac{\eta_i}{\eta_i-1}>\frac{\delta_i}{1-\frac{\delta_i}{\sigma_i}\left(\frac{1}{\rho_i}-1\right)}.$$

The general equilibrium (GE) effect on firms' quantity is ambiguous. This is intuitive: while market share increases with firms' exit ($\mathrm{d}\log\frac{q_i}{Q_i}>0$), the aggregate demand also goes down with less variety ($\mathrm{d}\log Q_i<0$). However, if $\mathbb{E}_{s\xi}\left[\frac{\mathrm{d}\log t}{\theta}\right]-\frac{\mathrm{d}\log t_i}{\theta_i}<0$ and $\mathbb{E}_{s\xi}\left[\frac{\mathrm{d}\log t}{\theta}\right]>0$, $\mathrm{d}\log q_i<0$.

The total quantity $\tilde{Q}_i=N_iq_i$. Then,

$$\begin{aligned}\mathrm{d}\log\tilde{Q}_i&=\mathrm{d}\log N_i+\mathrm{d}\log q_i\\&=\underbrace{\left(\delta_i\left(1-\frac{1}{\rho_i}\right)+\eta_i\theta_i-1\right)}_{<0}(1-\xi_i)\,\mathbb{E}_{s\xi}\left[\frac{\mathrm{d}\log t}{\theta}\right]+\underbrace{\left[\xi_i\delta_i\left(1-\frac{1}{\rho_i}\right)-(1-\xi_i)\eta_i\theta_i-\xi_i\right]}_{<0}\frac{\mathrm{d}\log t_i}{\theta_i}.\end{aligned}$$

The first coefficient is negative since

$$\begin{aligned}\delta_i\left(1-\frac{1}{\rho_i}\right)+\eta_i\theta_i-1&=-\frac{\eta_i}{\sigma_i}\left(\frac{1}{\rho_i}-1\right)\delta_i+\eta_i-(\eta_i-1)\delta_i-1\\&=\underbrace{-\frac{\eta_i}{\sigma_i}\left(\frac{1}{\rho_i}-1\right)\delta_i}_{\leq 0}+\underbrace{(\eta_i-1)(1-\delta_i)}_{<0}\end{aligned}$$

We then turn to prices. With homogeneous firms, the aggregate unit value, $\frac{N_ip_iq_i}{N_iq_i}$, is the same as individual price, p_i. Furthermore, the price change is equivalent to the markup change with only tariff shocks. Therefore,

$$\begin{aligned}\mathrm{d}\log p_i=\mathrm{d}\log\mu_i&=\left(\frac{1}{\rho_i}-1\right)\frac{1}{\sigma_i}\mathrm{d}\log\frac{q_i}{Q_i}\\&=\left(\frac{1}{\rho_i}-1\right)\frac{\delta_i}{\sigma_i}\left[(1-\xi_i)\,\mathbb{E}_{s\xi}\left[\frac{\mathrm{d}\log t}{\theta}\right]+\xi_i\frac{\mathrm{d}\log t_i}{\theta_i}\right].\end{aligned}$$

Finally, we discuss individual sales, $r_i = p_i q_i$ and aggregate sales, $R_i = p_i \tilde{Q}_i$.

$$
\begin{aligned}
\mathrm{d}\log r_i =& \mathrm{d}\log p_i + \mathrm{d}\log q_i \\
=& \left(\delta_i\left(1-\frac{1}{\rho_i}\right)+\eta_i\theta_i\right)(1-\xi_i)\,\mathbb{E}_{s\xi}\left[\frac{\mathrm{d}\log t}{\theta}\right] + \left[\xi_i\delta_i\left(1-\frac{1}{\rho_i}\right)-(1-\xi_i)\eta_i\theta_i\right]\frac{\mathrm{d}\log t_i}{\theta_i} \\
&+\left(\frac{1}{\rho_i}-1\right)\frac{\delta_i}{\sigma_i}\left[(1-\xi_i)\,\mathbb{E}_{s\xi}\left[\frac{\mathrm{d}\log t}{\theta}\right]+\xi_i\frac{\mathrm{d}\log t_i}{\theta_i}\right] \\
=& \left[\left(1-\frac{1}{\rho_i}\right)\left(1-\frac{1}{\sigma_i}\right)\delta_i+\eta_i\theta_i\right](1-\xi_i)\,\mathbb{E}_{s\xi}\left[\frac{\mathrm{d}\log t}{\theta}\right] \\
&+\underbrace{\left[\xi_i\delta_i\left(1-\frac{1}{\rho_i}\right)\left(1-\frac{1}{\sigma_i}\right)-(1-\xi_i)\eta_i\theta_i\right]}_{<0}\frac{\mathrm{d}\log t_i}{\theta_i} \\
=& \left[\left(1-\frac{1}{\rho_i}\right)\left(1-\frac{1}{\sigma_i}\right)\delta_i+\eta_i\theta_i\right](1-\xi_i)\,\mathbb{E}_{s\xi}\left(\left[\frac{\mathrm{d}\log t}{\theta}\right]-\frac{\mathrm{d}\log t_i}{\theta_i}\right) \\
&-\delta_i\left(\frac{1}{\rho_i}-1\right)\left(1-\frac{1}{\sigma_i}\right)\frac{\mathrm{d}\log t_i}{\theta_i}
\end{aligned}
$$

Even though $\mathrm{d}\log p_i$ is always positive to tariff shocks, the impact of $\mathbb{E}_{s\xi}[\mathrm{d}\log t/\theta]$ on $\mathrm{d}\log r_i$ is similar to that in $\mathrm{d}\log q_i$ and remains ambiguous. Note that

$$
\left(1-\frac{1}{\rho_i}\right)\left(1-\frac{1}{\sigma_i}\right)\delta_i+\eta_i\theta_i = (\eta_i-1)\delta_i\left[-\left(\frac{1}{\rho_i}-1\right)\frac{1}{\sigma_i}+\frac{\eta_i}{\eta_i-1}\frac{1}{\delta_i}-1\right],
$$

then we obtain the following sign condition:

$$
\left(1-\frac{1}{\rho_i}\right)\left(1-\frac{1}{\sigma_i}\right)\delta_i+\eta_i\theta_i>0 \iff \frac{\eta_i}{\eta_i-1}>\delta_i\left[1+\left(\frac{1}{\rho_i}-1\right)\frac{1}{\sigma_i}\right].
$$

We do similar exercises for the aggregate revenue

$$
\begin{aligned}
\mathrm{d}\log R_i =& \mathrm{d}\log r_i + \mathrm{d}\log N_i \\
=& \left[\left(1-\frac{1}{\rho_i}\right)\left(1-\frac{1}{\sigma_i}\right)\delta_i + \eta_i\theta_i\right](1-\xi_i)\,\mathbb{E}_{s\xi}\left[\frac{\mathrm{d}\log t}{\theta}\right] \\
&+ \left[\xi_i\delta_i\left(1-\frac{1}{\rho_i}\right)\left(1-\frac{1}{\sigma_i}\right) - (1-\xi_i)\eta_i\theta_i\right]\frac{\mathrm{d}\log t_i}{\theta_i} - \left[(1-\xi_i)\,\mathbb{E}_{s\xi}\left[\frac{\mathrm{d}\log t}{\theta}\right] + \xi_i\frac{\mathrm{d}\log t_i}{\theta_i}\right] \\
=& \underbrace{\left[\left(1-\frac{1}{\rho_i}\right)\left(1-\frac{1}{\sigma_i}\right)\delta_i + \eta_i\theta_i - 1\right]}_{<0}(1-\xi_i)\,\mathbb{E}_{s\xi}\left[\frac{\mathrm{d}\log t}{\theta}\right] \\
&+ \underbrace{\left[\xi_i\delta_i\left(1-\frac{1}{\rho_i}\right)\left(1-\frac{1}{\sigma_i}\right) - (1-\xi_i)\eta_i\theta_i - \xi_i\right]}_{<0}\frac{\mathrm{d}\log t_i}{\theta_i} \\
=& \left[\left(1-\frac{1}{\rho_i}\right)\left(1-\frac{1}{\sigma_i}\right)\delta_i + \eta_i\theta_i - 1\right](1-\xi_i)\,\mathbb{E}_{s\xi}\left(\left[\frac{\mathrm{d}\log t}{\theta}\right] - \frac{\mathrm{d}\log t_i}{\theta_i}\right) \\
&- \left[\delta_i\left(\frac{1}{\rho_i}-1\right)\left(1-\frac{1}{\sigma_i}\right)+1\right]\frac{\mathrm{d}\log t_i}{\theta_i}
\end{aligned}
$$

The signing follows that

$$
\begin{aligned}
\left(1-\frac{1}{\rho_i}\right)\left(1-\frac{1}{\sigma_i}\right)\delta_i + \eta_i\theta_i - 1 &= -\frac{\eta_i-1}{\sigma_i}\left(\frac{1}{\rho_i}-1\right)\delta_i + \eta_i - (\eta_i-1)\delta_i - 1 \\
&= \underbrace{-\frac{\eta_i-1}{\sigma_i}\left(\frac{1}{\rho_i}-1\right)\delta_i}_{\leq 0} + \underbrace{(\eta_i-1)(1-\delta_i)}_{<0} < 0.
\end{aligned}
$$

As the aggregate quantity, the aggregate revenue must decline in all markets despite that prices go up.

The case with $\beta \to 1$ With fixed entry h_i, the balanced flow condition is now $h_i M = \nu_i N_i$. Then

$$\mathrm{d}\log N_i = \mathrm{d}\log M.$$

Totally differentiating the free entry condition $\sum_i h_i\bar{\pi}_i = f_e$,

$$\sum_i \frac{h_i}{\varrho+\nu_i}\mathrm{d}\pi_i = 0 \Rightarrow \sum_i \frac{h_i\bar{\pi}_i}{\sum_k h_k\bar{\pi}_k}\frac{\pi_i}{\pi_i - f_i}\mathrm{d}\log\pi_i = 0.$$

Recall that $\mathrm{d}\log\pi_i = -\eta_i\theta_i\mathrm{d}\log N_i - \eta_i\mathrm{d}\log t_i$,

$$\sum_i s_i\xi_i\mathrm{d}\log M = -\sum_i s_i\xi_i\frac{\mathrm{d}\log t_i}{\theta_i} \Rightarrow \mathrm{d}\log M = -\mathbb{E}_{s\xi}\left[\frac{\mathrm{d}\log t}{\theta}\right],$$

in which $\xi_i = \frac{\pi_i\eta_i\theta_i}{\pi_i - f_i}$.

C Additional Results with Heterogeneous Firms

In this section, we solve the model equilibrium with heterogeneous firms and provide full statement of the comparative statics results and the omitted proofs.

C.1 Solving the equilibrium

We follow the same strategy to solve the equilibrium with heterogeneous firms. Compared to the case with homogeneous firms, there is one more equilibrium condition that determines the exit cutoff on firm productivity. This is the selection channel popularized by models of heterogeneous firms. Specifically, the zero-profit condition can be written as

$$\left(\mu_i(z_i^*) - 1\right)\frac{\tau_i}{z_i^*}q_i(z_i^*) = \left(1 - \frac{1}{\mu_i(z_i^*)}\right)p_i(z_i^*)q_i(z_i^*) = f_i, \tag{42}$$

where z_i^* is the exit cutoff and firms are indexed by their productivity draws and their export destination. In addition, the markup rule is pinned down by the pricing rule:

$$\frac{t_i}{P_i}\mu\left(\frac{q_i(z)}{Q_i}\right)\frac{\tau_i}{z} = \Upsilon'\left(\frac{q_i(z)}{Q_i}\right). \tag{43}$$

Given the price aggregator P_i and the real consumption Q_i, we can solve for $q_i(z)$ (and thus $\mu_i(z)$ and $\pi_i(z)$) as functions of P_i and Q_i.

The second set of equilibrium conditions uses the definition of the Kimball preference and the balance budget (or income accounting) equation to solve for P_i and Q_i. Specifically, we have

$$\frac{N_i}{1 - G(z_i^*)}\int_{z_i^*}^{\infty}\Upsilon\left(\frac{q_i(z;P_i,Q_i)}{Q_i}\right)\mathrm{d}G(z) = 1, \tag{44}$$

and

$$P_i = \bar{\delta}_i(P_i, Q_i)P_i^I = \bar{\delta}_i(P_i, Q_i)D_i(Q_i). \tag{45}$$

Together, they implicitly pin down P_i and Q_i (given N_i).

Third, the discounted expected net market-access value can be expressed as a function of N_i, P_i and Q_i:

$$\bar{\pi}_i(N_i) = \frac{1}{\varrho + \nu_i} \int_{z_i^*(N_i)}^{\infty} [\pi_i(z; N_i) - f_i] \, \mathrm{d}G(z), \tag{46}$$

as firm-level price and quantity depend on these three variables.

Finally, we have the two equilibrium conditions, the free entry condition and the balanced flow of firms, to determine the total number of entrants and the number of firms that export to each market $(M, \{N_i\})$:

$$\sum_{i \in \mathscr{I}} (h_i \bar{\pi}_i)^{\frac{1}{\beta}} = f_e^{\frac{1}{\beta}}, \qquad J_i[1 - G(z_i^*)]M = \nu_i N_i.$$

There are $L+1$ equations for $L+1$ unknowns. Similar to the case of homogeneous firms, we can derive that

$$J_i = h_i \left(\frac{h_i \bar{\pi}_i}{f_e} \right)^{\frac{1-\beta}{\beta}} = \frac{\nu_i N_i}{M[1 - G(z_i^*)]} \quad \Rightarrow \quad \bar{\pi}_i(N_i) = \left(\frac{\nu_i N_i}{h_i M[1 - G(z_i^*)]} \right)^{\frac{\beta}{1-\beta}} \frac{f_e}{h_i}, \tag{47}$$

Combined with equation (46), the above equation provides us an implicit function N_i in terms of M. We define such mapping by $N_i = N_i(M)$. Inserting it back into the free entry equation, we can pin down the equilibrium mass of total entrants M as in the case of homogeneous firms:

$$\sum_{i \in \mathscr{I}} (h_i \bar{\pi}_i(N_i(M)))^{\frac{1}{\beta}} = f_e^{\frac{1}{\beta}}.$$

C.2 Equilibrium conditions

We expand the equilibrium conditions to the first order in the shocks.

Pricing Totally differentiating the pricing equation (43)

$$\mathrm{d}\log\mu_i - \mathrm{d}\log P_i + \mathrm{d}\log\tau_i + \mathrm{d}\log t_i = -\frac{1}{\sigma_i}\mathrm{d}\log\frac{q_i}{Q_i}. \tag{48}$$

We suppress firm productivity z for brevity. Similarly, μ_i is an abbreviation for $\mu\left(\frac{q_i(z)}{Q_i}\right)$.

Selection Totally differentiating the selection equation (42),

$$\left.\frac{\partial\log\left(\mu_i(z)-1\right)\frac{\tau_i}{z}q_i(z)\right)}{\partial\log z}\right|_{z=z_i^*}\mathrm{d}\log z_i^* + \mathrm{d}\left(\log(\mu_i(z_i^*)-1)\frac{\tau_i}{z_i^*}q_i(z_i^*)\right) = \mathrm{d}\log f_i.$$

The first partial derivative has the following form:

$$\frac{\partial\log\left(\mu_i(z)-1\right)\frac{\tau_i}{z}q_i(z)\right)}{\partial\log z} = \frac{\mu_i(z)}{\mu_i(z)-1}\frac{\partial\log\mu_i(z)}{\partial\log z} - 1 + \frac{\partial\log q_i(z)}{\partial\log z} = \sigma_i(z) - 1.$$

Since $\frac{\mu_i\tau_i}{z} = P_i\Upsilon'\left(\frac{q_i}{Q_i}\right)$,

$$\frac{\partial\log\mu_i(z)}{\partial\log z} - 1 = \frac{\Upsilon''\left(\frac{q_i(z)}{Q_i}\right)\frac{q_i(z)}{Q_i}}{\Upsilon'\left(\frac{q_i(z)}{Q_i}\right)}\frac{\partial\log q_i(z)}{\partial\log z} = -\frac{1}{\sigma_i(z)}\frac{\partial\log q_i(z)}{\partial\log z}.$$

Plugging it into the equation, we obtain the RHS equals to $\sigma_i - 1$ with $\frac{\mu_i}{\mu_i-1} = \sigma_i$.[23] Finally, we rewrite the selection condition as follows:[24]

$$(\sigma_i(z_i^*)-1)\mathrm{d}\log z_i^* + \mathrm{d}\log\pi_i(z_i^*) = \mathrm{d}\log f_i. \tag{49}$$

Welfare Totally differentiating equation (44) and using that $\Upsilon'\left(\frac{q_i}{Q_i}\right)\frac{q_i}{Q_i} = \frac{t_i p_i q_i}{E_i\bar{\delta}_i}$, we obtain that

$$\bar{\delta}_i\mathrm{d}\log N_i + \left(\bar{\delta}_i - \delta_i(z_i^*)\lambda_i(z_i^*)\right)\frac{g(z_i^*)}{1-G(z_i^*)}\mathrm{d}z_i^* + \mathbb{E}^i_{\lambda_i}\left[\mathrm{d}\log\frac{q_i}{Q_i}\right] = 0 \tag{50}$$

[23] This is straightforward with the CES preference: $\pi \propto z^{\sigma-1} \Rightarrow \frac{\partial\log\pi}{\partial\log z} = \sigma - 1$,

[24] The notation $\mathrm{d}\log x_i \equiv \mathrm{d}\log x_i(z)$, the log change in x_i holding z constant.

