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Heterogeneous Impacts of the U.S.-China Trade War on Korea: What Drives Industry Differences?†

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This paper analyzes how the U.S.–China trade war affected Korean industries and identifies the industry characteristics that determined which industries gained or lost. I show that heterogeneity in responses is closely linked to capital intensity and export intensity, highlighting the role of economies of scale and export readiness. Using detailed industry-level data from Korean manufacturing, the analysis finds that capital-intensive industries with substantial pre-war investments and industries with high export intensity achieved greater growth and cost reductions following the tariff shocks. These findings indicate that industries positioned to expand their scale captured the gains, while others were left behind, emphasizing the importance of targeted and differentiated policy support for pre-investment, capital deepening, and export infrastructure ultimately to enable more industries to leverage external trade disruptions as opportunities for sustained growth.

Key Words: Tariff Elasticity, Trade War, Trade Fragmentation, Third-country Effect, Economies of Scale
JEL Code: F12, F13, F14, C33

I. Introduction

Since the late 2010s, scholars and policymakers have debated whether the global economy has shifted from globalization toward "slowbalization." Skepticism about globalization and concerns about its uneven distributional effects have fueled protectionist sentiment and the proliferation of new trade barriers. At the same time, fragmentation has become a central theme in both policy and academic debates (Aiyar *et al*. 2023; IMF 2023). The escalation of protectionist measures between the

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United States and China in 2018–19 marked the first full-scale trade war of this era. Both countries have since deepened their strategic rivalry through industrial and trade policies, with fragmentation pressures persisting into the mid-2020s.

Korea, as a highly open and export-oriented economy, is particularly sensitive to these developments. A growing body of research has examined the implications of global fragmentation for Korea (Yoon and Choi 2023; Kim and Song 2023; Ra and Kim 2023). Many studies highlight the risks: reduced exports and slower GDP growth. Others suggest potential opportunities, as restrictions on Chinese products could create substitution effects that benefit Korean exporters (Ra and Kim 2023; Kim and Park 2024). This paper explores these issues by analyzing how U.S.–China tariff escalation reshaped Korea's exports to its two largest markets. When the U.S. raises tariffs on Chinese goods, Korean firms may gain new export opportunities in the U.S. market. Likewise, Chinese barriers that apply to U.S. goods may divert demand toward or away from Korean suppliers. Although these are indirect third-country effects, they are of first-order importance for Korea given that the U.S. and China together account for the bulk of its export demand.[1]

Recent work by Fajgelbaum *et al*. (2024) shows that third-party countries experienced heterogeneous spillover effects from the U.S.–China trade war at the country–product level, depending on their ability to substitute Chinese or U.S. goods and their ability to expand their scale. Building on this framework, the present study brings the analysis to the industry level within a single country. In Section II, I examine which characteristics of Korean industries – including technology intensity, capital intensity, and export orientation – are associated with higher degrees of tariff elasticity, thereby linking theory-based determinants to observable industry traits. On the demand side, I show that lower tariff rates on Korean products and higher levels of technological sophistication are associated with greater elasticity, implying that such products were more effective substitutes for Chinese or U.S. goods. On the supply side, industries with greater capital intensity and higher export intensity also exhibit greater elasticity, consistent with a role for economies of scale.

Motivated by these findings, I then analyze in Section III how Korean manufacturing industries actually responded to the trade war shocks. The evidence shows that industries positioned to scale benefitted most: capital-intensive industries with substantial pre-war investments realized stronger growth in value-added and greater cost reductions in response to U.S. tariff shocks, while export-intensive industries recorded higher output growth and cost declines following Chinese tariff shocks. These findings underscore the critical role of economies of scale and preparedness to expand production in capturing opportunities created by external trade shocks. They also offer guidance for how Korea – and other countries facing similar circumstances – can identify and implement targeted policy measures to strengthen resilience and leverage future trade disruptions ultimately to ensure sustained growth.

Literature from around the world has increasingly documented how the U.S.–China trade war has affected third-party countries. Some short-run studies (Cigna *et*

[1]As of 2023, South Korea's exports to China amounted to USD 124.8 billion and exports to the United States reached USD 115.7 billion, each representing approximately 20 percent of total exports of USD 632.2 billion (Korea Customs Service, "Trade Statistics by Country," accessed December 25, 2024).

al. 2022) find little evidence of diverted trade despite sharp declines in U.S. imports from China. In contrast, longer-run analyses (Bown 2022; Freund *et al*. 2024; Alfaro and Chor 2023) document significant reallocations of U.S. imports away from China, with countries such as Vietnam and Mexico emerging as key beneficiaries. Other research has decomposed the channels of adjustment: Benguria (2023) separates an import-substitution effect from a supply-chain linkage effect, and Son (2022) documents an upstream propagation channel in which reduced Chinese demand for foreign inputs has adverse spillover effects on upstream suppliers across third countries.

Fajgelbaum *et al*. (2024) identify theory-based heterogeneous effects of the trade war across third-party countries. Examining exports to the United States, China, and the rest of the world, they show that while global exports expanded the overall, gains varied with each country's substitutability with U.S. or Chinese goods and with the economy of scale of the country. Building on their findings, this paper explores which industry-level characteristics – specifically capital intensity and export integration – drive the observed heterogeneity in these elasticities, thereby linking the theoretical determinants in Fajgelbaum *et al*. (2024) to concrete, observable industry traits.

Lastly, a growing body of work focuses on the trade war's impact on Korea specifically. On one hand, Son (2022) shows that firms in industries more exposed to U.S. tariff–induced vertical-supply-chain shocks suffered substantial slowdowns in sales growth and market valuation. Cheong and Seo (2024), on the other hand, find that heightened Chinese import penetration in the Korean market compressed the revenue of Korean firms both domestically and abroad. This paper contributes to this vein of the literature in two ways. First, it links model-consistent determinants of tariff elasticities to observable industry characteristics in Korea, identifying which industries were more exposed or better positioned to benefit. Second, it analyzes how Korean manufacturing industries responded to the trade war shocks, highlighting how the capacity to scale and the degree of export readiness shaped heterogeneous impacts.

The remainder of the paper is organized as follows. Section II presents the framework for understanding heterogeneity across industries and analyzes the relationship between tariff elasticities and industry characteristics. Section III examines how the U.S.–China trade war differentially affected Korean industries according to these characteristics. Section IV concludes with key findings and policy implications.

II. Tariff Cross-Elasticity and its Components

This section summarizes the framework of Fajgelbaum *et al*. (2024) to provide intuition with regard to tariff cross-elasticities. I then draw on their definition of elasticity to identify the components that determine the sign and magnitude of the response. Throughout the paper, "tariff elasticities" refer to the cross-elasticities of a third country's exports with respect to tariffs that the United States and China impose on each other's products. For ease of exposition, I use "tariff elasticities" and "tariff cross-elasticities" interchangeably.

A. *Heterogeneous Tariff Cross-Elasticity*

I employ the framework of Fajgelbaum *et al*. (2024) to clarify the economics of tariff elasticities and the factors driving their heterogeneity. I briefly outline the model here to establish, as noted above, the intuition behind these elasticities – and why they may differ across countries and products – but I refer readers to Fajgelbaum *et al*. (2024) for full details.[2]

Fajgelbaum *et al*. (2024) extend the standard Ricardian–Armington trade model by permitting country-pair substitution elasticities to vary at the industry level.[3] In most conventional models, the elasticity of substitution is assumed to vary across goods (or industries) but to remain constant across origin countries – implying, for example, that U.S. goods and Korean goods are equally substitutable regardless of whether the alternative is Mexican or German output. Such an assumption fails to capture country-specific preferences or the depth of economic cooperation that may influence substitution patterns beyond pure price effects.

Building on this structure, Fajgelbaum *et al*. (2024) show – both theoretically and empirically – that identical U.S.–China trade-war shocks can have heterogeneous effects at exporter-product level, resulting in winners and losers among third-party exporters.

The expressions of two types of tariff cross-elasticities are presented below.

$$\beta_{1i\omega}^{\ n} \equiv \left(1\{n = US\} + \frac{E_{\omega}^{\ US}}{E_{\omega}} \frac{\frac{b_i^{\ j}\sigma_{ii}^{\ j}}{X_{i\omega}/E_{\omega}}}{1-\frac{b_i^{\ j}\sigma_{ii}^{\ j}}{X_{i\omega}/E_{\omega}}} \right) \frac{\sigma_{CHi}^{\ j}}{s_{i\omega}^{\ n}} \tag{1}$$

$$\beta_{2i\omega}^{\ n} \equiv \left(1\{n = CH\} + \frac{E_{\omega}^{\ CH}}{E_{\omega}} \frac{\frac{b_i^{\ j}\sigma_{ii}^{\ j}}{X_{i\omega}/E_{\omega}}}{1-\frac{b_i^{\ j}\sigma_{ii}^{\ j}}{X_{i\omega}/E_{\omega}}} \right) \frac{\sigma_{USi}^{\ j}}{s_{i\omega}^{\ n}} \tag{2}$$

The tariff elasticities $\beta_{1i\omega}^{n}$ and $\beta_{2i\omega}^{n}$ capture the effects on the country *i*'s exports to *n* of U.S. tariffs on Chinese goods and of Chinese tariffs on U.S. goods, respectively. Specifically, $\beta_{1i\omega}^{n}$ represents the tariff elasticity of a country *i*'s variety ω of exports to destination country n with respect to U.S. tariffs on Chinese variety ω. It depends on the U.S. consumption share ($E_{\omega}^{US}/E_{\omega}$), exporter *i*'s share ($X_{i\omega}/E_{\omega}$), the elasticity of substitution with the Chinese good ($\sigma_{CH,i}^{j}$), the share of country *i* in U.S. spending in product ω ($s_{i\omega}^{US}$), and the exporter's supply curvature ($b_i^j \sigma_{ii}^j$).

[2]I also provide a detailed discussion of the model and an estimation of tariff elasticities in the Appendix, to which interested readers may refer for further information.

[3]Fajgelbaum *et al*. (2024) derived expressions for tariff cross-elasticities at the product–importer–exporter level and then applied them empirically to evaluate how third-country exports were affected by the U.S.–China trade war.

Analogously, $\beta_{2i\omega}^{n}$ is the tariff elasticity of a country i's variety ω of exports to destination country n with respect to Chinese tariffs on U.S. variety ω., and its structure mirrors that of $\beta_{1i\omega}^{n}$.

B. *Role of Industry Characteristics in Tariff Elasticities*

In the previous section, I decomposed tariff elasticities toward the United States and China into the corresponding country-, industry-, and product-level components, showing that each market's elasticity arises from a varying mix of these factors. Here, I use that framework to interpret these components and to test their associations with observable industry characteristics.

An ideal estimation would use a multi-country panel with harmonized, detailed product-level data. However, such comprehensive cross-country information is difficult to obtain. Accordingly, I limit the analysis to Korea, where relatively rich, disaggregated industry data exist. Accordingly, the analysis henceforth abstracts from country-level effects (i.e., importer-exporter effects). I then apply this framework to Korea's exports to the United States and China, abstracting from exports to the rest of the world in order to focus on the trade war impacts specific to Korea's two largest markets.

1. Determinants of Tariff Elasticities

Before discussing the determinants of tariff elasticities, I restate the expression from the theoretical model. Adapting Equation (1) specifically to the U.S. market ($n = \mathrm{US}$) gives the following:

$$\beta_{1i\omega}^{\mathrm{US}} \equiv \left(1 + \frac{E_{\omega}^{\mathrm{US}}}{E_{\omega}} \frac{\dfrac{b_i^{j}\sigma_{ii}^{j}}{X_{i\omega}/E_{\omega}}}{1 - \dfrac{b_i^{j}\sigma_{ii}^{j}}{X_{i\omega}/E_{\omega}}} \right) \frac{\sigma_{\mathrm{CH}i}^{j}}{s_{i\omega}^{\mathrm{US}}} \tag{1′}$$

Below, I focus on the factors of $\beta_{1i\omega}^{\mathrm{US}}$. An analogous discussion applies to the factors of $\beta_{2i\omega}^{\mathrm{CH}}$. For clarity, the following narrative specifically refers to the case of Korea ($i = \mathrm{KR}$).

Tariff elasticity toward the U.S. measures how Korea's exports of product ω to the United States respond to U.S. tariffs on Chinese varieties. It incorporates three trade-pattern variables – the U.S. share of global consumption of ω ($E_{\omega}^{US}/E_{\omega}$), the share of Korea's exports in global consumption ($X_{i\omega}/E_{\omega}$), and Korea's share in U.S. consumption ($s_{i\omega}^{US}$). In addition, two structural parameters are key: the elasticity of substitution between Chinese and Korean goods ($\sigma_{\mathrm{CH}i}^{j}$), reflecting demand-side substitutability, and the slope of Korea's industry-j supply curve (b_i^{j}), capturing

the supply-side structure.[4]

We consider demand-side factors first. Economic theory offers two opposing predictions regarding the role of the technological level in determining the elasticity of substitution with respect to Chinese products, σ_{CHi}^{j}. On one hand, differentiated and specialized goods – characteristic of high-tech industries – tend to have lower elasticities of substitution because consumers are less likely to switch between products even when prices diverge.[5] On the other hand, Korean high-tech producers are especially competitive in industries such as semiconductors, displays, and batteries. Therefore, a price increase for Chinese varieties could shift demand significantly toward Korean suppliers, which are more competitive than suppliers from other countries. Consequently, the net effect of technological sophistication on σ_{CHi}^{j} is theoretically ambiguous.

The level of U.S. tariffs imposed on Korean products also influences market access. Relatively low tariff rates on Korean varieties reduce their effective prices in the U.S. market, thereby improving Korea's ability to capture substitution-driven demand arising from U.S. tariffs on Chinese goods.

Now, we turn to supply-side factors. In Equation (1′), b_i^j denotes the slope of exporter *i*'s industry-*j* supply curve. When $b_i^j < 0$, expanding output lowers prices, indicating the presence of economies of scale.[6] In such industries, an increase in demand in one market (for example, the U.S.) lowers costs, thereby promoting further production and additional demand – both domestically and in third-country markets – thus creating a positive feedback loop.

Economies of scale can arise from multiple sources. Capital-intensive industries face large fixed and sunk costs but relatively low marginal costs; yet once capacity is reached, further expansion requires costly new investments. Consequently, economies of scale in capital-intensive industries may arise only after substantial prior investments. Export-expansion costs – such as market research, the development of new distribution channels, and logistics and infrastructure expenses – are also important. Industries well integrated into global trade networks face lower such costs, leading to economies of scale when expanding exports.[7]

2. Data

I obtain industry-level characteristics from the Industrial Statistical Analysis System (ISTANS). ISTANS offers two key advantages. First, by harmonizing data – from the Census of Mining and Manufacturing to the Korea Development Bank's

[4]The remaining term is σ_{ii}^{j}, which corresponds to the own-price demand elasticity (typically negative). It amplifies the effect of b_i^j with regard to the sign and magnitude of export elasticity.

[5]The most extreme example of the opposite – i.e., minimally differentiated products – includes crude oil or base metals, which are fully standardized commodity groups.

[6]Fajgelbaum *et al*. (2024) show in their Appendix that b_i^j is composed of production factor supply elasticity and returns to scale.

[7]Additional drivers of economies of scale include technological progress, efficiency gains, and supportive government policies.

TABLE 1—ISTANS CLASSIFICATION OF MANUFACTURING INDUSTRIES

Code	Industry	Code	Industry
I31	**High-Tech Industries**	**I33**	**Lower-Mid-Tech Industries**
I3101	Pharmaceuticals	I3301	Petroleum Refining
I3102	Semiconductors	I3302	Rubber
I3103	Displays	I3303	Plastics
I3104	Computers	I3304	Glass
I3105	Telecom. Equipment	I3305	Ceramics
I3106	Home Electronics	I3306	Cement
I3107	Precision Instruments	I3307	Other Non-Metallic
I3108	Batteries	I3308	Steel
I3109	Aerospace	I3309	Non-Ferrous Metals
		I3310	Casting
		I3311	Fabricated Metal Products
		I3312	Shipbuilding
I32	**Upper-Mid-Tech Industries**	**I34**	**Low-Tech Industries**
I3201	Petrochemicals	I3401	Food & Beverage
I3202	Fine Chemicals	I3402	Tobacco
I3203	Other Electronic Components	I3403	Textiles
I3204	Electrical Equipment	I3404	Apparel
I3205	General-Purpose Machinery	I3405	Leather & Footwear
I3206	Special-Purpose Machinery	I3406	Wood Products
I3207	Automotive	I3407	Paper & Pulp
I3208	Railway Equipment	I3408	Printing
I3209	Other Transport Equipment	I3409	Furniture
		I3410	Other Manufacturing

Facility Investment Survey – on a unified industrial-classification framework, ISTANS minimizes measurement error stemming from mixed units. Second, because the dependent variable $\hat{\beta}$ is defined at the six-digit HS level, ISTANS's Level-3 industry units map cleanly onto HS codes, avoiding any 1:N or N:N matchings.[8]

Of course, one could further reduce measurement error and omitted-variable bias by using the more granular classifications available in the original Census of Mining and Manufacturing database. However, I utilize ISTANS-level data so that I can consistently employ multiple factors measured at a harmonized unit and explore suggestive evidence for subsequent work.

ISTANS industry codes are organized into seven Level-1 categories: Agriculture, Forestry, and Fisheries; Mining; Manufacturing; Electricity, Gas, Steam, and Water

[8] ISTANS Level 3 includes 40 manufacturing industries: automobile; shipbuilding; railway rolling stock; aviation; other transport equipment; general-purpose machinery; special-purpose machinery; precision instruments; electrical equipment; food and beverages; tobacco; apparel; leather and footwear; printing; furniture; other manufacturing; home appliances; telecommunications equipment; computers; semiconductors; displays; batteries; other electronic components; steel; nonferrous metals; casting; fabricated metal products; petrochemicals; fine chemicals; pharmaceuticals; textiles; rubber; plastics; petroleum refining; paper; wood products; ceramics; cement; glass; and other non-metallic minerals. ISTANS also defines 20 service-industry categories, but they are not included in this analysis.

Supply; Wastewater Treatment and Resource Recycling; Construction; and Services. The Manufacturing and Services categories are further subdivided into Level-2 and Level-3 units – 40 Level-3 categories for Manufacturing and 20 for Services. This study restricts attention to the manufacturing sector.

Table 1 presents the Level-2 (in bold) and Level-3 classifications for manufacturing industries. All monetary variables are expressed in million KRW at 2017 constant prices.[9]

a. Tariff Elasticities toward the U.S. and China

First, the dependent variable is product-level tariff elasticity.[10] The average elasticity toward the United States for Korean goods is 0.763 – among the highest in the sample – while the average elasticity toward China is -0.364, placing Korea near the sample median.

Figure 1 illustrates the distribution of Korea's product-level tariff elasticities toward the United States and China. Both distributions are notably broad, reflecting considerable heterogeneity in substitution responses across products even within a single exporting economy. The negative mean elasticity toward China is not driven by a few extreme values but by the overall distribution, indicating that for most products, U.S. tariffs on Chinese goods tend to suppress Korean exports to China.[11]

[9] I used the manufacturing Producer Price Index provided by ISTANS to deflate monetary values.

[10] I use the exporter-product-level tariff elasticity estimates from Fajgelbaum *et al*. (2024). These are constructed as the sum of (i) exporter-level betas, (ii) industry-level betas, and (iii) exporter-product-level terms, with the last component determined by trade-pattern values for each destination (U.S., China, or the rest of the world). Readers should not confuse this with the industry-level betas (β_s from Fajgelbaum *et al*. (2024)), which are common across exporters and do not capture the specific export adjustments experienced by Korean industries. Relying on (β_s) alone would be inappropriate, since the outcomes of interest are actual export changes, which are reflected only in the total elasticity values. Accordingly, I use the total beta estimates but isolate the components relevant to Korean industries by either residualizing out the Korea-product-level trade-pattern variables or including them directly in the regressions.

[11] Among the 4,422 U.S. product lines subject to Chinese tariffs in 2018–19, an estimated 3,514 lines exhibited negative export-substitution elasticities.