Price index (budget balance) Note that

$$\frac{1}{\bar{\delta}_i} = \frac{N_i}{1 - G(z_i^*)} \int_{z_i^*}^{\infty} \Upsilon' \left(\frac{q_i(z)}{Q_i} \right) \frac{q_i(z)}{Q_i} g(z) \mathrm{d}z$$

Totally differentiating $\bar{\delta}_i$,

$$-\mathrm{d} \log \bar{\delta}_i = \mathrm{d} \log N_i + (1 - \lambda_i(z_i^*)) \frac{g(z_i^*)}{1 - G(z_i^*)} \mathrm{d}z_i^* + \mathbb{E}_{\lambda_i}^i \left[\left(1 - \frac{1}{\sigma_i} \right) \mathrm{d} \log \frac{q_i}{Q_i} \right]. \tag{51}$$

Then, we have

$$\mathrm{d} \log P_i + \frac{1}{\eta_i} \mathrm{d} \log Q_i = \mathrm{d} \log \bar{\delta}_i. \tag{52}$$

Markup

$$\mathrm{d} \log \mu_i = \left(\frac{1}{\rho_i} - 1 \right) \frac{1}{\sigma_i} \mathrm{d} \log \frac{q_i}{Q_i}, \tag{53}$$

in which

$$\rho_i = -\frac{\partial \log p_i}{\partial \log z} = \frac{1}{1 + \frac{\mu' \left(\frac{q_i}{Q_i} \right) \frac{q_i}{Q_i}}{\mu \left(\frac{q_i}{Q_i} \right)} \sigma_i}.$$

Variable and expected profit

$$\mathrm{d} \log \pi_i = \sigma_i \mathrm{d} \log \mu_i + \mathrm{d} \log \tau_i + \mathrm{d} \log q_i. \tag{54}$$

$$\mathrm{d} \log \bar{\pi}_i = -\mathrm{d} \log(\varrho + \nu_i) + \mathbb{E}_{\pi_i - f_i}^i \left[\frac{\pi_i \mathrm{d} \log \pi_i - f_i \mathrm{d} \log f_i}{\pi_i - f_i} \right]. \tag{55}$$

Balanced flow Totally differentiating equation (47),

$$\frac{1}{\beta} \mathrm{d} \log h_i + \frac{1 - \beta}{\beta} \left[\mathrm{d} \log \bar{\pi}_i - \mathrm{d} \log f_e \right] = \mathrm{d} \log \nu_i + \mathrm{d} \log N_i - \mathrm{d} \log M + \varphi_i^* \mathrm{d} \log z_i^*. \tag{56}$$

Free entry

$$\sum_{i\in\mathscr{I}} s_i \left[\mathrm{d}\log h_i + \mathrm{d}\log \bar{\pi}_i\right] = \mathrm{d}\log f_e, \tag{57}$$

in which $s_i = \left(\frac{h_i\bar{\pi}_i}{f_e}\right)^{\frac{1}{\beta}} = \frac{J_i\bar{\pi}_i}{\sum_k J_k\bar{\pi}_k}$.

C.3 A full description of equilibrium changes

We provide full versions of Propositions 4 and 5, and the special case of nested CES demand. Proofs are delegated to the next section. Consider tariff changes around an stationary equilibrium. It is useful to introduce the following notations:

$$\sigma_i^* \equiv \sigma_i(z_i^*), \quad \delta_i^* \equiv \delta_i(z_i^*), \quad r_i^* \equiv r_i(z_i^*), \quad q_i^* \equiv q_i(z_i^*).$$

We also define average variable profit, average revenue, and the local equilibrium coefficient γ_i by

$$\pi_i^m \equiv \int_{z_i^*}^{\infty} \pi_i(z)\frac{g(z)}{1-G(z_i^*)}\mathrm{d}z, \qquad r_i^m \equiv \int_{z_i^*}^{\infty} p_i(z)q_i(z)\frac{g(z)}{1-G(z_i^*)}\mathrm{d}z,$$
$$\gamma_i \equiv \frac{1}{\sigma_i^*}\left\{\bar{\delta}_i + \mathbb{E}^i_{\lambda_i}\left[\left(\bar{\delta}_i(\sigma_i-1)-\sigma_i\right)\rho_i\right]\right\} - \frac{\bar{\delta}_i}{\eta_i}.$$

Let $\lambda_i(z) = \frac{N_i t_i p_i(z) q_i(z)}{E_i} = \frac{r_i(z)}{r_i^m}$, the normalized sales weight of firms with productivity z in country i. Since $r_i(z)$ increases with z, we have $\lambda_i^* \equiv \lambda_i(z_i^*) < 1$.[25] We use $\mathbb{E}^i_x[y]$ to denote the x-weighted average of variable y:

$$\mathbb{E}^i_x[y] = \frac{\int_{z_i^*}^{\infty} x(z)y(z)\frac{g(z)}{1-G(z_i^*)}\mathrm{d}z}{\int_{z_i^*}^{\infty} x(z)\frac{g(z)}{1-G(z_i^*)}\mathrm{d}z}.$$

A useful and easily verifiable identity is $\mathbb{E}^i_{\lambda_i}[\delta_i] = \bar{\delta}_i$. Another example is $\mathbb{E}^i[\lambda_i] = 1$, where $x(z) = 1$.

Additionally, we denote the number of potential entrants in market i by M_i^p, i.e., $M_i^p = J_i M$. With the balanced flow condition, $\mathrm{d}\log M_i^p = \mathrm{d}\log N_i + \varphi_i^* \mathrm{d}\log z_i^*$, in which $\varphi_i^* \equiv \frac{z_i^* g(z_i^*)}{1-G(z_i^*)}$. In other words, φ_i^* is the absolute value of the elasticity of the survival share

[25] $\frac{\mathrm{d}\log r_i(z)}{\mathrm{d}\log z} = \rho(z)\left(\sigma(z)-1\right) > 0$.

$1 - G(z_i^*)$ with respect to the threshold z_i^*, i.e., $\varphi_i^* = -\frac{\mathrm{d}\log[1-G(z_i^*)]}{\mathrm{d}\log z_i^*}$.

We discuss equilibrium changes in key variables in what follows. In the homogeneous-firm case, the change in the number of firms (i.e., $\mathrm{d}\log N_i$) is a sufficient statistic that characterizes local changes. With heterogeneous firms, either $\mathrm{d}\log N_i$ or $\mathrm{d}\log z_i^*$ can be a sufficient statistic. We use z_i^* rather than N_i for cleaner expositions. The following proposition provides the full details in Proposition 4.

Proposition A.2. *Suppose that Assumptions 1′ and 2 hold in the initial equilibrium. Given tariff changes $\{\mathrm{d}\log t_i\}_{i\in\mathscr{I}}$, equilibrium changes in the entrant pool, market-specific potential entrants, cutoffs, and sectoral composite satisfy*

$$\mathrm{d}\log M = -\frac{\sum_{i\in\mathscr{I}} s_i \xi_i^t \mathrm{d}\log t_i}{\sum_{i\in\mathscr{I}} s_i \xi_i^M}, \qquad \mathrm{d}\log M_i^p = \Big(1 - \underset{\in(0,1)}{\xi_i^M}\Big)\mathrm{d}\log M - \underset{(+)}{\xi_i^t}\,\mathrm{d}\log t_i,$$

$$\mathrm{d}\log z_i^* = \underset{(+)}{z_i^M}\mathrm{d}\log M + z_i^t \mathrm{d}\log t_i, \qquad \mathrm{d}\log Q_i = \underset{(+)}{Q_i^z}\mathrm{d}\log z_i^* + \underset{(-)}{Q_i^t}\mathrm{d}\log t_i,$$

where s_i is the expected profit share as in (23),

$$z_i^M \equiv -\frac{1}{\frac{1-\beta}{\beta}\bar\pi_i^z - (N_i^z + \varphi_i^*)} > 0, \qquad z_i^t \equiv \frac{N_i^t - \frac{1-\beta}{\beta}\bar\pi_i^t}{\frac{1-\beta}{\beta}\bar\pi_i^z - (N_i^z + \varphi_i^*)},$$

$$\xi_i^M \equiv \frac{\frac{1-\beta}{\beta}\bar\pi_i^z}{\frac{1-\beta}{\beta}\bar\pi_i^z - (N_i^z + \varphi_i^*)} \in (0,1), \qquad \xi_i^t \equiv -\frac{\frac{1-\beta}{\beta}\left[\bar\pi_i^z N_i^t - (\varphi_i^* + N_i^z)\bar\pi_i^t\right]}{\frac{1-\beta}{\beta}\bar\pi_i^z - (N_i^z + \varphi_i^*)} > 0,$$

$$Q_i^z \equiv -\left[(\sigma_i^* - 1)\left(1 + \frac{\bar\delta_i}{\eta_i\gamma_i}\right) + (\bar\delta_i - \delta_i^*)\frac{\lambda_i^*\varphi_i^*}{\gamma_i}\right] > 0, \qquad Q_i^t \equiv \frac{\bar\delta_i}{\gamma_i} < 0.$$

Moreover, $\bar\pi^z, \bar\pi^t, N^z, N^t$ are the respective elasticities of $\bar\pi_i$ and N_i to z_i^* and t_i:

$$\mathrm{d}\log\bar\pi_i = \bar\pi_i^z \mathrm{d}\log z_i^* + \bar\pi_i^t \mathrm{d}\log t_i,$$
$$\mathrm{d}\log N_i = N_i^z \mathrm{d}\log z_i^* + N_i^t \mathrm{d}\log t_i,$$

where

$$\bar{\pi}_i^t \equiv \frac{\sigma_i^* \pi_i^m - r_i^m}{\pi_i^m - f_i} \frac{\bar{\delta}_i}{\sigma_i^* \gamma_i} < 0,$$
$$\bar{\pi}_i^z \equiv -\left\{ \frac{\pi_i^m (\sigma_i^* - 1)}{\pi_i^m - f_i} + \frac{\sigma_i^* \pi_i^m - r_i^m}{\pi_i^m - f_i} \frac{\bar{\delta}_i}{\sigma_i^* \gamma_i} \left[\frac{\sigma_i^* - 1}{\eta_i} + \left(1 - \frac{\delta_i^*}{\bar{\delta}_i}\right) \lambda_i^* \varphi_i^* \right] \right\} \leq 0,$$
$$N_i^t \equiv \frac{\mathbb{E}_{\lambda_i}^i [\rho_i \sigma_i]}{\sigma_i^* \gamma_i} < 0,$$
$$N_i^z \equiv -\frac{\mathbb{E}_{\lambda_i}^i [\rho_i \sigma_i]}{\sigma_i^* \gamma_i} \left[\frac{\sigma_i^* - 1}{\eta_i} + \left(1 - \frac{\delta_i^*}{\bar{\delta}_i}\right) \lambda_i^* \varphi_i^* \right] - \left(1 - \frac{\delta_i^*}{\bar{\delta}_i} \lambda_i^*\right) \varphi_i^* > -\varphi_i^*.$$

The proposition below presents the full details of Proposition 4 that characterizes equilibrium changes in response to a tariff increase in the focal market.

Proposition A.3. *Suppose that Assumptions 1′ and 2 hold in the initial equilibrium. Suppose the focal market j raises its tariff, $\mathrm{d}\log t_j > 0$, while $\mathrm{d}\log t_i = 0$ for every third market $i \neq j$. The equilibrium changes have the following properties:*

(i) In every market,

$$\mathrm{d}\log M < 0, \quad \mathrm{d}\log M_i^p < 0, \quad \mathrm{d}\log Q_i < 0, \quad \mathrm{d}\log \tilde{Q}_i < 0, \quad \mathrm{d}\log R_i < 0.$$

For every continuing firm, $\mathrm{d}\log p_i(z) = \mathrm{d}\log \mu_i(z) \geq 0$.

(ii) In every third market $i \neq j$,

$$\mathrm{d}\log z_i^* < 0, \qquad \mathrm{d}\log p_i^m \geq 0.$$

(iii) In the focal market, the sign of $\mathrm{d}\log z_j^*$ is ambiguous:

$$\mathrm{d}\log z_j^* = \underbrace{z_j^M}_{>0} \left[\underbrace{\left(\frac{s_j \xi_j^M}{\sum_{k \in \mathscr{I}} s_k \xi_k^M} - 1 \right)}_{<0} \underbrace{N_j^t}_{<0} + \underbrace{\bar{\pi}_j^t}_{\leq 0} \underbrace{\left(\frac{1-\beta}{\beta} - \frac{s_j \xi_j^M}{\sum_{k \in \mathscr{I}} s_k \xi_k^M} \frac{\varphi_j^* + N_j^z}{\bar{\pi}_j^z} \right)}_{>0} \right] \mathrm{d}\log t_j. \tag{58}$$

In the special case of nested CES demand, the above results can be further simplified,

and we summarize them in the following corollary.

Corollary A.1. *Suppose the demand system in each market is nested CES with $\sigma_i > \eta_i > 1$ and $\theta_i^{\text{CES}} \equiv \frac{\sigma_i - \eta_i}{\eta_i(\sigma_i - 1)}$ in the CES case. Given a set of tariff changes $\{\mathrm{d}\log t_i\}_{i \in \mathscr{I}}$, the following equations characterize changes in the equilibrium. First,*

$$z_i^M = \frac{\frac{\beta}{1-\beta}\frac{\eta_i \theta_i^{\text{CES}}}{\sigma_i - 1}}{\frac{\pi_i^m}{\pi_i^m - f_i}\eta_i \theta_i^{\text{CES}} + \frac{\beta}{1-\beta}\left(1 + \frac{\eta_i \theta_i^{\text{CES}}}{\sigma_i - 1}\lambda_i^* \varphi_i^*\right)}, \qquad z_i^t = \frac{z_i^M}{\theta_i^{\text{CES}}},$$

$$\xi_i^M = \frac{\frac{\pi_i^m}{\pi_i^m - f_i}\eta_i \theta_i^{\text{CES}}}{\frac{\pi_i^m}{\pi_i^m - f_i}\eta_i \theta_i^{\text{CES}} + \frac{\beta}{1-\beta}\left(1 + \frac{\eta_i \theta_i^{\text{CES}}}{\sigma_i - 1}\lambda_i^* \varphi_i^*\right)}, \qquad \xi_i^t = \frac{\xi_i^M}{\theta_i^{\text{CES}}}.$$

Then, we have

$$\begin{aligned}
\mathrm{d}\log M &= \sum_i \tilde{s}_i^M \cdot \frac{-\mathrm{d}\log t_i}{\theta_i^{\text{CES}}}, \\
\mathrm{d}\log z_i^* &= z_i^M \left(\mathrm{d}\log M + \frac{\mathrm{d}\log t_i}{\theta_i^{\text{CES}}}\right), \\
\mathrm{d}\log N_i &= (1 - \widetilde{\xi}_i)\mathrm{d}\log M + \widetilde{\xi}_i \frac{-\mathrm{d}\log t_i}{\theta_i^{\text{CES}}}.
\end{aligned}$$

where $\tilde{s}_i^M = \frac{s_i \xi_i^M}{\sum_i' s_{i'} \xi_{i'}^M}$, and $\widetilde{\xi}_i \equiv \xi_i^M + \varphi_i^* z_i^M = \frac{\frac{\pi_i^m}{\pi_i^m - f_i}\eta_i \theta_i^{\text{CES}} + \frac{\beta}{1-\beta}\frac{\eta_i \theta_i^{\text{CES}}}{\sigma_i - 1}\varphi_i^*}{\frac{\pi_i^m}{\pi_i^m - f_i}\eta_i \theta_i^{\text{CES}} + \frac{\beta}{1-\beta}\left(1 + \frac{\eta_i \theta_i^{\text{CES}}}{\sigma_i - 1}\lambda_i^* \varphi_i^*\right)} \in (0, \frac{1}{\lambda_i^*})$.

Next, the changes in the market-level aggregate outcomes are

$$\begin{aligned}
\mathrm{d}\log R_i &= \frac{(\eta_i - 1)(\sigma_i - 1)}{\sigma_i - \eta_i}\mathrm{d}\log z_i^* - \frac{\eta_i(\sigma_i - 1)}{\sigma_i - \eta_i}\mathrm{d}\log t_i, \\
\mathrm{d}\log \tilde{Q}_i &= \left[\frac{(\eta_i - 1)(\sigma_i - 1)}{\sigma_i - \eta_i} + \underbrace{(\lambda_i^* - \frac{q_i^*}{q_i^m})\varphi_i^*}_{>0}\right]\mathrm{d}\log z_i^* - \frac{\eta_i(\sigma_i - 1)}{\sigma_i - \eta_i}\mathrm{d}\log t_i, \\
\mathrm{d}\log Q_i &= \frac{\eta_i(\sigma_i - 1)}{\sigma_i - \eta_i}\mathrm{d}\log z_i^* - \frac{\eta_i \sigma_i}{\sigma_i - \eta_i}\mathrm{d}\log t_i;
\end{aligned}$$

the changes in market-level average outcomes are

$$\begin{aligned}
\mathrm{d}\log p_i^m &= \underbrace{\left(\frac{q_i^*}{q_i^m} - \lambda_i^*\right)\varphi_i^*}_{<0}\,\mathrm{d}\log z_i^*, \\
\mathrm{d}\log r_i^m &= \left[(1-\lambda_i^*)\,\varphi_i^* - (\sigma_i - 1)\right]\mathrm{d}\log z_i^*, \\
\mathrm{d}\log q_i^m &= \left[\left(1 - \frac{q_i^*}{q_i^m}\right)\varphi_i^* - (\sigma_i - 1)\right]\mathrm{d}\log z_i^*.
\end{aligned}$$

Finally, for continuing firms,

$$\begin{aligned}
&\mathrm{d}\log p_i(z) = \mathrm{d}\log \mu_i(z) = 0, \\
&\mathrm{d}\log \pi_i(z) = \mathrm{d}\log r_i(z) = \mathrm{d}\log q_i(z) = -(\sigma_i - 1)\mathrm{d}\log z_i^*.
\end{aligned}$$

Entry Interdependence Finally, we revisit the role of β in the presence of firm heterogeneity. We repeat the thought experiment in Section 4.4 and focus on the case of symmetric markets. Market subscripts are suppressed for brevity. From Proposition A.2, we know that the impact of β on $\mathrm{d}\log Q_i$ is fully captured by its impact on $\mathrm{d}\log z_i^*$ since $Q_i^z > 0$, and both Q_i^z and Q_i^t are independent of β.