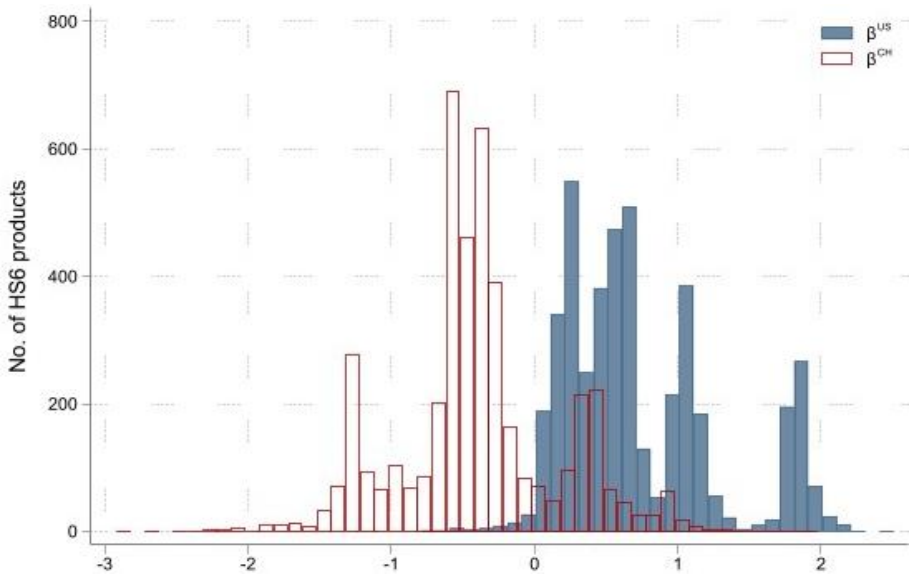


FIGURE 1. TARIFF ELASTICITIES TOWARD THE U.S. AND CHINA (PRODUCT-LEVEL, KOREA)

Note: The histogram's bin width is 0.1, and the figure includes only products subject to tariffs during the U.S.–China trade war.

Source: Author's calculations based on data from Fajgelbaum *et al*. (2024).

b. Demand-Side Factors

Technological Level

I use the ISTANS Level-2 classification to proxy technological level. Manufacturing industries are divided into four groups – low-technology, lower-middle–technology, upper-middle–technology, and high-technology. For ease of interpretation, I construct a 1–4 categorical variable, where higher values indicate greater technological intensity (see Table 2).

In addition, I use R&D expenditure data from the ISTANS Research and Development Activity Survey to capture industry-level technological sophistication and complexity. I normalize each industry's R&D expenditures by its output, compute the 2012–17 average, and then group industries into quintiles.

TABLE 2—VALUES OF TECHNOLOGICAL LEVEL VARIABLES

Value	1	2	3	4
Meaning	Low-Tech Industries	Lower-Mid-Tech Industries	Upper-Mid-Tech Industries	High-Tech Industries

U.S. and China's Tariff Rates on Korean Products

I obtain information on U.S. and Chinese tariff rates applied to Korean goods from Fajgelbaum *et al*. (2024) using the tariff rates in effect during the 2018–19 trade war.

c. Supply-Curve-Related Factors

Capital Intensity & Investment

Capital intensity is measured as the ratio of tangible fixed assets to employment using ISTANS data on fixed assets values and number of employees.[12] I calculate the 2012–17 average for each industry and group them into quintiles.

Industry-level facility-investment figures come from ISTANS's "Facility Investment by Industry and Investment Motive" tables. Because these data distinguish among different investment motives, I focus on investments aimed at expanding export-production capacity levels. To capture ex-ante investment intensity, I sum each industry's relevant facility investments in 2016 and 2017. This represents another advantage of the ISTANS dataset, as the original Census of Mining and Manufacturing database does not provide such detailed information on investment motives.

Export Intensity

I measure an industry's integration into the global trade system as the ratio of exports to total output. Output comes from ISTANS's Census of Mining and Manufacturing, and export data are from official trade statistics. Because export intensity is an industry-level characteristic, I compute its six-year average over 2012–17 and categorize industries into quintiles.

d. Trade-Pattern Factors

For each six-digit HS product ω, I construct three trade-pattern variables: the destination market's share of global consumption ($E_{\omega}^{\ n} / E_{\omega}$), the share of Korea in the global consumption of ω ($X_{KR\omega} / E_{\omega}$), and Korea's share within market n ($s_{KR\omega}^{\ n}$). The destination markets include the U.S. and China ($n = \{US, CH\}$). These are calculated from the country–product export values in Fajgelbaum *et al*. (2024). Defined at the export-market × HS 6-digit level, they capture the heterogeneity

TABLE 3—VARIABLES

Category	Variable	Definition	Unit
Elasticity of Substitution	Technology Level	Four categories	1–4
	R&D / Output	Quintiles of 2012–17 averages	1–5
	$\ln(1+\text{Tariff}_{KR})$	2018–19 average	
Supply Curve	Capital Intensity	Quintiles of 2012–17 averages	1–5
	$Investment_{t-1}$	Total in 2016–17	Million KRW
	Export Intensity	Quintiles of 2012–17 averages	1–5

[12]Both fixed assets and the number of employees are originally from the Census of Mining and Manufacturing.

of $\hat{\beta}$ across products within each industry.

Table 3 provides definitions of the dependent and explanatory variables used in the analysis.

3. Descriptive Patterns

One of the hypotheses is that supply-side factors shape the variation in tariff cross-elasticities. To examine this relationship, I present scatterplots of β^{US} and β^{CH} against capital intensity and export intensity respectively in Figure 2 and Figure 3. The tariff elasticities on the y-axis are residuals obtained after regressing the raw estimates on trade-pattern control variables, allowing us to focus on variations explained by industry traits. These elasticities are calculated as the weighted averages of product (HS6)-level estimates, using pre-war export shares to each market as weights, and are aggregated to the ISTANS-3 industry level.

The scatterplot between capital intensity and tariff cross-elasticities in Figure 2 indicates an overall positive association in both the $n=US$ and $n=CH$ cases. Industries with higher capital intensity tend to display larger cross-elasticities, suggesting that capital-intensive industries are more responsive to trade war shocks. This pattern is also more notable for the case of tariff elasticities with respect to Chinese tariffs imposed on U.S. goods.

The scatterplots using export intensity, however, point to a different pattern. For the U.S. case, the relationship between export intensity and the beta estimates is negative, indicating that industries more reliant on exports overall tend to exhibit weaker cross-elasticities toward the United States when export intensity alone is considered against tariff elasticities. In contrast, for the China case, the relationship

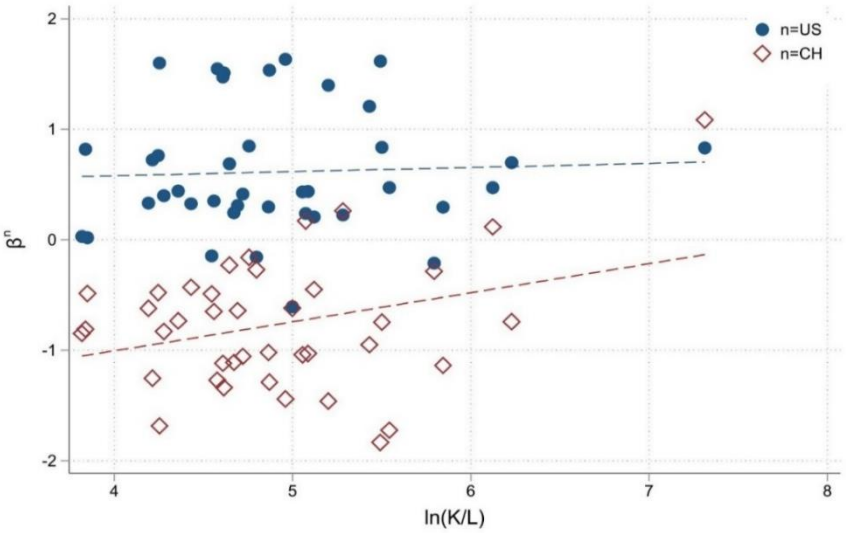


FIGURE 2. CAPITAL INTENSITY AND TARIFF ELASTICITIES

Source: Author's calculations based on ISTANS and Fajgelbaum *et al.* (2024) data.

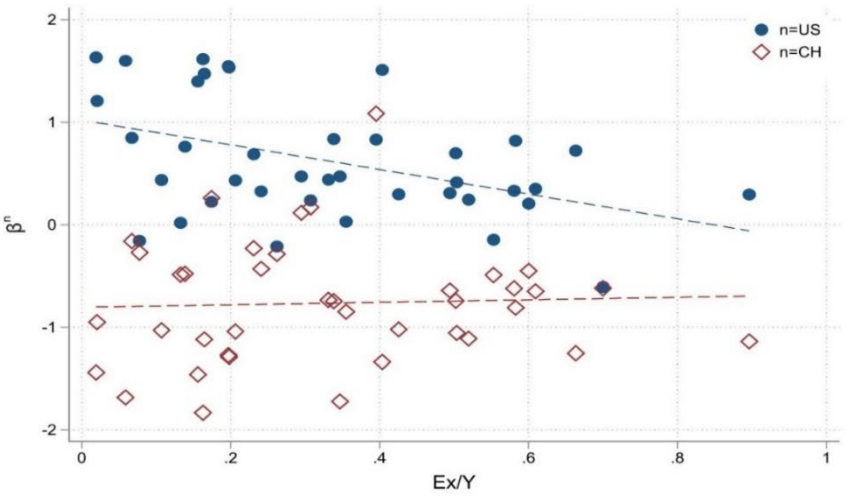


FIGURE 3. EXPORT INTENSITY AND TARIFF ELASTICITIES

Note: The "Computers" industry (3104), with an export intensity value of 2.18, is dropped from the graph.

Source: Author's calculations based on ISTANS and Fajgelbaum *et al.* (2024) data.

is slightly positive, suggesting that greater export orientation is associated with somewhat stronger cross-elasticities toward China. These contrasting results imply that export intensity does not have a uniform relationship with tariff responses.