It then suffices to study how β affects $\mathrm{d}\log z_i^*$. With symmetric market, $\mathrm{d}\log M$ is independent of β:

$$\mathrm{d}\log M = -\frac{1}{L}\frac{\xi^t}{\xi^M}\mathrm{d}\log t_j = -\frac{1}{L}\left((\varphi^* + N^z)\frac{\bar{\pi}^t}{\bar{\pi}^z} - N^t\right)\mathrm{d}\log t_j < 0,$$

in which $\bar{\pi}^z < 0$, $\bar{\pi}^t \leq 0$, $\varphi^* + N^z > 0$, $N^t < 0$, and they are independent of β. In third markets, we have

$$\mathrm{d}\log z_i^* \equiv z^M \mathrm{d}\log M = \frac{1}{(N^z + \varphi^*) - \frac{1-\beta}{\beta}\bar{\pi}^z}\mathrm{d}\log M.$$

It is then obvious that $\mathrm{d}\log z_i^*$ decreases with β.

The focal market is more complicated since z_j^t also depends on β. We can rewrite

$$\mathrm{d}\log z_j^* = \frac{\frac{L-1}{L}N^t + \frac{1}{L}\frac{\bar{\pi}^t}{\bar{\pi}^z}(\varphi^* + N^z) - \bar{\pi}^t\frac{1-\beta}{\beta}}{\frac{1-\beta}{\beta}\bar{\pi}^z - (N^z + \varphi^*)}\mathrm{d}\log t_j.$$

Let $\tilde{\beta}^{-1} = \frac{1-\beta}{\beta}$. Partially differentiating the above equation with respect to $\tilde{\beta}^{-1}$,

$$\begin{aligned}\frac{\partial \mathrm{d}\log z_j^*}{\partial \tilde{\beta}^{-1}} &= \frac{\bar{\pi}^t(N^z+\varphi^*) + \bar{\pi}^z\left(-\frac{L-1}{L}N^t - \frac{1}{L}\frac{\bar{\pi}^t}{\bar{\pi}^z}(\varphi^*+N^z)\right)}{\left[(N^z+\varphi^*) - \frac{1-\beta}{\beta}\bar{\pi}^z\right]^2} \\ &= \frac{\frac{L-1}{L}\left(\bar{\pi}^t(N^z+\varphi^*) - \bar{\pi}^z N^t\right)}{\left[(N^z+\varphi^*) - \frac{1-\beta}{\beta}\bar{\pi}^z\right]^2} < 0,\end{aligned}$$

as $\varphi_i^* + N_i^z > 0$, $\bar{\pi}_i^z < 0$, $\bar{\pi}_i^t \leq 0$ and $N_i^t < 0$. Since $\frac{\mathrm{d}\tilde{\beta}^{-1}}{\mathrm{d}\beta} < 0$, we obtain $\frac{\partial \mathrm{d}\log z_j^*}{\partial \beta} > 0$. Therefore, the impact of a bigger β on the consumption of the sectoral composites in the focal market is always positive, despite that $\mathrm{d}\log z_j^*$ can be either positive or negative.

C.4 Omitted Proofs in the heterogeneous-firm case

C.4.1 Solving for $\mathrm{d}\log M$ and $\mathrm{d}\log z_i^*$

We consider only $\mathrm{d}\log t_i$ and set $\mathrm{d}\log\tau_i = \mathrm{d}\log\nu_i = \mathrm{d}\log h_i = \mathrm{d}\log f_i = \mathrm{d}\log f_e = 0$. Also, let $\sigma_i^* = \sigma_i(z_i^*)$, $\varphi_i^* = \frac{z_i^* g(z_i^*)}{1-G(z_i^*)}$, $\pi_i^* = \pi_i(z_i^*)$, $\delta_i^* = \delta_i(z_i^*)$, and $\lambda_i^* = \lambda_i(z_i^*)$. Then, we obtain the following system of equations:

$$\begin{aligned}\mathrm{d}\log P_i &= \frac{1}{\rho_i\sigma_i}\mathrm{d}\log\frac{q_i}{Q_i} + \mathrm{d}\log t_i, \\ (\sigma_i^*-1)\mathrm{d}\log z_i^* + \mathrm{d}\log\pi_i^* &= 0, \\ \bar{\delta}_i\mathrm{d}\log N_i + \left(\bar{\delta}_i - \delta_i^*\lambda_i^*\right)\varphi_i^*\mathrm{d}\log z_i^* + \mathbb{E}^i_{\lambda_i}\left[\mathrm{d}\log\frac{q_i}{Q_i}\right] &= 0, \\ -\mathrm{d}\log P_i - \frac{1}{\eta_i}\mathrm{d}\log Q_i = \mathrm{d}\log N_i + (1-\lambda_i^*)\varphi_i^*\mathrm{d}\log z_i^* + \mathbb{E}^i_{\lambda_i}&\left[\left(1-\frac{1}{\sigma_i}\right)\mathrm{d}\log\frac{q_i}{Q_i}\right], \\ \mathrm{d}\log\pi_i &= \frac{1}{\rho_i}\mathrm{d}\log\frac{q_i}{Q_i} + \mathrm{d}\log Q_i, \\ \mathbb{E}^i_{\pi_i-f_i}\left[\frac{\pi_i\mathrm{d}\log\pi_i}{\pi_i-f_i}\right] &= \frac{\beta}{1-\beta}\left[\mathrm{d}\log N_i - \mathrm{d}\log M + \varphi_i^*\mathrm{d}\log z_i^*\right], \\ \sum_{i\in\mathscr{I}} s_i\left[\mathrm{d}\log N_i + \varphi_i^*\mathrm{d}\log z_i^*\right] &= \mathrm{d}\log M.\end{aligned}$$

First, we write $\mathrm{d}\log\frac{q_i}{Q_i} = \rho_i\sigma_i[\mathrm{d}\log P_i - \mathrm{d}\log t_i]$. Then

$$\mathrm{d}\log\pi_i = \sigma_i[\mathrm{d}\log P_i - \mathrm{d}\log t_i] + \mathrm{d}\log Q_i \Longrightarrow (\sigma_i^*-1)\mathrm{d}\log z_i^* = -\sigma_i^*[\mathrm{d}\log P_i - \mathrm{d}\log t_i] - \mathrm{d}\log Q_i.$$

Combining conditions on welfare and price index,

$$
\begin{aligned}
-\frac{\bar{\delta}_i}{\eta_i}\mathrm{d}\log Q_i =&\bar{\delta}_i\mathrm{d}\log P_i - \left(\bar{\delta}_i - \delta_i^*\lambda_i^*\right)\varphi_i^*\mathrm{d}\log z_i^* - \mathbb{E}^i_{\lambda_i}\left[\mathrm{d}\log\frac{q_i}{Q_i}\right] \\
&+ \bar{\delta}_i\left(1-\lambda_i^*\right)\varphi_i^*\mathrm{d}\log z_i^* + \bar{\delta}_i\,\mathbb{E}^i_{\lambda_i}\left[\left(1-\frac{1}{\sigma_i}\right)\mathrm{d}\log\frac{q_i}{Q_i}\right], \\
-\frac{\bar{\delta}_i}{\eta_i}\mathrm{d}\log Q_i =&\bar{\delta}_i\mathrm{d}\log P_i - (\bar{\delta}_i-\delta_i^*)\lambda_i^*\varphi_i^*\mathrm{d}\log z_i^* + \mathbb{E}^i_{\lambda_i}\left[\left(\bar{\delta}_i(\sigma_i-1)-\sigma_i\right)\rho_i\right]\left[\mathrm{d}\log P_i - \mathrm{d}\log t_i\right].
\end{aligned}
$$

We obtain the following relationship between $\mathrm{d}\log Q_i$ and $\mathrm{d}\log z_i^*$:

$$
\begin{aligned}
&\left\{\frac{1}{\sigma_i^*}\left(\bar{\delta}_i + \mathbb{E}^i_{\lambda_i}\left[\left(\bar{\delta}_i(\sigma_i-1)-\sigma_i\right)\rho_i\right]\right) - \frac{\bar{\delta}_i}{\eta_i}\right\}\mathrm{d}\log Q_i \\
&\quad= -\left\{\frac{\sigma_i^*-1}{\sigma_i^*}\left(\bar{\delta}_i + \mathbb{E}^i_{\lambda_i}\left[\left(\bar{\delta}_i(\sigma_i-1)-\sigma_i\right)\rho_i\right]\right) + (\bar{\delta}_i-\delta_i^*)\lambda_i^*\varphi_i^*\right\}\mathrm{d}\log z_i^* + \bar{\delta}_i\mathrm{d}\log t_i \\
\Rightarrow\quad \mathrm{d}\log Q_i &= -\left[(\sigma_i^*-1)\left(1+\frac{\bar{\delta}_i}{\eta_i\gamma_i}\right) + (\bar{\delta}_i-\delta_i^*)\frac{\lambda_i^*\varphi_i^*}{\gamma_i}\right]\mathrm{d}\log z_i^* + \frac{\bar{\delta}_i}{\gamma_i}\mathrm{d}\log t_i,
\end{aligned}
$$

in which $\gamma_i = \frac{1}{\sigma_i^*}\left(\bar{\delta}_i + \mathbb{E}^i_{\lambda_i}\left[\left(\bar{\delta}_i(\sigma_i-1)-\sigma_i\right)\rho_i\right]\right) - \frac{\bar{\delta}_i}{\eta_i}$.

Lemma A.1. *Suppose that Assumptions 1′ and 2 hold. Then, in every market i,*

$$
-\frac{\bar{\delta}_i}{\eta_i} \le \gamma_i < 0, \qquad Q_i^z \equiv -\left[(\sigma_i^*-1)\left(1+\frac{\bar{\delta}_i}{\eta_i\gamma_i}\right) + (\bar{\delta}_i-\delta_i^*)\frac{\lambda_i^*\varphi_i^*}{\gamma_i}\right] > 0.
$$

Proof. Strict concavity of Υ, together with $\Upsilon(0)=0$, implies that $\delta_i(z) > 1$ for every active firm. Since $\mathbb{E}^i_{\lambda_i}[\delta_i] = \bar{\delta}_i$, it follows that $\bar{\delta}_i > 1$. We first rewrite

$$
\bar{\delta}_i + \mathbb{E}^i_{\lambda_i}\left[\left(\bar{\delta}_i(\sigma_i-1)-\sigma_i\right)\rho_i\right] = \bar{\delta}_i\left(1-\mathbb{E}^i_{\lambda_i}[\rho_i]\right) + (\bar{\delta}_i-1)\,\mathbb{E}^i_{\lambda_i}[\rho_i\sigma_i] \ge 0.
$$

Moreover, $0 < \rho_i \le 1$ implies that markups are nondecreasing in productivity, and hence $\sigma_i(z) \le \sigma_i^*$ for every surviving firm. Therefore,

$$
0 \le \frac{1}{\sigma_i^*}\left\{\bar{\delta}_i + \mathbb{E}^i_{\lambda_i}\left[\left(\bar{\delta}_i(\sigma_i-1)-\sigma_i\right)\rho_i\right]\right\} \le \frac{\bar{\delta}_i}{\sigma_i^*}\left(1-\mathbb{E}^i_{\lambda_i}[\rho_i]\right) + (\bar{\delta}_i-1)\,\mathbb{E}^i_{\lambda_i}[\rho_i].
$$

Assumption 1′ implies $\sigma_i^* > \eta_i$ and $\bar{\delta}_i < \eta_i/(\eta_i-1)$. Consequently,

$$
\frac{\bar{\delta}_i}{\sigma_i^*} < \frac{\bar{\delta}_i}{\eta_i}, \qquad \bar{\delta}_i - 1 < \frac{\bar{\delta}_i}{\eta_i}.
$$

Using $0 < \mathbb{E}^i_{\lambda_i}[\rho_i] \leq 1$ in the preceding bound yields

$$0 \leq \frac{1}{\sigma_i^*}\left\{\bar{\delta}_i + \mathbb{E}^i_{\lambda_i}\left[\left(\bar{\delta}_i(\sigma_i - 1) - \sigma_i\right)\rho_i\right]\right\} < \frac{\bar{\delta}_i}{\eta_i}.$$

The definition of γ_i then gives

$$-\frac{\bar{\delta}_i}{\eta_i} \leq \gamma_i < 0.$$

Finally, multiplying the definition of Q_i^z by γ_i and substituting the definition of γ_i gives

$$\begin{aligned}\gamma_i Q_i^z = & -\frac{\sigma_i^* - 1}{\sigma_i^*}\left\{\bar{\delta}_i + \mathbb{E}^i_{\lambda_i}\left[\left(\bar{\delta}_i(\sigma_i - 1) - \sigma_i\right)\rho_i\right]\right\} \\ & - (\bar{\delta}_i - \delta_i^*)\lambda_i^*\varphi_i^* < 0,\end{aligned}$$

where the strict inequality follows from $\bar{\delta}_i > 1$, $0 < \rho_i \leq 1$, $\sigma_i^* > 1$, and $\bar{\delta}_i \geq \delta_i^*$. Since $\gamma_i < 0$, we conclude that $Q_i^z > 0$. ■

That is, holding tariffs, welfare increases with productivity threshold. With the CES demand, we have

$$\gamma_i = \frac{\eta_i - \sigma_i}{\eta_i(\sigma_i - 1)} < 0, \quad Q_i^z = \frac{\eta_i(\sigma_i - 1)}{\sigma_i - \eta_i} > \eta_i > 1.$$

We then turn to the welfare condition. Note that

$$\begin{aligned}
& \bar{\delta}_i \mathrm{d}\log N_i + \left[\left(\bar{\delta}_i - \delta_i^*\lambda_i^*\right)\varphi_i^* - \frac{\sigma_i^* - 1}{\sigma_i^*}\mathbb{E}^i_{\lambda_i}[\rho_i\sigma_i]\right]\mathrm{d}\log z_i^* = \frac{1}{\sigma_i^*}\mathbb{E}^i_{\lambda_i}[\rho_i\sigma_i]\mathrm{d}\log Q_i \\
\Rightarrow \quad & \bar{\delta}_i \mathrm{d}\log N_i + \left[\left(\bar{\delta}_i - \delta_i^*\lambda_i^*\right)\varphi_i^* - \frac{\sigma_i^* - 1}{\sigma_i^*}\mathbb{E}^i_{\lambda_i}[\rho_i\sigma_i]\right]\mathrm{d}\log z_i^* \\
= & \frac{1}{\sigma_i^*}\mathbb{E}^i_{\lambda_i}[\rho_i\sigma_i]\left\{-\left[(\sigma_i^* - 1)\left(1 + \frac{\bar{\delta}_i}{\eta_i\gamma_i}\right) + (\bar{\delta}_i - \delta_i^*)\frac{\lambda_i^*\varphi_i^*}{\gamma_i}\right]\mathrm{d}\log z_i^* + \frac{\bar{\delta}_i}{\gamma_i}\mathrm{d}\log t_i\right\} \\
\Rightarrow \quad & \bar{\delta}_i \mathrm{d}\log N_i = \left\{-\frac{\mathbb{E}^i_{\lambda_i}[\rho_i\sigma_i]}{\sigma_i^*\gamma_i}\left[(\sigma_i^* - 1)\frac{\bar{\delta}_i}{\eta_i} + (\bar{\delta}_i - \delta_i^*)\lambda_i^*\varphi_i^*\right] - \left(\bar{\delta}_i - \delta_i^*\lambda_i^*\right)\varphi_i^*\right\}\mathrm{d}\log z_i^* + \frac{\bar{\delta}_i\,\mathbb{E}^i_{\lambda_i}[\rho_i\sigma_i]}{\sigma_i^*\gamma_i}\mathrm{d}\log t_i \\
\Rightarrow \quad & \mathrm{d}\log N_i = \left\{-\frac{\mathbb{E}^i_{\lambda_i}[\rho_i\sigma_i]}{\sigma_i^*\gamma_i}\left[(\sigma_i^* - 1)\frac{1}{\eta_i} + (1 - \frac{\delta_i^*}{\bar{\delta}_i})\lambda_i^*\varphi_i^*\right] - \left(1 - \frac{\delta_i^*}{\bar{\delta}_i}\lambda_i^*\right)\varphi_i^*\right\}\mathrm{d}\log z_i^* + \frac{\mathbb{E}^i_{\lambda_i}[\rho_i\sigma_i]}{\sigma_i^*\gamma_i}\mathrm{d}\log t_i
\end{aligned}$$

Also,

$$\begin{aligned}
\mathrm{d}\log\pi_i &= \frac{\sigma_i}{\sigma_i^*}\left(-(\sigma_i^*-1)\mathrm{d}\log z_i^* - \mathrm{d}\log Q_i\right) + \mathrm{d}\log Q_i \\
&= -\sigma_i\frac{\sigma_i^*-1}{\sigma_i^*}\mathrm{d}\log z_i^* + \frac{\sigma_i^*-\sigma_i}{\sigma_i^*}\mathrm{d}\log Q_i \\
&= -\sigma_i\frac{\sigma_i^*-1}{\sigma_i^*}\mathrm{d}\log z_i^* + \frac{\sigma_i^*-\sigma_i}{\sigma_i^*}\left\{-\left[(\sigma_i^*-1)\left(1+\frac{\bar{\delta}_i}{\eta_i\gamma_i}\right)+(\bar{\delta}_i-\delta_i^*)\frac{\lambda_i^*\varphi_i^*}{\gamma_i}\right]\mathrm{d}\log z_i^* + \frac{\bar{\delta}_i}{\gamma_i}\mathrm{d}\log t_i\right\} \\
&= -\sigma_i\frac{\sigma_i^*-1}{\sigma_i^*}\mathrm{d}\log z_i^* - (\sigma_i^*-\sigma_i)\left[\frac{(\sigma_i^*-1)}{\sigma_i^*}\left(1+\frac{\bar{\delta}_i}{\eta_i\gamma_i}\right)+\frac{\bar{\delta}_i-\delta_i^*}{\sigma_i^*}\frac{\lambda_i^*\varphi_i^*}{\gamma_i}\right]\mathrm{d}\log z_i^* + \frac{\sigma_i^*-\sigma_i}{\sigma_i^*}\frac{\bar{\delta}_i}{\gamma_i}\mathrm{d}\log t_i \\
&= -(\sigma_i^*-1)\mathrm{d}\log z_i^* - (\sigma_i^*-\sigma_i)\left[\frac{(\sigma_i^*-1)}{\sigma_i^*}\frac{\bar{\delta}_i}{\eta_i\gamma_i}+\frac{\bar{\delta}_i-\delta_i^*}{\sigma_i^*}\frac{\lambda_i^*\varphi_i^*}{\gamma_i}\right]\mathrm{d}\log z_i^* + \frac{\sigma_i^*-\sigma_i}{\sigma_i^*}\frac{\bar{\delta}_i}{\gamma_i}\mathrm{d}\log t_i.
\end{aligned}$$

Comparing to the CES case, tariffs t_i have direct effect on firms' profit since markups are distorted. While aggregate demand shock (the third term) has direct impact on firms' market power, the redistribution of firms (the second term) imposes an additional one. Notice that average variable profit π_i^m and revenue r_i^m have the following form:

$$\begin{aligned}
\pi_i^m &= \int_{z_i^*}^{\infty}\pi_i(z)\frac{g(z)}{1-G(z_i^*)}\mathrm{d}z, \\
r_i^m &= \int_{z_i^*}^{\infty}p_i(z)q_i(z)\frac{g(z)}{1-G(z_i^*)}\mathrm{d}z = \frac{R_i}{N_i} \\
&= \int_{z_i^*}^{\infty}\sigma_i(z)\pi_i(z)\frac{g(z)}{1-G(z_i^*)}\mathrm{d}z.
\end{aligned}$$

Then,

$$\begin{aligned}
\mathbb{E}^i_{\pi_i-f_i}\left[\frac{\pi_i\mathrm{d}\log\pi_i}{\pi_i-f_i}\right] =& -(\sigma_i^*-1)\,\mathbb{E}^i_{\pi_i-f_i}\left[\frac{\pi_i}{\pi_i-f_i}\right]\mathrm{d}\log z_i^* \\
&- \mathbb{E}^i_{\pi_i-f_i}\left[\frac{\pi_i(\sigma_i^*-\sigma_i)}{\pi_i-f_i}\right]\left[\frac{(\sigma_i^*-1)}{\sigma_i^*}\frac{\bar{\delta}_i}{\eta_i\gamma_i}+\frac{\bar{\delta}_i-\delta_i^*}{\sigma_i^*}\frac{\lambda_i^*\varphi_i^*}{\gamma_i}\right]\mathrm{d}\log z_i^* \\
&+ \mathbb{E}^i_{\pi_i-f_i}\left[\frac{\pi_i(\sigma_i^*-\sigma_i)}{\pi_i-f_i}\right]\frac{\bar{\delta}_i}{\sigma_i^*\gamma_i}\mathrm{d}\log t_i \\
=& -\left\{\frac{\pi_i^m(\sigma_i^*-1)}{\pi_i^m-f_i}+\frac{\sigma_i^*\pi_i^m-r_i^m}{\pi_i^m-f_i}\left[\frac{(\sigma_i^*-1)}{\sigma_i^*}\frac{\bar{\delta}_i}{\eta_i\gamma_i}+\frac{\bar{\delta}_i-\delta_i^*}{\sigma_i^*}\frac{\lambda_i^*\varphi_i^*}{\gamma_i}\right]\right\}\mathrm{d}\log z_i^* \\
&+ \frac{\sigma_i^*\pi_i^m-r_i^m}{\pi_i^m-f_i}\frac{\bar{\delta}_i}{\sigma_i^*\gamma_i}\mathrm{d}\log t_i
\end{aligned}$$

We define that

$$\bar{\pi}_i^z = -\left\{\frac{\pi_i^m(\sigma_i^*-1)}{\pi_i^m - f_i} + \bar{\pi}_i^t\left[\frac{\sigma_i^*-1}{\eta_i} + \left(1-\frac{\delta_i^*}{\bar{\delta}_i}\right)\lambda_i^*\varphi_i^*\right]\right\} < 0, \quad \bar{\pi}_i^t = \frac{\sigma_i^*\pi_i^m - r_i^m}{\pi_i^m - f_i}\frac{\bar{\delta}_i}{\sigma_i^*\gamma_i} \leq 0,$$
$$N_i^z = -N_i^t\left[\frac{\sigma_i^*-1}{\eta_i} + (1-\frac{\delta_i^*}{\bar{\delta}_i})\lambda_i^*\varphi_i^*\right] - \left(1-\frac{\delta_i^*}{\bar{\delta}_i}\lambda_i^*\right)\varphi_i^*, \quad N_i^t = \frac{\mathbb{E}_{\lambda_i}^i[\rho_i\sigma_i]}{\sigma_i^*\gamma_i} < 0,$$

The inequality $\bar{\pi}_i^z < 0$ follows from part (iv) of Assumption 2.[26] The remaining displayed inequalities follow from $\gamma_i < 0$ and Assumption 2. Moreover, since $\gamma_i < 0$ and $N_i^t < 0$, we must have $\varphi_i^* + N_i^z > 0$. Under the CES demand, the above terms become

$$\bar{\pi}_i^z = -\frac{\pi_i^m(\sigma_i-1)}{\pi_i^m - f_i}, \quad \bar{\pi}_i^t = 0, \quad N_i^z = \frac{(\sigma_i-1)^2}{\sigma_i - \eta_i} - (1-\lambda_i^*)\varphi_i^*, \quad N_i^t = \frac{1}{\gamma_i} = \frac{\eta_i(\sigma_i-1)}{\eta_i - \sigma_i}$$

Then, we write the balanced flow condition,

$$\begin{aligned}
&\frac{1-\beta}{\beta}\left[\bar{\pi}_i^z \mathrm{d}\log z_i^* + \bar{\pi}_i^t \mathrm{d}\log t_i\right] = (N_i^z + \varphi_i^*)\,\mathrm{d}\log z_i^* + N_i^t \mathrm{d}\log t_i - \mathrm{d}\log M \\
\Rightarrow \quad &\left[\frac{1-\beta}{\beta}\bar{\pi}_i^z - (N_i^z + \varphi_i^*)\right]\mathrm{d}\log z_i^* = \left[N_i^t - \frac{1-\beta}{\beta}\bar{\pi}_i^t\right]\mathrm{d}\log t_i - \mathrm{d}\log M \\
\Rightarrow \quad &\mathrm{d}\log z_i^* = z_i^M \mathrm{d}\log M + z_i^t \mathrm{d}\log t_i,
\end{aligned}$$

where

$$z_i^M = -\frac{1}{\frac{1-\beta}{\beta}\bar{\pi}_i^z - (N_i^z + \varphi_i^*)}, \quad \text{and } z_i^t = \frac{N_i^t - \frac{1-\beta}{\beta}\bar{\pi}_i^t}{\frac{1-\beta}{\beta}\bar{\pi}_i^z - (N_i^z + \varphi_i^*)}.$$

[26] Equivalently, using the definitions of γ_i and Q_i^z, we can write

$$\bar{\pi}_i^z = -\frac{\pi_i^m(\sigma_i^*-1)}{\pi_i^m - f_i} + \frac{\sigma_i^*\pi_i^m - r_i^m}{\sigma_i^*(\pi_i^m - f_i)}\left[(\sigma_i^*-1) + Q_i^z\right] = -\frac{r_i^m(\sigma_i^*-1)}{\sigma_i^*(\pi_i^m - f_i)} + \frac{(\sigma_i^*\pi_i^m - r_i^m)Q_i^z}{\sigma_i^*(\pi_i^m - f_i)}.$$

Therefore,

$$\bar{\pi}_i^z < 0 \quad \Longleftrightarrow \quad \frac{\frac{\sigma_i^*\pi_i^m}{r_i^m} - 1}{\sigma_i^* - 1}Q_i^z < 1.$$

This assumption is always valid in the CES case since $\sigma_i^*\pi_i^m/r_i^m = 1$.

Therefore,

$$\begin{aligned}\mathrm{d}\log N_i - \mathrm{d}\log M + \varphi_i^* \mathrm{d}\log z_i^* =& \frac{1-\beta}{\beta}\left[\bar{\pi}_i^z \mathrm{d}\log z_i^* + \bar{\pi}_i^t \mathrm{d}\log t_i\right] \\ =& -\frac{\frac{1-\beta}{\beta}\bar{\pi}_i^z}{\frac{1-\beta}{\beta}\bar{\pi}_i^z - (N_i^z + \varphi_i^*)}\mathrm{d}\log M \\ &+ \frac{\frac{1-\beta}{\beta}\left[\bar{\pi}_i^z N_i^t - (\varphi_i^* + N_i^z)\bar{\pi}_i^t\right]}{\frac{1-\beta}{\beta}\bar{\pi}_i^z - (N_i^z + \varphi_i^*)}\mathrm{d}\log t_i \\ \equiv& -\xi_i^M \mathrm{d}\log M - \xi_i^t \mathrm{d}\log t_i.\end{aligned}$$

Then, we have solved for $\mathrm{d}\log M$:

$$\mathrm{d}\log M = -\frac{\sum_i s_i \xi_i^t \mathrm{d}\log t_i}{\sum_i s_i \xi_i^M}.$$

Note that $\varphi_i^* + N_i^z > 0$, $\bar{\pi}_i^z < 0$, $\bar{\pi}_i^t \leq 0$ and $N_i^t < 0$, we must have

$$\bar{\pi}_i^z N_i^t - (\varphi_i^* + N_i^z)\bar{\pi}_i^t = -\frac{\pi_i^m(\sigma_i^* - 1)}{\pi_i^m - f_i} N_i^t - \frac{\delta_i^*}{\bar{\delta}_i}\lambda_i^* \varphi_i^* \bar{\pi}_i^t > 0 \tag{59}$$

which implies that $\xi_i^t > 0$. Moreover, since $\bar{\pi}_i^z < 0$ and $\varphi_i^* + N_i^z > 0$, we must have $0 < \xi_i^M < 1$. Therefore, $\mathrm{d}\log M < 0$ when the tariff in market i increases.

With the CES demand, ξ_i^t and ξ_i^M take the following expressions:

$$\begin{aligned}\xi_i^M =& \frac{\frac{1-\beta}{\beta}\bar{\pi}_i^z}{\frac{1-\beta}{\beta}\bar{\pi}_i^z - (N_i^z + \varphi_i^*)} = \frac{\frac{\pi_i^m}{\pi_i^m - f_i}\eta_i \theta_i^{\mathrm{CES}}}{\frac{\pi_i^m}{\pi_i^m - f_i}\eta_i \theta_i^{\mathrm{CES}} + \frac{\beta}{1-\beta}\left(1 + \frac{\eta_i \theta_i^{\mathrm{CES}}}{\sigma_i - 1}\lambda_i^* \varphi_i^*\right)}, \\ \xi_i^t =& -\frac{\frac{1-\beta}{\beta}\left[\bar{\pi}_i^z N_i^t - (\varphi_i^* + N_i^z)\bar{\pi}_i^t\right]}{\frac{1-\beta}{\beta}\bar{\pi}_i^z - (N_i^z + \varphi_i^*)} = -\xi_i^M N_i^t = \xi_i^M \frac{1}{\theta_i^{\mathrm{CES}}},\end{aligned}$$

where we have used that $\eta_i \theta_i^{\mathrm{CES}} = \frac{\sigma_i - \eta_i}{\sigma_i - 1}$ from Section 4.3.

Signs of $\mathrm{d}\log z_i^*$ We then go back to the case with $\mathrm{d}\log z_i^*$. Since $\bar{\pi}_i^z < 0$ and thus $z_i^M > 0$. Then, $\mathrm{d}\log z_i^* < 0$ in the third market unambiguously. The case with the focal market is more complicated since z_i^t can be either positive (when β is close to one) or negative (when β is close to zero). In general, we cannot derive an unambiguous result on the sign of $\mathrm{d}\log z_j^*$.

In other words, the productivity threshold of exiting may fall or increase in the focal market.

$$\mathrm{d}\log z_j^* = z_j^M \left[\left(\frac{s_j \xi_j^M}{\sum_i s_i \xi_i^M} - 1 \right) N_j^t + \bar{\pi}_j^t \left(\frac{1-\beta}{\beta} - \frac{s_j \xi_j^M}{\sum_i s_i \xi_i^M} \frac{\varphi_j^* + N_j^z}{\bar{\pi}_j^z} \right) \right] \mathrm{d}\log t_j \tag{60}$$

With the CES demand (and thus $\bar{\pi}_j^t = 0$), $\mathrm{d}\log z_j^* = z_j^M \left(\frac{s_j \xi_j^M}{\sum_i s_i \xi_i^M} - 1 \right) N_j^t \mathrm{d}\log t_j > 0$, as $z_j^M > 0$, $N_j^t < 0$, $\mathrm{d}\log t_j > 0$, and $0 < s_j \xi_j^M / \sum_i s_i \xi_i^M < 1$. In other words, the exit cutoff increases in the focal market unambiguously.

Changes in M_i^p For the potential entrants M_i^p,

$$\mathrm{d}\log M_i^p = (1 - \xi_i^M) \mathrm{d}\log M - \xi_i^t \mathrm{d}\log t_i.$$

Therefore, $\mathrm{d}\log M_i^p < 0$ in both focal and third markets.

Changes in Q_i Finally, we consider the welfare change:

$$\mathrm{d}\log Q_i = Q_i^z \mathrm{d}\log z_i^* + \frac{\bar{\delta}_i}{\gamma_i} \mathrm{d}\log t_i.$$

In the third market, $\mathrm{d}\log Q_i < 0$ since $\mathrm{d}\log z_i^* < 0$ and $Q_i^z > 0$. In the focal market j,

$$\mathrm{d}\log Q_j = \left\{ Q_j^z z_j^M \left[\left(\frac{s_j \xi_j^M}{\sum_i s_i \xi_i^M} - 1 \right) N_j^t + \bar{\pi}_j^t \left(\frac{1-\beta}{\beta} - \frac{s_j \xi_j^M}{\sum_i s_i \xi_i^M} \frac{\varphi_j^* + N_j^z}{\bar{\pi}_j^z} \right) \right] + \frac{\bar{\delta}_j}{\gamma_j} \right\} \mathrm{d}\log t_j.$$

We show that the bracket is negative by showing that

$$Q_j^z z_j^M \left(\frac{s_j \xi_j^M}{\sum_i s_i \xi_i^M} - 1 \right) N_j^t + \frac{\bar{\delta}_j}{\gamma_j} = \frac{1}{\gamma_j} \left[Q_j^z z_j^M \left(\frac{s_j \xi_j^M}{\sum_i s_i \xi_i^M} - 1 \right) \frac{\mathbb{E}_{\lambda_j}^j [\rho_j \sigma_j]}{\sigma_j^*} + \bar{\delta}_j \right] < 0,$$

since the left term is negative. Note that $z_j^M \leq \frac{1}{N_j^z + \varphi_j^*}$,

$$\bar{\delta}_j + Q_j^z z_j^M \left(\frac{s_j \xi_j^M}{\sum_i s_i \xi_i^M} - 1 \right) \frac{\mathbb{E}_{\lambda_j}^j [\rho_j \sigma_j]}{\sigma_j^*} \geq \bar{\delta}_j - Q_j^z z_j^M \frac{\mathbb{E}_{\lambda_j}^j [\rho_j \sigma_j]}{\sigma_j^*} \geq \bar{\delta}_j - \frac{Q_j^z}{N_j^z + \varphi_j^*} \frac{\mathbb{E}_{\lambda_j}^j [\rho_j \sigma_j]}{\sigma_j^*}.$$

With $\gamma_j < 0$, it suffices to show that $\bar{\delta}_j > \frac{Q_j^z}{N_j^z+\varphi_j^*}\frac{\mathbb{E}_{\lambda_j}^j[\rho_j\sigma_j]}{\sigma_j^*}$. We can rewrite $N_j^z + \varphi_j^*$ as follows

$$N_j^z + \varphi_j^* = \frac{1}{\bar{\delta}_j}\left(\frac{\mathbb{E}_{\lambda_j}^j[\rho_j\sigma_j]}{\sigma_j^*}\left[(\sigma_j^* - 1) + Q_j^z\right] + \delta_j^*\lambda_j^*\varphi_j^*\right)$$

Then,

$$\frac{Q_j^z}{N_j^z+\varphi_j^*}\frac{\mathbb{E}_{\lambda_j}^j[\rho_j\sigma_j]}{\sigma_j^*} = \bar{\delta}_j\frac{\frac{\mathbb{E}_{\lambda_j}^j[\rho_j\sigma_j]}{\sigma_j^*}Q_j^z}{\frac{\mathbb{E}_{\lambda_j}^j[\rho_j\sigma_j]}{\sigma_j^*}\left[(\sigma_j^* - 1) + Q_j^z\right] + \delta_j^*\lambda_j^*\varphi_j^*} < \bar{\delta}_j.$$

We then complete the proof that $\mathrm{d}\log Q_j < 0$. Regardless of threshold changes, welfare loss in the focal market is certain.