In Appendix Table B1, I report the average $\hat{\beta}$ estimates – residuals after controlling for trade-pattern variables and aggregated to the ISTANS-3 level by (export value) weighted averages – together with capital intensity, export intensity, and prior investment for each industry, so that readers can see the underlying value levels.[13]

4. Empirical Specification

While the previous subsection documented simple correlations between industry-level characteristics and tariff elasticities, I now turn to a regression framework that separates their respective contributions and formally evaluates how these characteristics are linked to tariff cross-elasticities. Specifically, I estimate the following linear regression model:

$$\beta_{\omega}^{n} = \gamma_0 + \gamma_1 D_{\omega}^{n} + \gamma_2 S_{\omega}^{n} + \gamma_3 X_{\omega}^{n} + \delta^{n} + \varepsilon_{\omega}^{n} \tag{3}$$

[13]Several patterns emerge from the industry-level beta averages. Sectors with the highest β^{US} values include non-metallic minerals (glass, ceramics, cement), petrochemicals, and plastics, which are relatively capital-intensive, with some having a high level of prior investments. Export-oriented high-tech industries such as semiconductors, displays, and computers also show positive β^{US} values, though of smaller magnitude, highlighting the importance of export readiness. In contrast, most industries record negative β^{CH} values despite being capital-intensive, reflecting limited substitution opportunities under Chinese retaliation. Only a few exceptions – such as pharmaceuticals and petroleum refining – show positive responses.

Here, the superscript n denotes the export market (either the United States or China), and the subscript ω denotes the HS 6-digit product line. In principle, the specification should also include the subscript i = KR, indicating Korea as the exporting country. However, given that the empirical analysis involves only one exporter, I omit this subscript except when necessary to avoid confusion. D_{ω}^{n} includes demand-side variables, including the industry's technological level and the tariff rates imposed by the United States or China on Korean products. S_{ω}^{n} includes supply-side variables, specifically capital intensity, pre-trade war investment expenditures, the interaction of these two factors, and export intensity. Note that the demand- and supply-side variables are measured at the ISTANS Level-3 classification, which corresponds to multiple HS 6-digit product codes.[14]

The vector X_{ω}^{n} includes trade-pattern variables defined at the HS 6-digit product level. Lastly, δ^{n} denotes destination-market fixed effects. It is important to note that the estimated coefficients should be interpreted as partial correlations between the explanatory variables and the tariff elasticities.

5. Empirical Results

Table 4 reports descriptive statistics of the sample. Although the empirical analysis employs quintile indicators (1–5) for the ratios of R&D to output, capital intensity, and export intensity, the actual numerical cutoff values for these quintiles are also presented for reference and interpretability.

Table 5 presents estimates of Equation (3), showing only the demand- and supply-side covariates for readability. Column (3), which has both demand- and supply-side variables, presents the main specification. First, the tariff rate applied to each Korean product has a negative coefficient, indicating that higher import tariffs on Korean goods are associated with lower cross-elasticities. This aligns with the idea that Korean exporters may face competitive disadvantages in capturing substitution-driven demand if their products are subject to higher tariffs. The coefficient on the technology-level variable is positive: a one-category increase in technology level is associated a 0.067 increase in $\hat{\beta}$. This implies that, conditional on a 1 percent increase in the U.S. (China) tariff on Chinese (U.S.) goods, industries one technology level higher experienced a greater increase by 0.067 percentage points in Korea's exports to the U.S. (China) than did industries one level lower.[15]

[14]It is important to clarify that the industry level analyzed in this section – comprising 40 industries – differs from the "sector" level used in the Fajgelbaum *et al*. (2024) framework. Specifically, tariff elasticities can be decomposed as $\beta_{i\omega}{}^{n} = \beta_{i}{}^{n} + \beta_{j(\omega)}{}^{n} + \Gamma^{n} SIZE_{i\omega}{}^{n}$, where ω denotes the product and j(ω) the corresponding sector. Fajgelbaum *et al*. (2024) classify products into nine sectors, whereas my dataset distinguishes 40 industries, which are therefore more disaggregated. This difference is not problematic, however, as I focus here on total tariff elasticity rather than isolating only the industry component $\beta_{j(\omega)}{}^{n}$. The additional variation arising from a finer industry classification is absorbed into the last two terms of the decomposition.

[15]Tariff elasticity ($\hat{\beta}$) denotes the percentage increase in exports resulting from a 1 percent increase in the tariff rate; a value that is 0.067 higher implies greater export growth by 0.067 percentage points.

TABLE 4—SUMMARY STATISTICS

Category	Variable	N	Mean	St.D.	Min	Max
Dependent Variable	$\hat{\beta}$	9,052	0.155	0.774	–2.921	2.429
Trade Pattern	$X_{i\omega}/E_{\omega}$	9,052	0.026	0.051	0	0.948
	$E_{\omega}^{n}/E_{\omega}$	9,052	0.089	0.108	0	0.978
	$s_{i\omega}^{n}$	9,052	0.05	0.109	0	1
Elasticity of Substitution	Technology Level	9,052	2.076	1.043	1	4
	R&D/Output	9,044	0.019	0.019	0.003	0.137
	R&D/Output (Quintile)	9,044	2.767	1.471	1	5
	$\ln(1+Tariff_{KR})$	9,052	0.047	0.052	0	0.664
Supply Curve	Capital Intensity	9,052	185.272	183.86	45.532	1,498.85
	Capital Intensity (Quintile)	9,052	2.79	1.514	1	5
	$\ln(Investment_{t-1})$	9,052	12.167	2.356	4.605	17.399
	Export Intensity	9,052	0.357	0.221	0.019	2.177
	Export Intensity (Quintile)	9,052	2.899	1.323	1	5

Note: The low-technology group includes 3,739 observations; the lower-middle-technology group, 1,717; the upper-middle-technology group, 2,703; and the high-technology group, 863.

Source: Author's calculations.

TABLE 5—RESULTS OF THE CORRELATIONS WITH TARIFF ELASTICITIES ($\hat{\beta}$)

Dependent variable: $\hat{\beta}$	(1)	(2)	(3)
$\ln(1+Tariff_{KR})$	-0.289**		-0.249**
	(0.122)		(0.114)
Tech Level	0.092***		0.067***
	(0.005)		(0.006)
Capital Intensity		0.063*	0.069**
		(0.032)	(0.033)
$\ln(Investment_{t-1})$		0.009***	-0.003
		(0.003)	(0.003)
Capital Intensity × $\ln(Investment_{t-1})$		0.002	0.001
		(0.002)	(0.002)
Export Intensity		0.027***	0.010**
		(0.004)	(0.004)
No. of Observations	9322	9240	9052
Within R-squared	0.065	0.102	0.116

Note: All columns include the trade-pattern variables ($X_{i\omega}/E_{\omega}$, $E_{\omega}^{US}/E_{\omega}$, $s_{i\omega}^{US}$) and exporter–country (U.S. or China) fixed effects; for readability, their coefficients are omitted from the table. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively. Robust standard errors are shown in parentheses.

Source: Author's calculations

Column (3) shows that capital intensity is significantly positively correlated with tariff elasticity. While the interaction term between capital intensity and pre-war investment is positive, it is not statistically significant. This indicates that among capital-intensive industries, differences in prior investment did not significantly affect the corresponding tariff elasticities. Lastly, export intensity shows a positive and statistically significant relationship with $\hat{\beta}$. Specifically, a one-quintile increase in the export-to-output ratio corresponds to tariff elasticity that is 0.01 percentage point higher for exports toward the U.S. or China.

The full set of estimates including the trade-pattern variables $\left\{E^n_\omega / E_\omega, X_{KR\omega} / E_\omega, s^n_{KR\omega}\right\}$ is reported in Appendix Table B2. In addition, Appendix Table B3 presents the results when replacing the technology-level indicator with the R&D-to-output variable.

In summary, these results demonstrate that the impact of U.S.–China tariff changes on Korea's exports varied significantly depending on the industry characteristics. Tariff elasticities are substantially higher for products facing lower tariffs in the destination markets and for industries characterized by higher technological levels. Moreover, industries with greater capital intensity and higher export intensity levels exhibit greater tariff elasticities. This pattern supports the hypothesis that industries better able to realize economies of scale through production and export expansion were better positioned to grow in the U.S. or Chinese markets.

Before concluding this section, I want to emphasize that one should be cautious when interpreting the role of each factor. Although each explanatory variable has been categorized as either "demand-side" or "supply-side" for clarity, these labels are intended primarily to elucidate the potential major economic roles the variables may embody. However, certain variables may simultaneously influence both demand- and supply-side dimensions. For example, capital intensity – while treated here as a supply-side factor related to economies of scale – may also correlate with unobserved industry attributes that affect substitution elasticities directly. Thus, one cannot rule out the potential that the observed positive association between capital intensity and $\hat{\beta}$ reflects omitted demand-side factors rather than mechanisms solely pertaining to economies of scale.

III. Impact of the U.S.–China Trade War on Korean Industries

In Section II, I analyzed how bilateral tariff changes during the U.S.–China trade war affected Korea's exports to the United States and China (captured by tariff elasticities) and identified the industry characteristics most strongly correlated with these elasticities. In particular, I demonstrated that tariff elasticities vary significantly according to demand-side substitutability with Chinese or American products and factors related to economies of scale on the supply side.

Building on these findings, this section investigates in more depth how Korean industries were affected by the U.S.–China trade war using more detailed industry-level data. Specifically, I examine how various measures of industrial activity responded to the tariff shocks, with a primary focus on supply-side characteristics

related to economies of scale. These factors are particularly important given that they represent levers that firms and governments can utilize relatively directly and quickly in response to external economic shocks. Analyzing the role of demand-side factors – such as trade barriers and technological levels of exporting industries – remains an important direction for future research.

In sum, the key questions are as follows: Did industries predicted to benefit from economies of scale actually experience expanded production and reduced unit costs? Likewise, did industries with high export intensity levels – and correspondingly high tariff elasticities – successfully leverage the trade war as an opportunity for growth? To answer these questions, first I measure each industry's exposure to tariff changes and then examine empirically how industry-level outcomes responded to this exposure, relying on more disaggregated Korean industry data.

A. *Measurement and Data*

The analysis is based on KSIC 5-digit manufacturing industries. Appendix Table B4 lists the 2-digit industry classifications and reports the number of 5-digit industries included under each.