Changes in P_i It is useful to note that in the focal market,

$$\begin{aligned}
&(\sigma_j^* - 1)\mathrm{d}\log z_j^* + \mathrm{d}\log Q_j \\
&= \left\{\left((\sigma_j^* - 1) + Q_j^z\right) z_j^M\left[\left(\frac{s_j\xi_j^M}{\sum_i s_i\xi_i^M} - 1\right)N_j^t + \bar{\pi}_j^t\left(\frac{1-\beta}{\beta} - \frac{s_j\xi_j^M}{\sum_i s_i\xi_i^M}\frac{\varphi_j^* + N_j^z}{\bar{\pi}_j^z}\right)\right] + \frac{\bar{\delta}_j}{\gamma_j}\right\}\mathrm{d}\log t_j < 0,
\end{aligned}$$

where the negative sign comes from the same arguments that prove $\mathrm{d}\log Q_j < 0$. Then, $(\sigma_i^* - 1)\mathrm{d}\log z_i^* + \mathrm{d}\log Q_i < 0$ for all country i. Recall that

$$\mathrm{d}\log P_i - \mathrm{d}\log t_i = -\frac{1}{\sigma_i^*}\left[(\sigma_i^* - 1)\mathrm{d}\log z_i^* + \mathrm{d}\log Q_i\right].$$

Then, we observe $\mathrm{d}\log P_i > 0$ in both focal and third markets.

C.4.2 Changes in firm-level variables

Changes in π_i and $\bar{\pi}_i$ For profit,

$$\begin{aligned}
\mathrm{d}\log\pi_i &= \sigma_i\left[\mathrm{d}\log P_i - \mathrm{d}\log t_i\right] + \mathrm{d}\log Q_i \\
&= -\frac{\sigma_i}{\sigma_i^*}\left[(\sigma_i^* - 1)\mathrm{d}\log z_i^* + \mathrm{d}\log Q_i\right] + \mathrm{d}\log Q_i.
\end{aligned}$$

Then, $\mathrm{d}\log\pi_i$ always increases with σ_i. That is, conditional on survival, small firms (high σ_i) gain relative to large firms (low σ_i) in log term. We now consider the expected profit $\bar{\pi}_i$:

$$\mathrm{d}\log\bar{\pi}_i = \frac{\beta}{1-\beta}\left[\mathrm{d}\log N_i - \mathrm{d}\log M + \varphi_i^*\mathrm{d}\log z_i^*\right] = \frac{\beta}{1-\beta}\xi_j^t\left[\frac{s_j\xi_i^M}{\sum_k s_k\xi_k^M} - \mathbb{1}\{i=j\}\right]\mathrm{d}\log t_j$$

The expected profit drops in the focal market while increases in the third market. Whereas, the sign of average variable profit π_i^m is rather ambiguous. Observe that

$$\mathrm{d}\log\pi_i^m = \frac{\pi_i^m - f_i}{\pi_i^m}\left(\varphi_i^*\mathrm{d}\log z_i^* + \mathrm{d}\log\bar{\pi}_i\right) = \frac{\pi_i^m - f_i}{\pi_i^m}\left((\varphi_i^* + \bar{\pi}_i^z)\mathrm{d}\log z_i^* + \bar{\pi}_i^t\mathrm{d}\log t_i\right),$$

where the sign of $\varphi_i^* + \bar{\pi}_i^z$ is undetermined. Thus, the average profit may fall or increase even with the CES demand.

Changes in p_i and $\frac{q_i}{Q_i}$ We can discuss the implication on average revenue and quantity. Note that

$$\mathrm{d}\log\frac{q_i}{Q_i} = \rho_i\sigma_i\left[\mathrm{d}\log P_i - \mathrm{d}\log t_i\right] > 0,$$
$$\mathrm{d}\log\mu_i = \left(\frac{1}{\rho_i} - 1\right)\frac{1}{\sigma_i}\mathrm{d}\log\frac{q_i}{Q_i} = (1-\rho_i)\left[\mathrm{d}\log P_i - \mathrm{d}\log t_i\right] \geq 0.$$

Therefore, markup μ_i and producer price p_i weakly increase among all firms and in both focal and third markets; both responses are zero under CES demand. Under incomplete pass-through, larger firms respond more in prices.

Changes in r_i For sales,

$$\begin{aligned}
\mathrm{d}\log r_i &= -\frac{1}{\mu_i - 1}\mathrm{d}\log\mu_i + \mathrm{d}\log\pi_i \\
&= \left[1 + \rho_i(\sigma_i - 1)\right]\left[\mathrm{d}\log P_i - \mathrm{d}\log t_i\right] + \mathrm{d}\log Q_i \\
&= -\frac{1 + \rho_i(\sigma_i - 1)}{\sigma_i^*}\left[(\sigma_i^* - 1)\mathrm{d}\log z_i^* + \mathrm{d}\log Q_i\right] + \mathrm{d}\log Q_i \\
&= -\frac{1 + \rho_i(\sigma_i - 1)}{\sigma_i^*}(\sigma_i^* - 1)\mathrm{d}\log z_i^* + \frac{(\sigma_i^* - 1) - \rho_i(\sigma_i - 1)}{\sigma_i^*}\mathrm{d}\log Q_i
\end{aligned}$$

In third market, the first term is positive and the second negative. In the focal market, $\mathrm{d}\log r_j < 0$ if $\mathrm{d}\log z_j^* > 0$. But we do not know the sign when $\mathrm{d}\log z_j^* < 0$. With the CES

demand, $\mathrm{d}\log r_i = -(\sigma_i^* - 1)\mathrm{d}\log z_i^*$. That is, sales increases in third markets while decreases in the focal market.

Changes in q_i For quantity,

$$\begin{aligned}\mathrm{d}\log q_i &= \rho_i\sigma_i\left[\mathrm{d}\log P_i - \mathrm{d}\log t_i\right] + \mathrm{d}\log Q_i \\ &= -\frac{\rho_i\sigma_i}{\sigma_i^*}(\sigma_i^* - 1)\mathrm{d}\log z_i^* + \frac{\sigma_i^* - \rho_i\sigma_i}{\sigma_i^*}\mathrm{d}\log Q_i\end{aligned}$$

The analysis is identical to that on sales. With the CES demand, $\mathrm{d}\log q_i = -(\sigma_i^* - 1)\mathrm{d}\log z_i^*$. In both quantity and sales, small firms gain relative to large firms.

C.4.3 Changes in other aggregate variables

We use f_x^i to denote the density function of variables in market i, i.e., $f_x^i(z) = \frac{x(z)\frac{g(z)}{1-G(z_i^*)}}{\int_{z_i^*}^{\infty} x(z)\frac{g(z)}{1-G(z_i^*)}\mathrm{d}z}$. In particular, the welfare density of firms with productivity z in market i is given by

$$f_\Upsilon^i(z) = \frac{\Upsilon\left(\frac{q_i(z)}{Q_i}\right)\frac{g(z)}{1-G(z_i^*)}}{\int_{z_i^*}^{\infty}\Upsilon\left(\frac{q_i(z)}{Q_i}\right)\frac{g(z)}{1-G(z_i^*)}\mathrm{d}z},$$

Furthermore, we define that $f_x \succcurlyeq f_y$ if the distribution of x first-order stochastically dominates that of y. Consistent with the notation above, we let $x_i^m = \int_{z_i^*}^{\infty} x(z)\frac{g(z)}{1-G(z_i^*)}\mathrm{d}z$ denote the average of x among active exporters. The following lemmas turn out to be useful in later analysis.

Lemma A.2. *In any market i, $f_q^i \succcurlyeq f_r^i$, and $f_q^i \succcurlyeq f_\Upsilon^i$.*

Proof. It is well known that the monotone likelihood ratio property (MLRP) implies first order stochastic dominance. Namely, if $\frac{f_x}{f_y}$ increases in z, then $f_x \succcurlyeq f_y$. Note that $\frac{r_i(z)}{q_i(z)} = p_i(z)$ and p is decreasing on z, then $f_q^i \succcurlyeq f_r^i$. Since Υ is concave, $\Upsilon\left(\frac{q_i}{Q_i}\right)/q_i$ decreases on z, $f_q^i \succcurlyeq f_\Upsilon^i$. ■

Lemma A.3. *In any market i, $\lambda_i^* = \frac{r_i^*}{r_i^m} > \frac{q_i^*}{q_i^m}$, and $\frac{\delta_i^*}{\delta_i}\lambda_i^* > \frac{q_i^*}{q_i^m}$.*

Proof. Consider x and y such that $\frac{f_x}{f_y}$ satisfies the MLRP. Then,

$$\frac{x_i^*}{x_i^m} - \frac{y_i^*}{y_i^m} = \frac{1}{x_i^m y_i^m}\left(\int_{z_i^*}^{\infty}(x_i^* y(z) - y_i^* x(z))\frac{g(z)}{1-G(z_i^*)}\mathrm{d}z\right) < 0$$

since $\frac{x_i^*}{y_i^*} < \frac{x(z)}{y(z)}$ for $z > z_i^*$. Using this relationship, we obtain $\lambda_i^* > \frac{q_i^*}{q_i^m}$, and $N_i \Upsilon\left(\frac{q_i^*}{Q_i}\right) > \frac{q_i^*}{q_i^m}$. Also,

$$N_i \Upsilon\left(\frac{q_i^*}{Q_i}\right) = N_i \delta_i^* \Upsilon'\left(\frac{q_i^*}{Q_i}\right)\frac{q_i^*}{Q_i} = \frac{N_i \delta_i^* t_i r_i^*}{\bar{\delta}_i E_i} = \frac{\delta_i^*}{\bar{\delta}_i}\lambda_i^*$$

■

Changes in R_i Aggregate sales drop in all markets. To see this,

$$\mathrm{d}\log R_i = \left(1 - \frac{1}{\eta_i}\right)\mathrm{d}\log Q_i - \mathrm{d}\log t_i < 0.$$

Since N_i may become larger or smaller, the sign of average revenue r_i^m is ambiguous. This will also be true even with the CES demand. In the third market, while firms may export more value, small exporters also enter.

Changes in $\tilde{Q}_i$ The total quantity $\tilde{Q}_i = N_i \int_{z_i^*}^{\infty} q_i \frac{g(z)}{1-G(z_i^*)}\mathrm{d}z$. Then,

$$\mathrm{d}\log \tilde{Q}_i = \mathrm{d}\log N_i + \varphi_i^* \mathrm{d}\log z_i^* - \frac{q_i^*}{q_i^m}\varphi_i^* \mathrm{d}\log z_i^* + \mathbb{E}_{q_i}^i[\mathrm{d}\log q_i],$$

where

$$\mathbb{E}_{q_i}^i[\mathrm{d}\log q_i] = -\mathbb{E}_{q_i}^i[\rho_i\sigma_i]\frac{\sigma_i^* - 1}{\sigma_i^*}\mathrm{d}\log z_i^* + \left(1 - \frac{\mathbb{E}_{q_i}^i[\rho_i\sigma_i]}{\sigma_i^*}\right)\mathrm{d}\log Q_i,$$

and q_i^m is the average quantity. Using the welfare condition and the expression of $\mathrm{d}\log\frac{q_i}{Q_i}$, we obtain

$$\begin{aligned}
\mathrm{d}\log \tilde{Q}_i &= \left(\frac{\delta_i^*}{\bar{\delta}_i}\lambda_i^* - \frac{q_i^*}{q_i^m}\right)\varphi_i^* \mathrm{d}\log z_i^* + \left(-\frac{1}{\bar{\delta}_i}\mathbb{E}_{\lambda_i}^i[\rho_i\sigma_i] + \mathbb{E}_{q_i}^i[\rho_i\sigma_i]\right)[\mathrm{d}\log P_i - \mathrm{d}\log t_i] + \mathrm{d}\log Q_i \\
&\leq \left(\frac{\delta_i^*}{\bar{\delta}_i}\lambda_i^* - \frac{q_i^*}{q_i^m}\right)\varphi_i^* \mathrm{d}\log z_i^* - \left(1 - \frac{1}{\bar{\delta}_i}\right)\frac{\mathbb{E}_{\lambda_i}^i[\rho_i\sigma_i]}{\sigma_i^*}[(\sigma_i^* - 1)\mathrm{d}\log z_i^* + \mathrm{d}\log Q_i] + \mathrm{d}\log Q_i \\
&= \left(\frac{\delta_i^*}{\bar{\delta}_i}\lambda_i^* - \frac{q_i^*}{q_i^m}\right)\varphi_i^* \mathrm{d}\log z_i^* + \left\{-\left(1 - \frac{1}{\bar{\delta}_i}\right)\frac{\mathbb{E}_{\lambda_i}^i[\rho_i\sigma_i]}{\sigma_i^*}[(\sigma_i^* - 1) + Q_i^z] + Q_i^z\right\}\mathrm{d}\log z_i^* \\
&\quad + \left\{-\left(1 - \frac{1}{\bar{\delta}_i}\right)\frac{\mathbb{E}_{\lambda_i}^i[\rho_i\sigma_i]}{\sigma_i^*} + 1\right\}\frac{\bar{\delta}_i}{\gamma_i}\mathrm{d}\log t_i,
\end{aligned}$$

where the first inequality uses that $\mathbb{E}^i_{q_i}[\rho_i\sigma_i] \leq \mathbb{E}^i_{\lambda_i}[\rho_i\sigma_i]$, a result of Lemma A.2, and the second equality uses the expression of $\mathrm{d}\log Q_i$ in $\mathrm{d}\log z_i^*$.

Lemma A.4. *Suppose that Assumptions 1′ and 2 hold. If the focal market j raises its tariff, $\mathrm{d}\log t_j > 0$, while $\mathrm{d}\log t_i = 0$ for every third market $i \neq j$, then total quantity falls in every market:*

$$\mathrm{d}\log \tilde{Q}_i < 0 \qquad \textit{for every market } i.$$

Proof. We first consider a third market $i \neq j$. Because $\mathrm{d}\log t_i = 0$ and $\mathrm{d}\log z_i^* < 0$, the preceding upper bound implies $\mathrm{d}\log \tilde{Q}_i < 0$ if the coefficient on $\mathrm{d}\log z_i^*$ is positive. Lemma A.3 gives

$$\frac{\delta_i^*}{\bar{\delta}_i}\lambda_i^* - \frac{q_i^*}{q_i^m} > 0.$$

It therefore remains to establish

$$f(\bar{\delta}_i) \equiv Q_i^z - \left(1 - \frac{1}{\bar{\delta}_i}\right)\frac{\mathbb{E}^i_{\lambda_i}[\rho_i\sigma_i]}{\sigma_i^*}(\sigma_i^* - 1 + Q_i^z) > 0.$$

Using the definitions of Q_i^z and γ_i, exact algebra gives

$$\begin{aligned}\gamma_i f(\bar{\delta}_i) = &-\frac{\sigma_i^* - 1}{\sigma_i^*}\left[\bar{\delta}_i\left(1 - \mathbb{E}^i_{\lambda_i}[\rho_i]\right) + (\bar{\delta}_i - 1)\left(1 - \frac{1}{\eta_i}\right)\mathbb{E}^i_{\lambda_i}[\rho_i\sigma_i]\right] \\ &+ \left(1 - \frac{\delta_i^*}{\bar{\delta}_i}\right)\lambda_i^*\varphi_i^*\left[\frac{\bar{\delta}_i - 1}{\sigma_i^*}\,\mathbb{E}^i_{\lambda_i}[\rho_i\sigma_i] - \bar{\delta}_i\right].\end{aligned}$$

The first line is strictly negative. Moreover,

$$\frac{\mathbb{E}^i_{\lambda_i}[\rho_i\sigma_i]}{\sigma_i^*} \leq 1$$

implies

$$\frac{\bar{\delta}_i - 1}{\sigma_i^*}\,\mathbb{E}^i_{\lambda_i}[\rho_i\sigma_i] - \bar{\delta}_i \leq -1.$$

Since $\bar{\delta}_i \geq \delta_i^*$, the second line is nonpositive. Hence $\gamma_i f(\bar{\delta}_i) < 0$. Lemma A.1 gives $\gamma_i < 0$, so $f(\bar{\delta}_i) > 0$. The coefficient on $\mathrm{d}\log z_i^*$ is therefore strictly positive, which proves $\mathrm{d}\log \tilde{Q}_i < 0$

in every third market.

We next consider the focal market. The preceding upper bound can be written as

$$\mathrm{d}\log\tilde{Q}_j \leq A_j \mathrm{d}\log z_j^* + B_j \mathrm{d}\log t_j,$$

where

$$\begin{aligned} A_j &= \left(\frac{\delta_j^*}{\bar{\delta}_j}\lambda_j^* - \frac{q_j^*}{q_j^m}\right)\varphi_j^* + f(\bar{\delta}_j) > 0, \\ B_j &= \left[1 - \left(1 - \frac{1}{\bar{\delta}_j}\right)\frac{\mathbb{E}_{\lambda_j}^j[\rho_j\sigma_j]}{\sigma_j^*}\right]\frac{\bar{\delta}_j}{\gamma_j} < 0. \end{aligned}$$

Substituting equation (60) and correctly factoring out N_j^t yields

$$\begin{aligned} &A_j \mathrm{d}\log z_j^* + B_j \mathrm{d}\log t_j \\ &= N_j^t \mathrm{d}\log t_j \left\{ A_j z_j^M \left[\left(\frac{s_j\xi_j^M}{\sum_i s_i\xi_i^M} - 1 \right) + \frac{\bar{\pi}_j^t}{N_j^t}\left(\frac{1-\beta}{\beta} - \frac{s_j\xi_j^M}{\sum_i s_i\xi_i^M}\frac{\varphi_j^* + N_j^z}{\bar{\pi}_j^z} \right) \right] + \frac{B_j}{N_j^t} \right\}. \end{aligned}$$

The focal-market weight lies strictly between zero and one, and

$$\frac{\bar{\pi}_j^t}{N_j^t}\left(\frac{1-\beta}{\beta} - \frac{s_j\xi_j^M}{\sum_i s_i\xi_i^M}\frac{\varphi_j^* + N_j^z}{\bar{\pi}_j^z} \right) \geq 0.$$

It is therefore sufficient to show

$$-A_j z_j^M + \frac{B_j}{N_j^t} > 0.$$

The definitions of B_j and N_j^t imply

$$\frac{B_j}{N_j^t} = 1 + \left(\frac{\sigma_j^*}{\mathbb{E}_{\lambda_j}^j[\rho_j\sigma_j]} - 1 \right)\bar{\delta}_j.$$

In addition,

$$N_j^z + \varphi_j^* = \frac{1}{\bar{\delta}_j}\left\{ \frac{\mathbb{E}_{\lambda_j}^j[\rho_j\sigma_j]}{\sigma_j^*}(\sigma_j^* - 1 + Q_j^z) + \delta_j^*\lambda_j^*\varphi_j^* \right\},$$

and the definitions of A_j and $f(\bar{\delta}_j)$ give

$$A_j = N_j^z + \varphi_j^* - \frac{q_j^*}{q_j^m}\varphi_j^* - (\sigma_j^* - 1) + \left(1 - \frac{\mathbb{E}_{\lambda_j}^j[\rho_j \sigma_j]}{\sigma_j^*}\right)(\sigma_j^* - 1 + Q_j^z).$$

Moreover,

$$\begin{aligned}
&\left(\frac{\sigma_j^*}{\mathbb{E}_{\lambda_j}^j[\rho_j \sigma_j]} - 1\right)\bar{\delta}_j(N_j^z + \varphi_j^*) \\
=\ &\left(1 - \frac{\mathbb{E}_{\lambda_j}^j[\rho_j \sigma_j]}{\sigma_j^*}\right)(\sigma_j^* - 1 + Q_j^z) \\
&+ \left(\frac{\sigma_j^*}{\mathbb{E}_{\lambda_j}^j[\rho_j \sigma_j]} - 1\right)\delta_j^* \lambda_j^* \varphi_j^* \\
\geq\ &\left(1 - \frac{\mathbb{E}_{\lambda_j}^j[\rho_j \sigma_j]}{\sigma_j^*}\right)(\sigma_j^* - 1 + Q_j^z).
\end{aligned}$$

Finally, $\bar{\pi}_j^z < 0$ implies

$$z_j^M = \frac{1}{N_j^z + \varphi_j^* - \frac{1-\beta}{\beta}\bar{\pi}_j^z} < \frac{1}{N_j^z + \varphi_j^*}.$$

Combining the preceding identities and inequalities yields

$$\begin{aligned}
-A_j z_j^M + \frac{B_j}{N_j^t} &> -\frac{A_j}{N_j^z + \varphi_j^*} + 1 + \left(\frac{\sigma_j^*}{\mathbb{E}_{\lambda_j}^j[\rho_j \sigma_j]} - 1\right)\bar{\delta}_j \\
&\geq \frac{\frac{q_j^*}{q_j^m}\varphi_j^* + \sigma_j^* - 1}{N_j^z + \varphi_j^*} > 0.
\end{aligned}$$

Because $N_j^t < 0$ and $\mathrm{d}\log t_j > 0$, the focal-market upper bound is strictly negative. Therefore, $\mathrm{d}\log \tilde{Q}_j < 0$. ■

Changes in p_i^m Finally, we consider the aggregate price level. Recall that $p_i^m = \frac{R_i}{\bar{Q}_i} = \frac{\int_{z_i^*}^{\infty} r_i g(z) \mathrm{d}z}{\int_{z_i^*}^{\infty} q_i g(z) \mathrm{d}z}$, then

$$\begin{aligned}
\mathrm{d}\log p_i^m &= \left(-\frac{r_i^*}{r_i^m} + \frac{q_i^*}{q_i^m}\right) \varphi_i^* \mathrm{d}\log z_i^* + \mathbb{E}_{r_i}^i[\mathrm{d}\log r_i] - \mathbb{E}_{q_i}^i[\mathrm{d}\log q_i] \\
&= \left(-\frac{r_i^*}{r_i^m} + \frac{q_i^*}{q_i^m}\right) \varphi_i^* \mathrm{d}\log z_i^* + \left(1 - \mathbb{E}_{r_i}^i[\rho_i] + \mathbb{E}_{r_i}^i[\rho_i\sigma_i] - \mathbb{E}_{q_i}^i[\rho_i\sigma_i]\right)(\mathrm{d}\log P_i - \mathrm{d}\log t_i)
\end{aligned}$$

Lemma A.3 shows that $-\frac{r_i^*}{r_i^m} + \frac{q_i^*}{q_i^m} < 0$, and Lemma A.2 implies that $\mathbb{E}_{r_i}^i[\rho_i\sigma_i] \geq \mathbb{E}_{q_i}^i[\rho_i\sigma_i]$.

With $\mathbb{E}_{r_i}^i[\rho_i] \leq 1$ and $\mathrm{d}\log P_i - \mathrm{d}\log t_i > 0$, we proved that $\mathrm{d}\log p_i^m \geq 0$ if $\mathrm{d}\log z_i^* < 0$. That is, average price weakly rises at the aggregate level in third markets. In the focal market, the sign is ambiguous. For example, we have shown that the average price will go up if goods are homogeneous. Whereas, it is immediate that the average price will go down with the CES demand ($\mathrm{d}\log z_i^* > 0$).

D Additional Results with Tariff Uncertainty

This appendix provides the details for the HSA model with tariff uncertainty in Section 5.2. Throughout, p_i is the producer price, $t_i p_i$ is the consumer price, E_i is expenditure at consumer prices, and $R_i = E_i/t_i$ is ex-tariff export revenue. We distinguish the proportional shift in the tariff distribution, $\varepsilon_i = \mathrm{d}\log t_i^e$, from the tariff change that is eventually realized, $\mathrm{d}\log t_i$.

D.1 HSA demand

The HSA inner nest is characterized by a linearly homogeneous consumer price aggregator A_i and a market-share function $s(\cdot)$ such that

$$\int_{\Omega_i} s\left(\frac{t_i p_\omega^i}{A_i}\right) \mathrm{d}\omega = 1,$$

where $s(\cdot)$ maps a variety's relative price to its market share among varieties exported from the home country to destination i. The aggregator A_i differs from the ideal price index, $\tilde{P}_i^I$, while homotheticity implies that the composite consumption good (i.e., real consumption) is linearly homogeneous in individual-variety consumption. The market share function satisfies $s(\upsilon) > 0$, $s'(\upsilon) < 0$, and $\lim_{\upsilon\to\infty} s(\upsilon) = 0$. Matsuyama and Ushchev (2020) show that the

HSA ideal price satisfies

$$\log \tilde{P}_i^I = C + \log A_i - N_i \int_{\upsilon_i}^{\infty} \frac{s(\zeta)}{\zeta} \, \mathrm{d}\zeta.$$

Let $P_i \equiv A_i/t_i$ and $\upsilon_i \equiv p_i/P_i = t_i p_i/A_i$. The HSA preferences imply that

$$\frac{\mathrm{d} \log \tilde{P}_i^I}{\mathrm{d} \log t_i p_\omega^i} = s\left(\frac{t_i p_\omega^i}{A_i}\right) = s(\upsilon_i).$$

Similar to the HDIA case, we present the local HSA demand statistics as follows:

$$\sigma(\upsilon) = 1 - \frac{\upsilon s'(\upsilon)}{s(\upsilon)}, \quad \mu(\upsilon) = \frac{\sigma(\upsilon)}{\sigma(\upsilon) - 1}, \quad \rho(\upsilon) = \left(1 - \frac{\upsilon \mu'(\upsilon)}{\mu(\upsilon)}\right)^{-1}, \quad \delta(\upsilon) = 1 + \frac{\int_{\upsilon}^{\infty} \frac{s(\zeta)}{\zeta} \, \mathrm{d}\zeta}{s(\upsilon)},$$

where $\sigma(\upsilon)$ is variety-level demand elasticity, $\mu(\upsilon)$ the markup, $\rho(\upsilon)$ the cost pass-through, and $\delta(\upsilon)$ the infra-marginal surplus ratio.

D.2 Equilibrium conditions

We now expand the equilibrium conditions in Section 5.2 around the initial equilibrium, holding technology, fixed costs, hazards, and market-access parameters fixed. Differentiating the symmetric share condition gives

$$\mathrm{d} \log N_i - (\sigma_i - 1) \mathrm{d} \log \upsilon_i = 0.$$

The definitions of ρ_i and μ_i, together with the pricing rule, give

$$\mathrm{d} \log p_i = \mathrm{d} \log \mu_i = -\left(\frac{1}{\rho_i} - 1\right) \mathrm{d} \log \upsilon_i.$$

To differentiate the ideal-price expression, note that

$$\mathrm{d}\left(N_i \int_{\upsilon_i}^{\infty} \frac{s(\zeta)}{\zeta} \, \mathrm{d}\zeta\right) = (\delta_i - 1) \mathrm{d} \log N_i - \mathrm{d} \log \upsilon_i,$$

where $N_i s(v_i) = 1$. The final local price expressions are therefore

$$\mathrm{d}\log v_i = \frac{\mathrm{d}\log N_i}{\sigma_i - 1}, \qquad \mathrm{d}\log p_i = -\frac{\frac{1}{\rho_i} - 1}{\sigma_i - 1}\mathrm{d}\log N_i,$$
$$\mathrm{d}\log P_i^I = -\left[\delta_i - 1 + \frac{\frac{1}{\rho_i} - 1}{\sigma_i - 1}\right]\mathrm{d}\log N_i, \quad \mathrm{d}\log \tilde{P}_i^I = \mathrm{d}\log t_i - \left[\delta_i - 1 + \frac{\frac{1}{\rho_i} - 1}{\sigma_i - 1}\right]\mathrm{d}\log N_i.$$

Define the HSA entry elasticity by

$$\theta_i^{\mathrm{HSA}} \equiv \left(\frac{1}{\rho_i} - 1\right)\frac{\sigma_i}{\sigma_i - 1}\left(\frac{1}{\eta_i} - \frac{1}{\sigma_i}\right) + 1 - \frac{\eta_i - 1}{\eta_i}\delta_i. \tag{61}$$

Equivalently,

$$\eta_i\theta_i^{\mathrm{HSA}} = \left(\frac{1}{\rho_i} - 1\right)\frac{\sigma_i - \eta_i}{\sigma_i - 1} + \eta_i - (\eta_i - 1)\delta_i.$$

The definitions of μ_i and ρ_i, together with the share differential, also imply

$$\mathrm{d}\log \sigma_i = \left(\frac{1}{\rho_i} - 1\right)\mathrm{d}\log N_i.$$

Under CES outer demand, expected profit can be written as

$$\pi_i^e(N_i) = \frac{D_i^{\eta_i}[P_i^I(N_i)]^{1-\eta_i}}{N_i\sigma_i(N_i)}\,\mathbb{E}\left[(t_i^e)^{-\eta_i}\right].$$

A proportional shift maps every tariff realization into $(1 + \varepsilon_i)t_i^e$ and therefore changes the expectation in this expression by $-\eta_i\varepsilon_i$. Combining this result with the local price expressions gives

$$\mathrm{d}\log \pi_i = -\eta_i\theta_i^{\mathrm{HSA}}\mathrm{d}\log N_i - \eta_i\mathrm{d}\log t_i,$$
$$\mathrm{d}\log \pi_i^e = -\eta_i\theta_i^{\mathrm{HSA}}\mathrm{d}\log N_i - \eta_i\varepsilon_i. \tag{62}$$

Thus, realized outcomes depend directly on $\mathrm{d}\log t_i$, whereas entry depends on ε_i.

The remaining first-order equilibrium equations follow from balanced flow and free entry:

$$\frac{\pi_i^e}{\pi_i^e - f_i}\mathrm{d}\log \pi_i^e = \frac{\beta}{1-\beta}\left(\mathrm{d}\log N_i - \mathrm{d}\log M\right),$$
$$\sum_{i\in\mathscr{I}} s_i\mathrm{d}\log N_i = \mathrm{d}\log M, \qquad s_i \equiv \frac{J_i\bar{\pi}_i}{\sum_{k\in\mathscr{I}} J_k\bar{\pi}_k}.$$

Assumption 1 remains sufficient under HSA demand. In particular, $\delta_i < \eta_i/(\eta_i - 1)$ makes the market-size component of θ_i^{HSA} strictly positive, while $0 < \rho_i \leq 1$ and $\sigma_i > \eta_i$ make the markup component nonnegative. Hence the three conditions jointly imply $\theta_i^{\text{HSA}} > 0$ and

$$\frac{\partial \log \pi_i(N_i, t_i)}{\partial \log N_i} = -\eta_i \theta_i^{\text{HSA}} < 0, \qquad \frac{\partial \log \pi_i^e(N_i)}{\partial \log N_i} = -\eta_i \theta_i^{\text{HSA}} < 0.$$

D.3 Equilibrium responses to expected tariffs

We use the preceding system to prove Proposition 6. The derivation is for the interior case $0 < \beta < 1$; the endpoint cases can be obtained, where well defined, as limits.

Proof of Proposition 6. Substituting the expected-profit differential in equation (62) into the balanced-flow condition gives

$$\frac{\pi_i^e}{\pi_i^e - f_i}\left(-\eta_i \theta_i^{\text{HSA}} \mathrm{d}\log N_i - \eta_i \varepsilon_i\right) = \frac{\beta}{1-\beta}\left(\mathrm{d}\log N_i - \mathrm{d}\log M\right).$$

Define

$$\xi_i \equiv \frac{\dfrac{\pi_i^e}{\pi_i^e - f_i}\eta_i \theta_i^{\text{HSA}}}{\dfrac{\beta}{1-\beta} + \dfrac{\pi_i^e}{\pi_i^e - f_i}\eta_i \theta_i^{\text{HSA}}} \in (0,1), \qquad \widetilde{s}_i \equiv \frac{s_i \xi_i}{\sum_{k \in \mathscr{I}} s_k \xi_k}. \tag{63}$$

Solving the market-level equation and substituting it into the free-entry condition gives the final equilibrium responses:

$$\begin{aligned} \mathrm{d}\log N_i &= (1 - \xi_i)\mathrm{d}\log M - \xi_i \frac{\varepsilon_i}{\theta_i^{\text{HSA}}}, \\ \mathrm{d}\log M &= -\frac{\sum_{i \in \mathscr{I}} s_i \xi_i \frac{\varepsilon_i}{\theta_i^{\text{HSA}}}}{\sum_{i \in \mathscr{I}} s_i \xi_i} = -\sum_{i \in \mathscr{I}} \widetilde{s}_i \cdot \frac{\varepsilon_i}{\theta_i^{\text{HSA}}}. \end{aligned} \tag{64}$$

These are the two formulas stated in Proposition 6. ■

When all expected tariff shifts are nonnegative and at least one is positive, equation (64) implies $\mathrm{d}\log M < 0$ and then $\mathrm{d}\log N_i < 0$ in every market, including markets with $\varepsilon_i = 0$. Expected tariffs determine these entry responses, while the first line of equation (62) governs realized profit. If the tariff distribution is degenerate and $\varepsilon_i = \mathrm{d}\log t_i$, the expected- and realized-profit equations coincide and reduce to the deterministic-tariff formulas.

D.4 Aggregate outcomes and the empirical exercise

Aggregate formulas For compactness, define

$$\chi_i \equiv \delta_i - 1 + \frac{\frac{1}{\rho_i} - 1}{\sigma_i - 1} > 0.$$

The ideal-price change becomes

$$\mathrm{d}\log\left(t_i P_i^I\right) = \mathrm{d}\log t_i - \chi_i \mathrm{d}\log N_i.$$

Applying CES outer demand gives the final aggregate expressions:[27]

$$\begin{aligned}
\mathrm{d}\log Q_i &= \eta_i \chi_i \mathrm{d}\log N_i - \eta_i \mathrm{d}\log t_i, \\
\mathrm{d}\log R_i &= (\eta_i - 1)\chi_i \mathrm{d}\log N_i - \eta_i \mathrm{d}\log t_i, \\
\mathrm{d}\log \tilde{Q}_i &= \left[\eta_i \chi_i + (1 - \delta_i)\right] \mathrm{d}\log N_i - \eta_i \mathrm{d}\log t_i, \\
\mathrm{d}\log p_i &= -\left[\chi_i + (1 - \delta_i)\right] \mathrm{d}\log N_i = -\frac{\frac{1}{\rho_i} - 1}{\sigma_i - 1} \mathrm{d}\log N_i.
\end{aligned} \tag{65}$$

Here $R_i = E_i / t_i$, while homogeneous firms imply that p_i is also the average producer price and $\tilde{Q}_i = R_i / p_i$ is total physical quantity.

Connecting to the empirical setting To connect with our empirical setting, we consider the following scenario in which focal market announces a tariff increase. While third markets do not announce any tariff elevation, the expected tariff there increases. Formally, the focal tariff is fully anticipated and realized:

$$t_i^e = t_j(\mathrm{d}\log t_j + 1) > t_j,$$

[27] Recall that equation (26) for the HDIA case gives

$$\begin{aligned}
\mathrm{d}\log Q_i &= \left(\frac{\delta_i}{\rho_i} - \eta_i \theta_i\right) \mathrm{d}\log N_i - \eta_i \mathrm{d}\log t_i \\
&= \eta_i \left[(\delta_i - 1) + \left(\frac{1}{\rho_i} - 1\right) \frac{\delta_i}{\sigma_i}\right] \mathrm{d}\log N_i - \eta_i \mathrm{d}\log t_i.
\end{aligned}$$

Hence, we may define $\chi^{\mathrm{HDIA}} = \delta_i - 1 + \left(\frac{1}{\rho_i} - 1\right) \frac{\delta_i}{\sigma_i}$, as opposed to χ^{HSA} defined above. They coincide when the demand is fully CES.

so t_i^e has a degenerate distribution. For each third market $i \neq j$, the tariff distribution shifts upward but the realized tariff does not change:

$$\varepsilon_i > 0, \qquad \mathrm{d}\log t_i = 0.$$

The empirical outcomes—the number of exporters, export value, physical quantity, and average unit value—are realized objects, even though their extensive-margin response is determined by expected tariff risk.