1. U.S.–China Trade War Shock

This analysis employs a difference-in-differences framework to assess whether changes in industrial activity vary with the intensity of the U.S.–China tariff shock. At the industry level, I define the treatment shock as the product of each industry's exposure to a given market ($n = \{US, CH\}$) and the log difference in that market's tariff on the other. Formally, this is expressed as follows:

$$\begin{aligned} Shock_i^{US} &= Expos_i^{US} \times \Delta \ln T_{CH}^{US} \\ Shock_i^{CH} &= Expos_i^{CH} \times \Delta \ln T_{US}^{CH} \end{aligned} \tag{4}$$

with $i = KR$ throughout the section.

Here, $Expos_i^n$ measures industry *i*'s pre-treatment exposure to the U.S. or Chinese market. To avoid endogeneity with the trade war itself, I compute exposure using 2012 data – several years prior to the 2018–19 tariffs – following the methodology of Benguria (2023) and Claessens *et al.* (2012). Exposure is defined as the share of industry i's total output in 2012 accounted for by exports to each respective market:

$$\begin{aligned} Expos_i^{US} &= Ex_{i,2012}^{US} / Y_{i,2012} \\ Expos_i^{CH} &= Ex_{i,2012}^{CH} / Y_{i,2012} \end{aligned} \tag{5}$$

The industry-specific tariff changes ($\Delta \ln T_m^n$) are obtained from Fajgelbaum *et al.* (2024).[16] Export values for 2012 are from UN Comtrade, and 2012 output ($Y_{i,2012}$) are from the Census of Mining and Manufacturing (Statistics Korea, 2024a). As the tariff and export data are reported at the HS 6-digit level and other variables in KSIC 5-digit, I map HS 6-digit codes to KSIC10 5-digit industries using the Integrated Economic Classification Concordance Table provided by the Statistics Korea Classification Portal(Statistics Korea, 2024b).

Figure 4 plots the average shock measures for each 2-digit industry, each calculated as the simple average of the corresponding underlying 5-digit industry value. This provides a clear picture of which industries were most exposed to tariff actions. Several observations emerge. First, the dispersion and magnitude of shocks are greater for Shock_{CH} than for Shock_{US}, indicating that Chinese tariff changes on U.S. goods generated larger and more heterogeneous shocks to Korean manufacturing industries. Second, some industries were hit by sizable shocks from both tariff measures – for example, metals (24) and electrical equipment (28) – while many industries cluster near the origin, reflecting relatively modest exposure to either tariff action. Third, industries such as refined petroleum (19) and computers and semiconductors (26) stand out with disproportionately high Shock_{CH} values relative to Shock_{US}, underscoring the asymmetry of trade-war impacts. In contrast, the fabricated metals (27) industry shows a relatively higher Shock_{US} value.

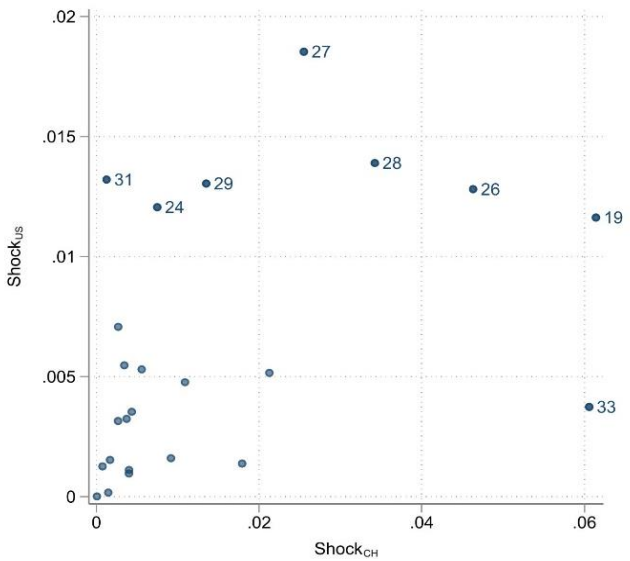


FIGURE 4. SHOCK VARIABLES

Source: Author's calculations based on Census of Mining and Manufacturing and Fajgelbaum *et al*. (2024) data.

[16]If $n = \text{US}$, then $m = \text{CH}$, and vice versa.

2. Korean Industry Activities

The primary objective of this analysis is to provide a comprehensive understanding of how the trade war shock affected Korean industries by examining changes across various dimensions of industrial activity. To this end, I utilize data from the Census of Mining and Manufacturing, which covers a broad set of industrial activities. Specifically, I use measures of scale (such as output and value added) and input factors (such as capital, investment, and employment). Additionally, I construct a unit cost variable by dividing total production costs by output. All changes in these industrial measures are calculated as log differences between the pre-treatment (2016–17) and post-treatment (2018–19) periods.

To capture pre-existing industry characteristics associated with increasing returns or economies of scale (as discussed in Section II), I measure each industry's capital intensity, pre-war investment level, and export intensity using their averages over the 2012–15 period. Using values from the pre-war period (2012–15) mitigates potential endogeneity concerns by ensuring that these industry characteristics were not influenced by the tariff shocks or any subsequent changes between 2016-17 and 2018-19.

TABLE 6—VARIABLES

Variable	Definition	Unit
$Shock_{US}$	$Expos_{US} \times \Delta \ln T_{CH}^{US}$	
$Expos_{US}$	Exports to the US/output(2012)	
$\Delta \ln T_{CH}^{US}$	$T_{CH}^{US} = 1 + t_{CH}^{US}$	
$Shock_{CH}$	$Expos_{CH} \times \Delta \ln T_{US}^{CH}$	
$Expos_{CH}$	Exports to China/output(2012)	
$\Delta \ln T_{US}^{CH}$	$T_{US}^{CH} = 1 + t_{US}^{CH}$	
Δ ln(output)	Difference between 2016-17(T-1) and 2018-19(T)	ln(million KRW)
Δ ln(VA)		ln(million KRW)
Δ ln(average output)		ln(million KRW)
Δ ln(average VA)		ln(million KRW)
Δ ln(employees)		ln(number of persons)
Δ ln(fixed assets)		ln(million KRW)
ln(investment)		ln(million KRW)
Δ (production costs/output)		
Capital intensity (K/L)	Fixed assets/employees (2012-15)	Million KRW/person
Prior investment	Investment/fixed assets (2012-15)	
Export intensity (Ex/Y)	Exports/output (2012-15)	

Table 6 summarizes the definitions and measurement units for all key variables.[17] The analysis is restricted to manufacturing industries for which detailed 5-digit data are available. All monetary variables are expressed in millions of Korean won, adjusted to 2017 constant prices.[18] Throughout this section, I again omit the exporter subscript ($i = KR$) for simplicity.

B. *Model Specification*

The average-effect specification is given by

$$\Delta Y_s = \alpha_0 + \alpha_1 Shock_s^{US} + \alpha_2 Shock_s^{CH} + \Delta Y_{s,T-1} + \eta_{I(s)} + \varepsilon_s. \quad (6)$$

Here, ΔY_s denotes the change in outcome Y for industry s between 2016–17 and 2018–19 (i.e., $\Delta Y_{s,T} = Y_{s,T} - Y_{s,T-1}$), while $\Delta Y_{s,T-1}$ is the lagged difference between 2014–15 and 2016–17. The term $\eta_{I(s)}$ represents fixed effects at the KSIC 2-digit level, and ε_s is the idiosyncratic error.

This specification estimates how the intensity of U.S. and Chinese tariff shocks affected industry-level outcomes (Y). It can be viewed as a variant of the differences-in-differences (DiD) framework. The coefficient α_1 captures the average effect of the trade shock caused by the U.S. tariffs on Chinese goods on Korean industry outcomes, while α_2 captures the impact of the shock resulting from Chinese tariffs on U.S. imports.

Identifying α_1 and α_2 requires three key assumptions. First, the trade-war shock – or the treatment – must be exogenous. Second, treated and control industries must satisfy a parallel-trends condition in the absence of a shock. Third, there must be no omitted confounding variables.

The exogeneity of the shock requires both elements of $Shock_s^n$ – specifically, (a) changes in U.S.-China bilateral tariffs and (b) the degree of pre-war exposure to the U.S. or Chinese market of industry s – to be exogenous with respect to the error term. Tariff changes in the U.S.-China trade war are widely considered exogenous geopolitical events and have been extensively used as treatment variables in numerous DiD analyses in the literature (Fajgelbaum *et al*., 2020; Amiti *et al*., 2019).

[17] All key variables constructed from the Census of Mining and Manufacturing adhere to the definitions employed in that survey. Specifically, "Production" refers to the annual production value reported in the survey, and "Value Added" (VA) denotes the value added reported therein. "Average Production" and "Average VA" are computed by dividing total Production and total VA, respectively, by the number of establishments. "Employment" is measured as the total number of persons engaged, including full-time wage employees, temporary and daily workers, self-employed persons, unpaid family workers, and other categories of workers. "Fixed Assets" refers to the year-end book value of tangible assets—specifically land; buildings and structures; machinery and equipment; ships, vehicles, and transport equipment; tools, instruments, and fixtures; and assets under construction. "Investment" is taken as the gross fixed-asset investment reported in the survey. The change in year-end fixed-asset balances equals gross investment less completed construction additions, asset retirements, and depreciation. "Production Costs" encompass the survey's major cost components—raw-material costs, fuel costs, electricity costs, water costs, subcontracting costs, and repair costs—i.e., all expenses incurred in the course of production. For further detail on any of these series, readers can refer to the official report of the Census of Mining and Manufacturing.

[18] I used the manufacturing producer price index provided by ISTANS for deflation.

While perfect exogeneity of market exposure – the second element – cannot be guaranteed, using pre-war values helps mitigate potential endogeneity concerns between exposure and subsequent industry outcomes.

Moreover, to ensure that the DiD estimates capture the causal impact of the shock, there must be no anticipation effects. Existing studies have documented that the timing, scope, and targeted tariff lines were difficult to anticipate, and no significant pre-trends were observed among the treated tariff lines.[19] Similarly, I conduct a simple event study and confirm no significant pre-treatment shifts in industry activities during 2016–17.

Because most 5-digit KSIC10 industries are treated, a clear control group is not available for a direct pre-trend comparison. Therefore, I control for industry-specific trends by including the lagged dependent variable. Time-invariant characteristics at the 5-digit industry level are differenced out, and 2-digit fixed effects absorb changes common to broader industry groups, further mitigating omitted-variable bias.