Equation (64) implies that M and N_i fall in every market. In the third market, there is not a term of the realized tariff in equation (65). Since all coefficients in front of $\mathrm{d}\log N_i$ in the first three expressions of equation (65) are positive, Q_i, R_i, and $\tilde{Q}_i$ fall. The average price weakly rises, with a strict increase whenever $\rho_i < 1$. The focal market has the same signs because its decline in N_j is reinforced by the direct effect of $\mathrm{d}\log t_j > 0$ on quantities and revenue.

These signs match the baseline predictions in Corollary 1. The distinctive implication of tariff uncertainty is the separation between the shock governing entry and the shock governing realized demand. The belief shift ε_i changes expected profit and hence M and N_i, whereas the realized change $\mathrm{d}\log t_i$ only enters the direct demand terms in realized aggregate variables. Consequently, elevated but unrealized tariff risk depresses realized third-market trade entirely through the extensive margin. The following corollary summarizes the above discussion.

Corollary A.2. *Suppose that Assumption 1 holds in the initial equilibrium. Suppose further that $t_i^e = t_j(\mathrm{d}\log t_j + 1) > t_j$ in the focal market, and $\varepsilon_i > 0$ but $\mathrm{d}\log t_i = 0$ in every third market $i \neq j$. Then $\mathrm{d}\log M < 0$, and the equilibrium changes have the following properties:*

(i) In the focal market j,

$$\mathrm{d}\log N_j,\ \mathrm{d}\log R_j,\ \mathrm{d}\log \tilde{Q}_j,\ \mathrm{d}\log Q_j < 0, \qquad \mathrm{d}\log p_j \geq 0.$$

(ii) In every third market $i \neq j$,

$$\mathrm{d}\log N_i,\ \mathrm{d}\log R_i,\ \mathrm{d}\log \tilde{Q}_i,\ \mathrm{d}\log Q_i < 0, \qquad \mathrm{d}\log p_i \geq 0.$$

E Additional Results with non-CRS Production

We consider a static special case of the environment in Sections 3 à la Krugman (1980). Namely, we return to the standard entry assumption that market accesses are deterministic. Aftering paying the entry cost f_e, firms can serve all markets. Firms are homogeneous, and there is no exit or discounting. The equilibrium is one-shot, and we focus on an interior initial equilibrium in which all markets are served.

In such an equilibrium, firm homogeneity implies that $N_i = M$ in every market. The aggregation condition further implies that the relative quantity q_i/Q_i is common across markets:

$$M\Upsilon\left(\frac{q_i}{Q_i}\right) = 1 \quad \Longrightarrow \quad \frac{q_i}{Q_i} = \Upsilon^{-1}\left(\frac{1}{M}\right). \tag{66}$$

Since local inner-nest demand statistics are functions of q_i/Q_i under the common Υ, $\sigma_i = \sigma$, $\delta_i = \delta$, and $\rho_i = \rho$ in all market i. Notably, market size, outer-nest elasticities η_i, iceberg costs τ_i may still differ across destinations. We assume that Assumption 1 still holds in the initial equilibrium.

We now extend the linear production function in the baseline model to a power function $q^f = f(l) = l^\alpha$, with $\alpha > 0$. $\alpha < 1$, $\alpha = 1$, and $\alpha > 1$ then correspond to decreasing, constant, and increasing returns to scale, respectively. Let q_i denote the delivered quantity in market i and q^f the total produced quantity, then $q^f = \sum_{i\in\mathscr{I}} \tau_i q_i$. Total cost C, marginal cost c, and the marginal cost elasticity ψ are

$$C(q^f) = (q^f)^{1/\alpha}, \qquad c(q^f) = \frac{1}{\alpha}(q^f)^{1/\alpha - 1}, \qquad \psi \equiv -\frac{c'(q^f)q^f}{c(q^f)} = 1 - \frac{1}{\alpha} < 1. \tag{67}$$

As before, firms choose quantities to maximize profits $\sum_i p_i q_i - C(\sum_i \tau_i q_i)$. Standard markup rule applies to show that $p_i = \mu\tau_i c$, in which $\mu = \sigma/(\sigma-1)$. With free entry, the operating profit equals to the fixed costs: $\sum_i p_i q_i - C(q^f) = f_e + \sum_i f_i > 0$. We then impose the assumption that $\psi < 1/\sigma$ to ensure variable profits at the firm level. To see this,

$$\sum_i p_i q_i - C(q^f) = \frac{1/\sigma - \psi}{1-\psi}\sum_i p_i q_i > 0 \quad \Longleftrightarrow \quad \psi < \frac{1}{\sigma} \text{ or } \alpha < \frac{\sigma}{\sigma - 1}.$$

Retain $\pi_i = (p_i - \tau_i c)q_i$ as the contribution above marginal cost. Since $\pi_i = c\tau_i q_i/(\sigma-1)$,

the contribution and production shares, s_π and s_q, coincide:

$$s_i^\pi = \frac{\pi_i}{\sum_k \pi_k} = \frac{\tau_i q_i}{q^f} = s_i^q.$$

The ideal price index satisfies $P_i^I = D_i(Q_i) = N_i t_i p_i q_i / Q_i$. Differentiating demand and pricing, with θ_i defined in (24), gives

$$\begin{aligned} \mathrm{d}\log p_i &= \mathrm{d}\log c - \frac{\delta}{\sigma}\left(\frac{1}{\rho} - 1\right)\mathrm{d}\log M, \\ \mathrm{d}\log q_i &= \left[\delta\left(\frac{1}{\rho} - 1\right) - \eta_i\theta_i\right]\mathrm{d}\log M - \eta_i \mathrm{d}\log t_i - \eta_i \mathrm{d}\log c. \end{aligned} \tag{68}$$

The differential of the operating profit is $\sum_i \pi_i(\mathrm{d}\log q_i + \sigma \mathrm{d}\log p_i)$. Substituting it into free entry yields

$$\left(\sum_i s_i^\pi \eta_i \theta_i\right)\mathrm{d}\log M - \left(\sigma - \sum_i s_i^\pi \eta_i\right)\mathrm{d}\log c = -\sum_i s_i^\pi \eta_i \mathrm{d}\log t_i. \tag{69}$$

Separately, substituting the quantity responses into $\mathrm{d}\log c = -\psi \sum_i s_i^q \mathrm{d}\log q_i$ gives

$$\psi\left[\delta\left(\frac{1}{\rho} - 1\right) - \sum_i s_i^q \eta_i \theta_i\right]\mathrm{d}\log M + \left(1 - \psi \sum_i s_i^q \eta_i\right)\mathrm{d}\log c = \psi \sum_i s_i^q \eta_i \mathrm{d}\log t_i.$$

Using $s_i^q = s_i^\pi$, adding ψ times (69) eliminates the tariff terms and yields

$$\psi\delta\left(\frac{1}{\rho} - 1\right)\mathrm{d}\log M + (1 - \psi\sigma)\mathrm{d}\log c = 0. \tag{70}$$

Equations (69) and (70) jointly determine entry and marginal cost. When $\psi = 0$, marginal cost is unchanged and these equations recover the static baseline with common entry. Aggregate producer revenue, $R_i = N_i p_i q_i$, satisfies

$$\begin{aligned} \mathrm{d}\log R_i &= (\eta_i - 1)\left[\delta - 1 + \frac{\delta}{\sigma}\left(\frac{1}{\rho} - 1\right)\right]\mathrm{d}\log M - \eta_i \mathrm{d}\log t_i - (\eta_i - 1)\mathrm{d}\log c \\ &= (\eta_i - 1)\underbrace{\left[(\delta - 1) + \frac{1}{1 - \psi\sigma}\frac{\delta}{\sigma}\left(\frac{1}{\rho} - 1\right)\right]}_{>0}\mathrm{d}\log M - \eta_i \mathrm{d}\log t_i, \end{aligned} \tag{71}$$

where the second equality follows from (70), and the coefficient of $\mathrm{d}\log M$ is always positive

with $\psi < 1/\sigma$. In other words, despite the adjustment from the intensive margin, the revenue response follows the entry response. Moreover, the impact of the entry margin increases with ψ. A decreasing return to scale production function ($\psi < 0$) only reduces but never overturns the impact of the entry margin. An increasing return to scale production function ($\psi > 0$) instead amplifies it.

We now solve for the changes in $\mathrm{d}\log M$ and $\mathrm{d}\log c$. We first generalize θ_i in (24) to incorporate the non-CRS production function:

$$\theta_i^{\mathrm{NC}} \equiv \left(\frac{1}{\eta_i} - \frac{1}{\sigma}\right)\left(\frac{1}{\rho} - 1\right)\frac{\delta}{1-\psi\sigma} + 1 - \frac{\eta_i - 1}{\eta_i}\delta > 0,$$

where positivity follows from Assumption 1 and $\psi < 1/\sigma$. θ_i^{NC} coincides with θ_i when $\psi = 0$. Substituting (70) into (69) implies that

$$\mathrm{d}\log M = -\frac{\sum_i s_i^{\pi}\eta_i \mathrm{d}\log t_i}{\sum_i s_i^{\pi}\eta_i\theta_i^{\mathrm{NC}}} = \sum_i \tilde{s}_i^{\mathrm{NC}} \cdot \frac{-\mathrm{d}\log t_i}{\theta_i^{\mathrm{NC}}}, \qquad \mathrm{d}\log c = -\frac{\psi\delta}{1-\psi\sigma}\left(\frac{1}{\rho} - 1\right)\mathrm{d}\log M,$$

in which $\tilde{s}_i^{\mathrm{NC}} = s_i^{\pi}\eta_i\theta_i^{\mathrm{NC}} / \sum_k s_k^{\pi}\eta_k\theta_k^{\mathrm{NC}}$. With $s_i = \frac{\pi_i - f_i}{\sum_k(\pi_k - f_k)}$ and $\xi_i = \frac{\pi_i\eta_i\theta_i}{\pi_i - f_i}$ for the Melitz entry ($\beta \to 1$) case in Section 4.3, the normalized weight is $\tilde{s}_i = \pi_i\eta_i\theta_i / \sum_k \pi_k\eta_k\theta_k$. Thus, $\tilde{s}_i^{\mathrm{NC}}$ is identical to $\tilde{s}_i$, evaluated with θ_i^{NC} in place of θ_i. We then write

$$\mathrm{d}\log M = \sum_i \tilde{s}_i \cdot \frac{-\mathrm{d}\log t_i}{\theta_i^{\mathrm{NC}}}$$

Finally, we connect back to the empirical setting in which only the focal market raises its tariff, i.e., $\mathrm{d}\log t_j > 0$. The, $\mathrm{d}\log M < 0$, and $\mathrm{d}\log R_i < 0$ in all markets. As in the benchmark case, fewer firms enter into the industry, and aggregate third-market exports fall.

The sign of $\mathrm{d}\log c$ follows directly from the sign of ψ. Thus, marginal cost falls under decreasing returns ($\alpha < 1$, $\psi < 0$) and rises under increasing returns ($1 < \alpha < \sigma/(\sigma-1)$, $\psi > 0$) whenever $\rho < 1$. In particular, $\mathrm{d}\log c = 0$ under constant returns to scale ($\psi = 0$) or complete pass-through ($\rho = 1$). Under decreasing returns, the fall in marginal cost encourages third-market exports, but never outweighs the aggregate effect of reduced entry.

F Additional Results with Oligopolistic Competition

This appendix provides the microfoundation for foreign demand summarized in Section 5.4. We derive the local demand schedule for home exports after accounting for compet-

ing suppliers' pricing and sectoral expenditure adjustment. The baseline comparative statics continue to hold under Assumption 1, evaluated at the resulting effective demand elasticity.

F.1 An extended environment

We retain the home firms' pricing and entry decisions from Section 3, but replace the exogenous foreign demand schedule with an explicit destination-market structure. Home varieties form a composite Q_i with ideal price index P_i^I, while other suppliers provide a foreign composite Q_i^f priced at P_i^f. Following Atkeson and Burstein (2008), a representative foreign composite producer chooses its price in response to P_i^I, taking total sectoral expenditure E_i^S as given. We continue to normalize the home wage to one.

Consumers substitute between the two composites with constant elasticity $\bar{\eta}_i > 1$. Their demands and the sectoral price index are

$$\begin{aligned} Q_i =& E_i^S (P_i^I)^{-\bar{\eta}_i} (P_i^S)^{\bar{\eta}_i - 1}, \quad Q_i^f = E_i^S (P_i^f)^{-\bar{\eta}_i} (P_i^S)^{\bar{\eta}_i - 1}, \\ P_i^S =& \left[(P_i^I)^{1-\bar{\eta}_i} + (P_i^f)^{1-\bar{\eta}_i} \right]^{1/(1-\bar{\eta}_i)}. \end{aligned} \tag{72}$$

We focus on an interior equilibrium, with home expenditure share

$$\alpha_i^S \equiv \frac{P_i^I Q_i}{E_i^S} = \frac{(P_i^I)^{1-\bar{\eta}_i}}{(P_i^I)^{1-\bar{\eta}_i} + (P_i^f)^{1-\bar{\eta}_i}} \in (0,1). \tag{73}$$

Thus, E_i^S includes spending on both composites, whereas expenditure on home varieties is $E_i = P_i^I Q_i = \alpha_i^S E_i^S$, as in the baseline. We assume that the sectoral demand elasticity is $\phi_i \in [1, \bar{\eta}_i]$: substitution across sectors is no stronger than substitution between the composites. Then, sectoral expenditure responds according to

$$\mathrm{d}\log E_i^S = (1-\phi_i)\mathrm{d}\log P_i^S = (1-\phi_i)\left[\alpha_i^S \mathrm{d}\log P_i^I + (1-\alpha_i^S)\mathrm{d}\log P_i^f\right]. \tag{74}$$

The foreign producer has cost function $C_i(q)$, marginal cost $c_i(q) = C_i'(q) > 0$, and marginal-cost elasticity $\psi_i(q) \equiv -q c_i'(q)/c_i(q)$. We impose $\psi_i(q) < 1/\bar{\eta}_i$ for all $q > 0$. This permits increasing, constant, or decreasing returns and ensures a unique interior pricing optimum when one exists. Appendix F.2 derives the optimal local price response:

$$\mathrm{d}\log P_i^f = \eta_i^c \mathrm{d}\log P_i^I + \eta_i^e \mathrm{d}\log E_i^S, \tag{75}$$

where $\eta_i^c < 1$ and $\text{sign}(\eta_i^e) = -\text{sign}(\psi_i(Q_i^f))$. Neither pricing coefficient is required to be positive.

Differentiating home demand first gives

$$\mathrm{d}\log Q_i = \mathrm{d}\log E_i^S - \mathrm{d}\log P_i^I + (\bar{\eta}_i - 1)(1 - \alpha_i^S)\left(\mathrm{d}\log P_i^f - \mathrm{d}\log P_i^I\right).$$

Substituting the foreign price response yields

$$\begin{aligned}\mathrm{d}\log Q_i = & -\left[1 + (\bar{\eta}_i - 1)(1 - \alpha_i^S)(1 - \eta_i^c)\right]\mathrm{d}\log P_i^I \\ & + \underbrace{\left[1 + (\bar{\eta}_i - 1)(1 - \alpha_i^S)\eta_i^e\right]}_{>0}\mathrm{d}\log E_i^S. \end{aligned} \tag{76}$$

The coefficient on expenditure is positive, as proved below, so sectoral expenditure remains a positive demand shifter after competitors adjust prices.

Combining (74) and (75) gives

$$\left[1 + \eta_i^e(\phi_i - 1)(1 - \alpha_i^S)\right]\mathrm{d}\log P_i^S = \left[\alpha_i^S + (1 - \alpha_i^S)\eta_i^c\right]\mathrm{d}\log P_i^I.$$

Define the equilibrium elasticity of the sectoral price index with respect to the home composite price as

$$\kappa_i \equiv \frac{\alpha_i^S + (1 - \alpha_i^S)\eta_i^c}{1 + \eta_i^e(\phi_i - 1)(1 - \alpha_i^S)} \in (0, 1), \qquad \mathrm{d}\log P_i^S = \kappa_i \mathrm{d}\log P_i^I. \tag{77}$$

The bounds on κ_i are established in Appendix F.2. Hence, an increase in the home composite price raises the sectoral price index less than proportionally, and $\mathrm{d}\log E_i^S = (1-\phi_i)\kappa_i \mathrm{d}\log P_i^I$ is weakly negative, strictly so if $\phi_i > 1$.

To recover the baseline demand schedule, use the first line of (72) and differentiate:

$$\begin{aligned}\mathrm{d}\log Q_i &= \mathrm{d}\log E_i^S - \bar{\eta}_i \mathrm{d}\log P_i^I + (\bar{\eta}_i - 1)\mathrm{d}\log P_i^S \\ &= -\bar{\eta}_i \mathrm{d}\log P_i^I + (\bar{\eta}_i - \phi_i)\mathrm{d}\log P_i^S.\end{aligned}$$

Substituting (77) then yields

$$\mathrm{d}\log Q_i = -\eta_i \mathrm{d}\log P_i^I, \qquad \eta_i \equiv \phi_i\kappa_i + \bar{\eta}_i(1 - \kappa_i) \in (\phi_i, \bar{\eta}_i).$$

Therefore, the oligopolistic competition gives rise to the effective elasticity of home demand with respect to the home composite price, η_i. It is a weighted average of the sectoral and

within-sector elasticities, with weights determined by the home expenditure share and the competitors' pricing response. If Assumption 1 holds with this effective elasticity, the comparative statics in Section 4 apply. With interdependent entry, a unilateral tariff reduces entry and aggregate home exports in every destination and raises P_i^I.