C. *Results*

1. Descriptive Statistics

TABLE 7—SUMMARY STATISTICS

Variable	N	Mean	St.D.	Min	Max
$Shock_{US}$	445	0.007	0.019	2.15×10^{-9}	0.169
$Expos_{US}$	445	0.064	0.155	5.44×10^{-7}	1.520
$\Delta \ln T_{CH}^{US}$	445	0.096	0.062	6.76×10^{-8}	0.305
$Shock_{CH}$	445	0.015	0.062	0	0.952
$Expos_{CH}$	445	0.131	0.402	2.41×10^{-7}	4.685
$\Delta \ln T_{US}^{CH}$	445	0.119	0.052	0	0.439
ln(output)	444	-0.009	0.250	-1.543	2.001
Δ ln(VA)	443	-0.006	0.272	-2.220	2.155
Δ ln(average output)	444	-0.013	0.213	-1.212	1.852
Δ ln(average VA)	443	-0.010	0.241	-2.032	2.006
Δ ln(employees)	444	-0.002	0.189	-0.767	1.739
Δ ln(fixed assets)	444	0.029	0.289	-1.036	2.014
ln (investment)	443	11.528	1.665	4.683	17.430
Δ (production costs/output)	444	-0.004	0.046	-0.383	0.250
Capital intensity (K/L)	445	147.789	186.559	6.676	2586.852
Prior investment	445	0.180	0.064	0.023	0.461
Export intensity (Ex/Y)	445	0.598	1.371	1.44×10^{-6}	12.705

Note: Prior investment is measured as the ratio of investment to fixed assets during 2012-15.

Source: Author's calculation.

Before turning to the regression results, first I present descriptive statistics and

[19]For instance, Fajgelbaum *et al*. (2020) demonstrate, via an event study, that there was no tariff-anticipation effect.

stylized patterns of the key variables. Table 7 reports the summary statistics. First, examining $\Delta \ln T_{CH}^{US}$ and $\Delta \ln T_{US}^{CH}$ reveals that while all manufacturing industries experienced increased U.S. tariffs on Chinese imports, China did not impose tariffs on U.S. products in certain industries. Both countries imposed additional tariff rates up to approximately 30–44 percent across industries[20]. The exposure measures (Expos^{US} and Expos^{CH}) show that, on average, Korean industries exported 6.4 percent and 13.5 percent of their total output to the U.S. and China, respectively.[21]

Another notable feature is that most industry-level activities declined on average during the U.S.–China trade-war period. This decline likely reflects the broader slowdown not only in the global economy – including the U.S. and Chinese markets – but also in Korea's domestic demand. Moreover, Cheong and Seo (2024) suggest that the U.S. tariffs on Chinese goods may have prompted China to increase exports to Korea, potentially exerting adverse effects on Korean firms.

I also examine whether the sample contains sufficient variation, given the relatively limited sample size. Figures 5 and 6 present kernel density plots for two outcome variables – $\Delta \ln \text{Output}$ and $\Delta \ln \text{VA}$ – and two shock variables. While the outcome variables display ample variation, the shock variables are more concentrated around small values.

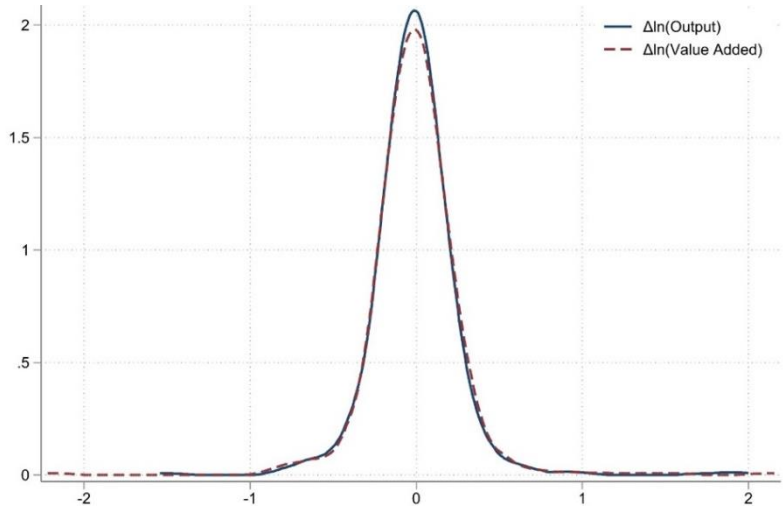


FIGURE 5. KERNEL DENSITY FOR SIZE OUTCOME VARIABLES

Note: The curve shows the kernel density of the data.

Source: Author's calculations based on the Census of Mining and Manufacturing.

[20]To be precise, it is a 0.305- 0.439 log difference.

[21]In certain industries, the exposure share exceeds one (both Expos_i^{US} and Expos_i^{CH} attain maximum values above unity). This arises in processing-component industries where firms import parts for further processing and then export the finished components abroad. For instance, in 2013 the automobile remanufactured parts manufacturing industry (KSIC10 = 30400) reported export values that far surpassed its shipment values. Moreover, because export and production data are recorded at different points in time, it is possible for export revenues to exceed measured production output.

FIGURE 6. KERNEL DENSITY FOR SHOCK VARIABLES

Note: The curve shows the kernel density of the data.

Source: Author's calculations based on the Census of Mining and Manufacturing and Fajgelbaum *et al*. (2024) data.

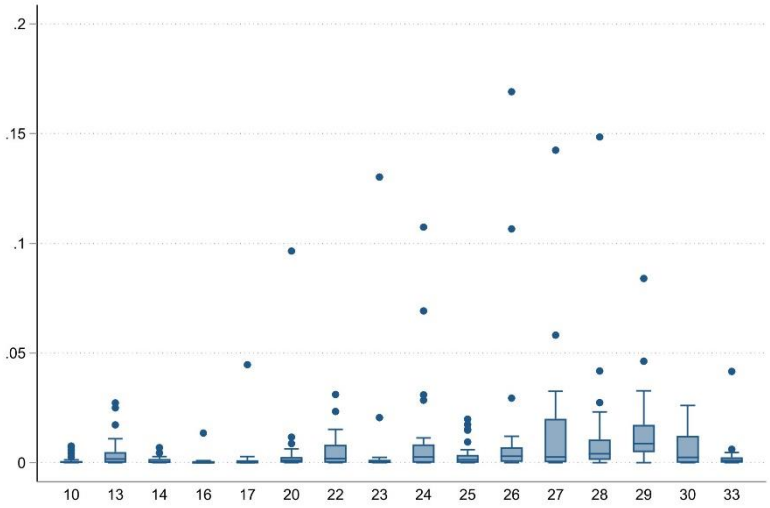


FIGURE 7. WITHIN VARIATION OF Shock^{CH}

Note: The figure includes the 2-digit industries that have at least ten observations of 5-digit industries. Boxes show the median and interquartile range (25th-75th percentiles); whiskers extend to furthest points within 1.5×IQR from box edges; dots represent outliers beyond whiskers.

Source: Author's calculations based on the Census of Mining and Manufacturing and Fajgelbaum *et al*. (2024) data.

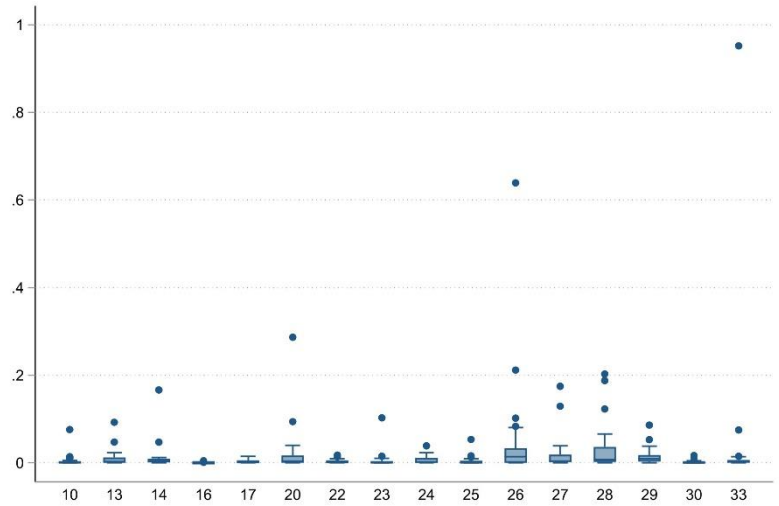


FIGURE 8. WITHIN VARIATION OF Shock^{CH}

Note: The figure includes the 2-digit industries that have at least ten observations of 5-digit industries. Boxes show the median and interquartile range (25th-75th percentiles); whiskers extend to furthest points within 1.5×IQR from box edges; dots represent outliers beyond whiskers.

Source: Author's calculations based on the Census of Mining and Manufacturing and Fajgelbaum *et al*. (2024) data

Because the regressions include 2-digit industry fixed effects, it is important to verify that there is sufficient variation within each 2-digit industry. Figures 7 and 8 present boxplots of the two shock variables, illustrating the extent of heterogeneity across and within industries.[22] These figures reveal substantial dispersion in several 2-digit industries, supporting the identification strategy exploiting within-industry variation. I also report the coefficients of variation (calculated as the ratio of the standard deviation to the mean) for each 2-digit industry in Table B5 in the Appendix, which also indicate a reasonable degree of within-industry variation. Boxplots of outcome variables (log difference in output, VA, and average costs) are in Figures A1-A3 in the Appendix.

2. Average Effects

Table 8 reports the average effects of U.S. and Chinese tariff shocks on Korean manufacturing industries. The results indicate that U.S. tariffs on Chinese goods (Shock^{US}) are associated with increases in Korean output (column 1), with a coefficient of 1.744, significant at the 10 percent level. In contrast, the estimated average effects of Chinese tariffs on U.S. goods (Shock^{CH}) are generally indistinguishable from zero.

These patterns suggest that, on average, Korean industries benefitted modestly

[22]Only industries with ten or more observations are included.

TABLE 8—AVERAGE EFFECTS OF THE U.S.–CHINA TRADE WAR

	(1)	(2)	(3)
Dependent variable:	Δ ln(output)	Δ ln(VA)	Δ (costs/output)
$Shock^{US}$	**1.744***	1.167	0.136
	(0.993)	(1.077)	(0.256)
$Shock^{CH}$	-0.219	0.041	-0.072
	(0.264)	(0.174)	(0.059)
No. of obs.	443	442	443
Within R-sq	0.034	0.019	0.065

Note: All specifications include two-digit industry fixed effects and control for the lagged dependent variable. Standard errors clustered at the two-digit level are in parentheses. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively. Variables not explicitly shown in the table are included in the estimation but not displayed. Constant estimates are omitted from the table.

Source: Author's calculation.

from U.S. tariff measures but not from Chinese retaliation. The weak or insignificant average responses to Chinese tariffs on U.S. goods may reflect several factors: greater heterogeneity in tariff elasticities across industries, the possibility that Korean industries did not significantly adjust their exports in response to Chinese tariffs, and possibly a demand-side channel.[23]

The average estimates, however, mask potential heterogeneity of effects across industries. The next subsection explores whether this variation is systematically related to certain industry characteristics – specifically capital intensity, pre-war investment, and export intensity – that proxy for industries' ability to exploit economies of scale and their readiness to expand exports.

For completeness, Appendix Tables 6-10 report results for additional outcomes, including input use and per-firm output.[24] In what follows, I continue to report such auxiliary outcomes in the Appendix while focusing the main text on the core measures of output, value added, and costs.

Identification Check and Robustness

Finally, to ensure that the results are not driven by pre-existing trends, I estimate an event-study specification.[25] Figures 9 and 10 present the event-study estimates

[23]The demand-side aspect is reflected in the fact that the cross-elasticities with respect to Chinese tariffs are, on average, lower and more negative than those for U.S. tariffs, suggesting that Korean goods functioned more as complements to U.S. goods in the Chinese market than as substitutes. Because this demand-side channel was limited, there was also less scope for Korean industries to realize economies of scale in response to Chinese tariffs on U.S. goods. Although I do not analyze these demand-side aspects in detail in Section III, they provide another plausible explanation for the observed asymmetry.

[24]The appendix results confirm that the heterogeneous gains documented for VA, output, and costs are mirrored in adjustments in inputs and per-firm outcomes. In particular, industries able to exploit economies of scale not only increased their value added and reduced their costs but also expanded employment and capital, with per-firm growth playing a central role. These patterns provide further evidence that the key mechanism was the ability of well-positioned industries to scale up production efficiently when substitution opportunities emerged.

[25]The event-study is estimated by $\Delta Y_{s,t} = \alpha_0 + \sum_{t=T-1}^{T} \alpha_{1t} Shock_s^{US} D_t + \sum_{t=T-1}^{T} \alpha_{2t} Shock_s^{CH} D_t + \Delta Y_{s,t-1} + \eta_{l(s)}$

for the three outcomes, using Shock^{US} and Shock^{CH} as treatment variables. Across both figures, the coefficients for the pre-period are not significant, providing no evidence of differential pre-trends, which supports the validity of the identification strategy and strengthens the causal interpretation of the results.

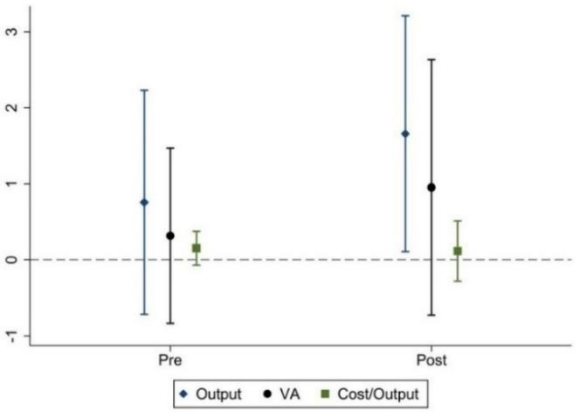


FIGURE 9. EVENT-STUDY USING Shock^{US}

Note: The graph reports estimates of α_{1t} from $\Delta Y_{s,t} = \alpha_0 + \sum_{t=T-1}^{T} \alpha_{1t} \text{Shock}_s^{US} D_t + \sum_{t=T-1}^{T} \alpha_{2t} \text{Shock}_s^{CH} D_t + \Delta Y_{s,t-1} + \eta_{I(s)} + \varepsilon_s$ where "Pre" denotes $t = T\text{-}1$ and "Post" denotes $t = T$. The band indicates the 90% confidence interval.

Source: Author's calculations

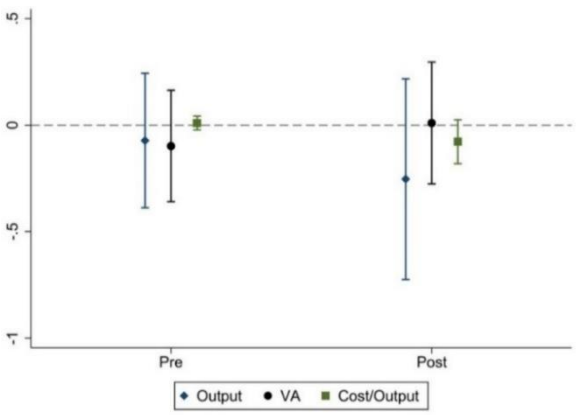


FIGURE 10. EVENT-STUDY USING Shock^{CH}

Note: The graph reports estimates of α_{2t} from $\Delta Y_{s,t} = \alpha_0 + \sum_{t=T-1}^{T} \alpha_{1t} \text{Shock}_s^{US} D_t + \sum_{t=T-1}^{T} \alpha_{2t} \text{Shock}_s^{CH} D_t + \Delta Y_{s,t-1} + \eta_{I(s)} + \varepsilon_s$ where "Pre" denotes $t = T\text{-}1$ and "Post" denotes $t = T$. The band indicates the 90% confidence interval.

Source: Author's calculations.

$+\varepsilon_s$, where $t = T-1$ indicates the pre-treatment period (capturing the change between 2014-15 and 2016-17).

TABLE 9—RESULTS FROM CONTROLLING FOR THE INCREASE IN CHINESE IMPORT PENETRATION

Dependent variable:	(1) Δ ln(output)	(2) Δ ln(VA)	(3) Δ (costs/output)
$Shock^{US}$	**1.744***	1.165	0.136
	(0.995)	(1.086)	(0.256)
$Shock^{CH}$	-0.221	0.048	-0.072
	(0.260)	(0.173)	(0.060)
$\Delta ImShare_{CH}^{KR}$	-0.026	0.098	0.002
	(0.133)	(0.147)	(0.036)
No. of obs.	443	442	443
Within R-sq	0.035	0.019	0.065

Note: All specifications include two-digit industry fixed effects and control for the lagged dependent variable. Standard errors clustered at the two-digit level are in parentheses. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively. Variables not explicitly shown in the table are included in the estimation but not displayed. Constant estimates are omitted from the table.

Source: Author's calculation.

Moreover, I conduct a robustness analysis to account for the possibility that Chinese goods manufacturers – facing restricted access to the U.S. market due to U.S. tariffs – may have sharply increased their exports to Korea through a "push-out" effect. To test this channel, I add as a control the change in China's import penetration rate in the Korean market between 2016–17 and 2018–19. As reported in Table 9, the results remain very similar to the estimates in Table 8, indicating that the observed effects are not driven by changes in Chinese export penetration into Korea.

3. Heterogeneity by Industry Characteristics

Next, I examine heterogeneous effects according to industry characteristics. To this end, I augment the average-effect model with interaction terms between the trade-war shocks and pre-war industry characteristics, as follows:

$$\begin{aligned}\Delta Y_s = {} & \mu_0 + \mu_1 Shock_s^{US} + \mu_2 Shock_s^{US} X_{s,12-15} \\ & + \mu_3 Shock_s^{CH} + \mu_4 Shock_s^{CH} X_{s,12-15} \\ & + \mu_5 X_{s,12-15} + \Delta Y_{s,T-1} + \eta_{I(s)} + \varepsilon_s\end{aligned} \tag{7}$$

As noted previously, each characteristic $X_{s,12-15}$ is measured according to its 2012–2015 industry-level average in order to mitigate potential endogeneity concerns.[26] The coefficients μ_2 and μ_4 capture how the impact of the U.S. and Chinese tariff shocks vary according to those pre-war industry traits.

[26]An industry characteristic is identical regardless of the tariff-imposing country ($n = \{US, CH\}$).

a. Heterogeneous Effects by Economies of Scale

According to the results in Section II, industries with high capital intensity and high export intensity levels – characteristics consistent with economies of scale – tended to exhibit higher tariff elasticities. To test whether such patterns hold in the more granular industry data, I classify industries based on their likelihood of experiencing economies of scale and estimate the effects of U.S. and Chinese tariffs separately for each group.

First, using the estimated elasticity values (β) gained by replicating Fajgelbaum *et al*. (2024)., I define industries as experiencing economies of scale if their estimated tariff elasticity toward the U.S., $\beta_{1,s}^{US}$, and toward the rest of the world, $\beta_{1,s}^{RW}$, are both positive. Such industries are assigned $ESI_s^{US}=1$.[27] Likewise, industries for which both $\beta_{2,s}^{CH}$ and $\beta_{2,s}^{RW}$ are positive are assigned $ESI_s^{CH}=1$. Formally, for each market $\mathrm{n}\in\{\mathrm{US},\mathrm{CH}\}$, ESI_s^n is defined as follows:

$$ESI_s^n=1\left\{\beta_s^n>0\ \&\ \beta_s^{RW}>0\right\} \tag{8}$$

Note that the notation for β has been simplified for notational convenience and readability.

Table 10 shows the share of 5-digit industries (by count) within each 2-digit industry that are assigned $ESI_s^{US}=1$ or $ESI_s^{CH}=1$. Notably, industries experienced economies of scale much more frequently in response to the U.S. tariffs imposed on China.[28] Fourteen out of 24 two-digit industries exhibit economies of scale in all of their constituent 5-digit industries, and even those with a share below one still report a high proportion with $ESI_s^{US}=1$. In contrast, a much smaller share of 5-digit industries show export changes consistent with economies of scale in response to Chinese tariffs on the United States. Overall, about 35 percent of 5-digit industries experienced economies of scale with respect to $Shock^{CH}$ compared with 85 percent for $Shock^{US}$.[29]

Looking more closely at the industry breakdown, industries such as food products (10), beverages (11), and wood and paper (16–17) record high $ESI=1$ shares under both tariff measures, though these are not typically Korea's capital- or export-intensive industries. Their high incidence likely reflects relatively small-scale and simpler cost structures, where even modest expansions can generate economies-of-scale signals. In contrast, chemicals (20), basic metals (24), and fabricated metals

[27]ESI denotes an "elasticity-based scale indicator."