Finally, the price-index differential implies

$$\mathrm{d}\log P_i^I - \mathrm{d}\log P_i^f = \underbrace{\frac{1-\kappa_i}{1-\alpha_i^S}}_{>0}\,\mathrm{d}\log P_i^I. \tag{78}$$

Home prices therefore rise relative to competitors' prices whenever P_i^I increases. From (73), the home expenditure share satisfies

$$\mathrm{d}\log \alpha_i^S = (1-\bar{\eta}_i)\left(\mathrm{d}\log P_i^I - \mathrm{d}\log P_i^S\right) = -(\bar{\eta}_i - 1)(1-\kappa_i)\mathrm{d}\log P_i^I. \tag{79}$$

Thus, a unilateral tariff lowers home exporters' market shares in both focal and third markets. It protects competing suppliers from home competition even in destinations that impose no tariff.

F.2 Omitted derivations

We first derive the foreign price response. Given P_i^I and E_i^S, the representative foreign composite producer solves

$$\max_{P_i^f>0}\; P_i^f Q_i^f - C_i(Q_i^f), \qquad \text{subject to} \quad Q_i^f = \frac{E_i^S (P_i^f)^{-\bar{\eta}_i}}{(P_i^I)^{1-\bar{\eta}_i} + (P_i^f)^{1-\bar{\eta}_i}}.$$

Its own-price demand elasticity, holding expenditure and the home price fixed, is

$$\tilde{\eta}_i \equiv -\frac{\partial \log Q_i^f}{\partial \log P_i^f} = \bar{\eta}_i + (1-\bar{\eta}_i)(1-\alpha_i^S) = 1 + (\bar{\eta}_i - 1)\alpha_i^S \in (1, \bar{\eta}_i).$$

The first-order condition gives the markup rule

$$P_i^f = \frac{\tilde{\eta}_i}{\tilde{\eta}_i - 1} c_i(Q_i^f).$$

To establish uniqueness, let p denote a candidate foreign price and $Q_i^f(p)$ the quantity implied by its demand equation, holding P_i^I and E_i^S fixed. As p rises, the foreign expenditure

share decreases, so $\alpha_i^S(p)$ and $\tilde{\eta}_i(p)$ increase. The desired markup $\tilde{\eta}_i(p)/(\tilde{\eta}_i(p)-1)$ therefore decreases. Meanwhile,

$$\frac{\mathrm{d}}{\mathrm{d}\log p}\log\frac{p}{c_i(Q_i^f(p))} = 1-\psi_i(Q_i^f(p))\tilde{\eta}_i(p) > 0.$$

The inequality follows from $\psi_i(q) < 1/\bar{\eta}_i$ and $1 < \tilde{\eta}_i(p) < \bar{\eta}_i$, including when $\psi_i(q) \leq 0$. Thus, the markup equation has at most one solution. Moreover, the profit derivative has the sign of $\tilde{\eta}_i(p)/[\tilde{\eta}_i(p)-1] - p/c_i(Q_i^f(p))$, so any solution is the unique interior optimum.

For the local response, evaluate cost elasticities at the initial foreign quantity $q = Q_i^f$. Differentiating foreign demand and the markup yields

$$\begin{aligned}\mathrm{d}\log Q_i^f &= \mathrm{d}\log E_i^S - \mathrm{d}\log P_i^f + (\tilde{\eta}_i - 1)\left(\mathrm{d}\log P_i^I - \mathrm{d}\log P_i^f\right),\\ \mathrm{d}\log\frac{\tilde{\eta}_i}{\tilde{\eta}_i - 1} &= \frac{\bar{\eta}_i - \tilde{\eta}_i}{\tilde{\eta}_i}\left(\mathrm{d}\log P_i^I - \mathrm{d}\log P_i^f\right).\end{aligned}$$

The second equality follows by differentiating $\tilde{\eta}_i = 1 + (\bar{\eta}_i - 1)\alpha_i^S$ and using $\mathrm{d}\log\alpha_i^S = -(\bar{\eta}_i - 1)(1-\alpha_i^S)(\mathrm{d}\log P_i^I - \mathrm{d}\log P_i^f)$. Since $\mathrm{d}\log c_i(q) = -\psi_i(q)\mathrm{d}\log Q_i^f$, the markup rule implies

$$\begin{aligned}\mathrm{d}\log P_i^f &= \frac{\bar{\eta}_i - \tilde{\eta}_i}{\tilde{\eta}_i}\left(\mathrm{d}\log P_i^I - \mathrm{d}\log P_i^f\right) - \psi_i(q)\mathrm{d}\log Q_i^f,\\ (1-\psi_i(q))\mathrm{d}\log P_i^f &= A_i^{h,I}\left(\mathrm{d}\log P_i^I - \mathrm{d}\log P_i^f\right) - \psi_i(q)\mathrm{d}\log E_i^S,\end{aligned}$$

where

$$A_i^{h,I} \equiv \frac{\bar{\eta}_i - \tilde{\eta}_i}{\tilde{\eta}_i} - (\tilde{\eta}_i - 1)\psi_i(q).$$

The coefficient on the foreign price after rearranging is positive:

$$1 - \psi_i(q) + A_i^{h,I} = \frac{\bar{\eta}_i}{\tilde{\eta}_i} - \tilde{\eta}_i\psi_i(q) > \frac{\bar{\eta}_i}{\tilde{\eta}_i} - \frac{\tilde{\eta}_i}{\bar{\eta}_i} > 0.$$

Consequently, the coefficients in (75) are

$$\eta_i^c = \frac{A_i^{h,I}}{1-\psi_i(q)+A_i^{h,I}}, \qquad \eta_i^e = -\frac{\psi_i(q)}{1-\psi_i(q)+A_i^{h,I}}. \tag{80}$$

Since $1-\psi_i(q) > 0$, we have $1-\eta_i^c = (1-\psi_i(q))/(1-\psi_i(q)+A_i^{h,I}) > 0$, even if η_i^c is negative. The expenditure coefficient has the opposite sign to $\psi_i(q)$. Holding $\tilde{\eta}_i$ fixed, its expression

$\eta_i^e = -\tilde{\eta}_i\psi_i(q)/(\bar{\eta}_i - \tilde{\eta}_i^2\psi_i(q))$ is strictly decreasing in $\psi_i(q)$. Taking the limits as $\psi_i(q) \to -\infty$ and $\psi_i(q) \to 1/\bar{\eta}_i$ gives

$$\eta_i^e \in \left(-\frac{\tilde{\eta}_i}{\bar{\eta}_i^2 - \tilde{\eta}_i^2}, \frac{1}{\tilde{\eta}_i}\right).$$

Signing We now establish the signs used in Appendix F.1. First, because $(\bar{\eta}_i - 1)(1 - \alpha_i^S) = \bar{\eta}_i - \tilde{\eta}_i$, the preceding bounds imply

$$1 + (\bar{\eta}_i - 1)(1 - \alpha_i^S)\eta_i^e = 1 + (\bar{\eta}_i - \tilde{\eta}_i)\eta_i^e \in \left(\frac{\bar{\eta}_i}{\bar{\eta}_i + \tilde{\eta}_i}, \frac{\bar{\eta}_i}{\tilde{\eta}_i}\right).$$

This proves that the coefficient on sectoral expenditure in (76) is positive.

Next, the denominator of κ_i is positive. If $\eta_i^e \geq 0$, it is at least one. If $\eta_i^e < 0$, the restriction $\phi_i \leq \bar{\eta}_i$ and the preceding bound give

$$1 + \eta_i^e(\phi_i - 1)(1 - \alpha_i^S) \geq 1 + \eta_i^e(\bar{\eta}_i - 1)(1 - \alpha_i^S) > \frac{\bar{\eta}_i}{\bar{\eta}_i + \tilde{\eta}_i} > 0.$$

Its numerator is also positive. Substituting (80) and using $\tilde{\eta}_i - 1 = (\bar{\eta}_i - 1)\alpha_i^S$ yields

$$\begin{aligned}\alpha_i^S + (1 - \alpha_i^S)\eta_i^c &= \frac{\alpha_i^S(1 - \psi_i(q)) + A_i^{h,I}}{1 - \psi_i(q) + A_i^{h,I}} \\ &= \frac{\alpha_i^S[1 - \bar{\eta}_i\psi_i(q)] + (\bar{\eta}_i - \tilde{\eta}_i)/\tilde{\eta}_i}{1 - \psi_i(q) + A_i^{h,I}} > 0.\end{aligned}$$

Both terms in the last numerator are positive, since $\alpha_i^S > 0$, $\bar{\eta}_i\psi_i(q) < 1$, and $\tilde{\eta}_i < \bar{\eta}_i$. Hence, $\kappa_i > 0$ without requiring $\eta_i^c \geq 0$.

To prove the upper bound, subtract the numerator of κ_i from its denominator:

$$1 - \kappa_i = \frac{(1 - \alpha_i^S)[1 - \eta_i^c + (\phi_i - 1)\eta_i^e]}{1 + \eta_i^e(\phi_i - 1)(1 - \alpha_i^S)}. \tag{81}$$

The remaining bracket is positive because

$$1 - \eta_i^c + (\phi_i - 1)\eta_i^e = \frac{1 - \phi_i\psi_i(q)}{1 - \psi_i(q) + A_i^{h,I}} > 0.$$

Indeed, $1 - \phi_i\psi_i(q) \geq 1$ if $\psi_i(q) \leq 0$, while $1 - \phi_i\psi_i(q) \geq 1 - \bar{\eta}_i\psi_i(q) > 0$ if $\psi_i(q) > 0$. Together with $1 - \alpha_i^S > 0$ and the positive denominator, this establishes $1 - \kappa_i > 0$. Therefore, $0 < \kappa_i < 1$.

G Additional Quantitative Results

G.1 Independence of $\mathrm{d}\log M$ and $\mathrm{d}\log Q_{\text{agg}}$ from β

In Table 3, $\mathrm{d}\log M$ and $\mathrm{d}\log Q_{\text{agg}}$ are independent of β. In a symmetric equilibrium where all markets share the same parameters and equal revenue shares ($s_i = 1/L$), we have $\xi_i = \xi$ for all i, so equation (22) simplifies to

$$\mathrm{d}\log M = -\frac{1}{L}\frac{\mathrm{d}\log t_j}{\theta},$$

regardless of the value of ξ and β.

For $\mathrm{d}\log Q_{\text{agg}}$, the key step is the identity

$$\sum_i s_i \,\mathrm{d}\log N_i = \mathrm{d}\log M,$$

which follows from combining the log-differential of the free entry condition (21), which leads to $\sum_i s_i \,\mathrm{d}\log \bar{\pi}_i = 0$, with the entry technology (20), which links each market's profit change to its entry deviation from the global pool. Aggregating the $\mathrm{d}\log Q_i$ equation in Proposition 3 across markets with equal weights and invoking this identity, all β-dependent terms cancel and $\mathrm{d}\log Q_{\text{agg}}$ reduces to

$$\mathrm{d}\log Q_{\text{agg}} = -\frac{\delta}{L\rho\theta}\,\mathrm{d}\log t_j,$$

a function only of demand and entry parameters. Intuitively, β governs how firm entry is distributed across markets but not the total entry.

G.2 Calibrating the CES Version of the Model

The demand structure does not affect the calibration of η and β, so their values are the same as those reported in Table 2a. However, the change in the demand system does affect the calibration of the local elasticities σ, δ, and ρ. In particular, under CES demand, we have $\delta = \sigma/(\sigma-1)$ and $\rho = 1$. Therefore, we only need to calibrate σ. We choose σ to match the change in the number of exporters in the third market (or equivalently, the change in the number of exporters in the focal market, because we have chosen β and η to match the relative change in the number of exporters in the two types of markets). Under CES, we have

$$\theta = 1 - \frac{\eta - 1}{\eta}\frac{\sigma}{\sigma - 1}.$$

Substituting θ and η in the expression, we obtain $\sigma = 1.24$, smaller than the value in the benchmark case.

G.3 Sensitivity of the Calibrated β to the Fixed-Cost Share

The targeted moments identify only the composite $\tilde{f}(1-\beta)/\beta$, where $\tilde{f} = 1/(1-f/\pi)$. Table A.11 re-solves the wedge equation $\xi/(1-\xi) = \eta\theta\tilde{f}(1-\beta)/\beta$ for β at alternative fixed-cost-to-profit ratios, holding η, θ, and ξ at their calibrated values. The implied fixed-cost-to-revenue ratio is $f/r = (f/\pi)/\sigma$. All other parameters and tariff responses are unchanged across rows. Over the range implied by existing estimates of fixed export costs, the calibrated β remains close to its baseline value.

Table A.11: Sensitivity of the Calibrated β to the Fixed-Cost Share

f/π (%)	Implied f/r (%)	$\tilde{f}$	β
0.0	0.0	1.00	0.46
1.9	1.0	1.02	0.46
5.0	2.6	1.05	0.47
10.0	5.2	1.11	0.48
14.7	7.7	1.17	0.50
20.0	10.5	1.25	0.51
30.0	15.7	1.43	0.54
50.0	26.2	2.00	0.63

G.4 Robustness to the Number of Markets

The baseline sets the total number of symmetric markets to $L = 8$ so that the focal market's share $1/L$ matches its average share of China's exports of the investigated product. This count is uncertain in two directions. Focal shares vary across investigations, and the share is measured relative to exports only: once domestic sales enter the denominator, the focal market's share of total sales is smaller and the implied L larger. This subsection re-runs the calibration and the counterfactual for $L \in \{5, 8, 10, 20, 40\}$.

The number of markets enters the calibration only through the focal share in the two exporter-count equations, $\mathrm{d}\log N_j = -\left(\frac{1-\xi}{L} + \xi\right)\frac{\mathrm{d}\log t_j}{\theta}$ and $\mathrm{d}\log N_i = -\frac{1-\xi}{L}\frac{\mathrm{d}\log t_j}{\theta}$. Writing $a \equiv -\mathrm{d}\log N_i/\mathrm{d}\log t_j$ and $b \equiv (\mathrm{d}\log N_i - \mathrm{d}\log N_j)/\mathrm{d}\log t_j$, both fixed by the data, the two equations give $\theta = 1/(aL+b)$ and $\xi = b\theta$, so both fall roughly in proportion to $1/L$: the smaller the focal market, the more elastic entry must be to produce the same third-market

decline in exporters. The elasticity η comes from the cross-market difference in per-exporter revenue responses and does not involve L, and neither does δ. Given η and θ, β rises with L toward $\eta/(\eta+b)$, σ falls toward one, and ρ rises. Table A.12 reports the calibrated parameters and Table A.13 the model-implied responses for each number of markets.

Table A.12: Calibrated Parameters for Alternative Numbers of Markets

L	η	β	σ	δ	ρ
5	1.17	0.42	2.25	6.69	0.90
8	1.17	0.46	1.91	6.69	0.91
10	1.17	0.47	1.77	6.69	0.92
20	1.17	0.50	1.43	6.69	0.93
40	1.17	0.52	1.23	6.69	0.94

Notes. Each row repeats the baseline calibration of Section 6 with the total number of symmetric markets set to L; $L = 8$ is the baseline. All rows target the same moments.

Table A.13: Model-implied Responses to 84.5% Tariff for Alternative Numbers of Markets

				Focal market (j)					Third markets (i)				
L	β	$\mathrm{d}\log M$	$\mathrm{d}\log Q_{\mathrm{agg}}$	$\mathrm{d}\log N_j$	$\mathrm{d}\log \bar{r}_j$	$\mathrm{d}\log p_j$	$\mathrm{d}\log Q_j$	Share	$\mathrm{d}\log N_i$	$\mathrm{d}\log \bar{r}_i$	$\mathrm{d}\log p_i$	$\mathrm{d}\log Q_i$	Share
5	0.42	-33.2	-247.9	-82.9	-71.4	28.6	-654.4	52.8	-20.8	0.0	7.2	-146.3	47.2
8	0.46	-28.6	-209.8	-82.9	-71.4	28.6	-654.4	39.0	-20.8	0.0	7.2	-146.3	61.0
10	0.47	-27.0	-197.1	-82.9	-71.4	28.6	-654.4	33.2	-20.8	0.0	7.2	-146.3	66.8
20	0.50	-23.9	-171.7	-82.9	-71.4	28.6	-654.4	19.1	-20.8	0.0	7.2	-146.3	80.9
40	0.52	-22.4	-159.0	-82.9	-71.4	28.6	-654.4	10.3	-20.8	0.0	7.2	-146.3	89.7

Notes. All entries except Share are log changes multiplied by 100; Share is in percent. Each row uses the calibrated parameters in the corresponding row of Table A.12; the row for $L = 8$ reproduces Panel A of Table 3. $\mathrm{d}\log Q_{\mathrm{agg}} = \sum_i \mathrm{d}\log Q_i/L$. Share: market's contribution to $\mathrm{d}\log Q_{\mathrm{agg}}$. 84.5% tariff ($\mathrm{d}\log t_j = \ln(1.845) \approx 0.61$) on focal market only.

The market-level columns are identical across rows because they are the targeted moments, which the calibration matches exactly for any number of markets. What varies with L is the calibrated parameters and the aggregate: as the focal market becomes a smaller part of the total, $\mathrm{d}\log M$ and $\mathrm{d}\log Q_{\mathrm{agg}}$ shrink in absolute value and the third markets' share of the aggregate decline rises. The calibrated β moves within a narrow band, so the conclusion that entry is neither independent nor fully interdependent does not hinge on the market count.