[28]Again, this asymmetry likely reflects differences in tariff coverage between U.S. and Chinese tariffs.

[29]Furthermore, the overlap between ESI^{US} and ESI^{CH} is limited. Out of 445 five-digit industries, 380 are classified as $ESI^{US}=1$, but only 151 of these are also $ESI^{CH}=1$. By contrast, 62 industries are $ESI^{CH}=1$ while not showing scale responses to U.S. shocks, underscoring the asymmetry in the adjustment.

TABLE 10—SHARE OF 5-DIGIT INDUSTRIES WITH ESI=1 (COUNT-BASED)

KSIC10 2-digit		N. of 5-digits	$ESI_s^{US}=1$	$ESI_s^{CH}=1$
10	Food products	40	0.98	0.90
11	Beverages	9	0.89	1.00
12	Tobacco products	1	0.00	1.00
13	Textiles, except apparel	26	0.96	0.00
14	Wearing apparel, clothing accessories and fur articles	15	1.00	0.00
15	Leather, luggage and footwear	7	1.00	0.00
16	Wood and products of wood and cork; except furniture	13	1.00	0.92
17	Pulp, paper and paper products	17	1.00	0.94
18	Printing and reproduction of recorded media	8	1.00	0.50
19	Coke, briquettes and refined petroleum products	4	1.00	0.75
20	Chemicals and chemical products	30	0.37	0.10
21	Pharmaceuticals, medicinal chemical and botanical products	5	0.20	0.00
22	Rubber and plastics products	23	1.00	0.78
23	Other non-metallic mineral products	32	0.94	0.91
24	Basic metals	24	0.29	0.08
25	Fabricated metal products, except machinery and furniture	32	0.44	0.03
26	Electronic components, computer; visual, sounding and comm. equipment	31	1.00	0.35
27	Medical, precision and optical instruments, watches and clocks	17	1.00	0.00
28	Electrical equipment	23	0.96	0.13
29	Other machinery and equipment	42	1.00	0.10
30	Motor vehicles, trailers and semitrailers	13	1.00	0.00
31	Other transport equipment	9	1.00	0.00
32	Furniture	6	1.00	0.00
33	Other manufacturing	18	1.00	0.11

(25) – industries well known for their capital intensity – show much lower ESI shares, suggesting that capital intensity alone is insufficient to realize scale effects without prior investment or slack capacity. Korea's export-oriented and technologically advanced industries, including electronics (26), electrical equipment (28), and machinery (29), display nearly universal $ESI^{US}=1$ responses but far lower $ESI^{CH}=1$ shares. Finally, it should be emphasized that this discussion of the 2-digit level is intended to provide intuition with regard to the distribution of ESI values, while the empirical analysis relies on variation within industries at the 5-digit level.

Table 11 reports heterogeneous effects by economies of scale. These results show that industries flagged as scale-ready ($ESI=1$) exhibit significant reductions in their cost per unit of output when exposed to tariff shocks. For both U.S. and Chinese tariff shocks, the interaction terms with ESI are negative and statistically significant in column (3), while output and value-added responses are imprecisely estimated. These patterns provide preliminary evidence consistent with economy-of-scale

TABLE 11—HETEROGENEOUS EFFECTS BY ECONOMIES OF SCALE (ESI)

	(1)	(2)	(3)
Dependent variable:	Δ ln(output)	Δ ln(VA)	Δ (costs/output)
$Shock^{US}$	7.030	4.090	0.901**
	(5.962)	(5.949)	(0.321)
$Shock^{US} \times ESI^{US}$	-6.289	-3.529	**-0.923****
	(6.096)	(6.096)	(0.409)
$Shock^{CH}$	-0.114	0.073	-0.054
	(0.217)	(0.195)	(0.048)
$Shock^{CH} \times ESI^{CH}$	-1.739	0.030	**-0.329****
	(1.998)	(1.206)	(0.138)
No. of obs.	443	442	443
Within R-sq	0.079	0.029	0.107

Note: All specifications include two-digit industry fixed effects and control for the lagged dependent variable. Standard errors clustered at the two-digit level are in parentheses. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively. Variables not explicitly shown in the table are included in the estimation but not displayed.

Source: Author's calculation.

mechanisms, suggesting that industries with the capacity to expand production more efficiently translate trade war shocks into cost reductions. This motivates a closer examination of underlying industry characteristics – specifically capital intensity and export intensity – that may drive such heterogeneous responses.

b. Heterogeneous Effects by Economy-of-Scale Factors

Next, I analyze how the impact of the trade war shock varies with individual industry characteristics closely linked to economies of scale. In Section II, I argued that higher capital intensity increases the likelihood of experiencing economies of scale – particularly when capacity constraints are relaxed by prior investments. I also noted that industries more deeply integrated into global export networks (i.e., export-intensive) are better positioned to achieve an export expansion at a lower cost. In this sub-section, I incorporate these characteristics into the empirical model via X_i to examine how trade war shocks differ according to their level.

Appendix Figure A4 presents scatterplots of capital intensity and export intensity, two features expected to be closely related to economies of scale.[30] I also present scatterplots at the 2-digit industry level in Appendix Figure A5 to illustrate which industries exhibit particularly high values of these variables.[31] While such heterogeneity at the 2-digit level is absorbed by the industry fixed effects in the subsequent regressions, the plots provide useful descriptive context.

[30]For readability, extreme outliers are omitted, i.e., observations with capital intensity values over 1000 or export intensity values exceeding 1.

[31]Again, I drop the outlier—19 (Coke, briquettes, and refined petroleum products)—which has a capital intensity value exceeding 2,000 million KRW per worker.

Capital Intensity and Prior Investment

Table 12 reports the results of interacting capital intensity with the U.S.–China trade war shocks and estimating the corresponding effect on industry outcomes. The coefficients on the interaction term suggest that higher capital intensity per se is not associated with stronger positive responses; rather, capital-intensive industries exposed to U.S. tariffs tended to experience weaker gains in value added and smaller reductions in unit costs. For Chinese tariff shocks, the interaction terms are small and statistically insignificant.

These results suggest that capital intensity alone is not sufficient to generate economies-of-scale responses. Industries that are highly capital intensive but had not expanded their capacity before the trade war may have faced greater rigidity with regard to their efforts to scale up production when substitution opportunities arose. This highlights the need to consider capital intensity jointly with industries' prior investment behavior in order to identify conditions under which economies of scale cab be realized.

Table 13 incorporates this additional dimension by interacting U.S. tariff shocks with both capital intensity and prior investment. The triple interaction terms are positive and significant for value added and negative for unit costs, pointing to complementarities between being capital intensive and having invested ahead of time. Again, for Chinese tariff shocks, none of the coefficients are significant.

These findings align with the mechanism of economies of scale: industries that were both capital intensive and that had already made substantial pre-war investments were able to exploit economies of scale – expanding their output and reducing costs – when exposed to trade war shocks. With fixed costs already sunk and capacity constraints relaxed, such industries could quickly scale up, realizing the classic efficiency gains from economies of scale. In contrast, industries with high capital intensity but no prior investments were not able to exploit these opportunities.

Taken together, the results from Tables 12 and 13 indicate that capital intensity by itself is not sufficient to generate economies of scale, whereas capital-intensive industries that had already invested before the trade war were able to translate tariff shocks into efficiency gains. The pattern of weaker value-added responses and higher costs in Table 12 is reversed once prior investment is taken into account in Table 13, where such industries show higher output and greater value added alongside lower unit costs. Additional results in the Appendix further support this interpretation (Appendix Table B9). When input use and per-firm outcomes are examined, the triple interaction terms are again positive and significant for capital and value added per firm. These findings are consistent with the mechanism that well-prepared, capital-intensive industries could mobilize additional inputs and expand firm-level production more efficiently, thereby realizing genuine economies of scale in the wake of U.S. tariff shocks.

For Chinese tariff shocks, neither the interaction with capital intensity nor the triple interaction with prior investment yields significant results, indicating no systematic heterogeneity in Korean industries' responses on this margin.

TABLE 12—HETEROGENEOUS EFFECTS BY CAPITAL INTENSITY

Dependent variable:	(1) Δ ln(output)	(2) Δ ln(VA)	(3) Δ (costs/output)
$Shock^{US}$	2.312	6.228**	-0.650*
	(2.219)	(2.615)	(0.315)
$Shock_{US} \times K/L$	-0.002	**-0.048*****	**0.008*****
	(0.013)	(0.017)	(0.002)
$Shock^{CH}$	-0.097	-0.106	-0.011
	(0.199)	(0.233)	(0.034)
$Shock_{CH} \times K/L$	-0.003	0.001	-0.001
	(0.005)	(0.006)	(0.001)
No. of obs.	444	443	444
Within R-sq	0.061	0.068	0.106

Note: All specifications include two-digit industry fixed effects and control for the lagged dependent variable. Standard errors clustered at the two-digit level are in parentheses. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively. Variables not explicitly shown in the table are included in the estimation but not displayed.

Source: Author's calculation.

TABLE 13— HETEROGENEOUS EFFECTS BY THE INTERACTION BETWEEN CAPITAL INTENSITY AND INVESTMENTS

Dependent variable:	(1) Δ ln(output)	(2) Δ ln(VA)	(3) Δ (costs/output)
$Shock^{US}$	11.567*	26.629***	-0.586
	(6.717)	(8.180)	(0.791)
$Shock_{US} \times K/L$	-0.024	**-0.241*****	**0.025*****
	(0.026)	(0.067)	(0.004)
$Shock_{US} \times K/L \times Prior\ Investment$	0.069	**1.256*****	**-0.124*****
	(0.109)	(0.328)	(0.027)
$Shock^{CH}$	-1.824	-1.678	-0.130
	(2.557)	(2.466)	(0.439)
$Shock_{CH} \times K/L$	0.009	0.013	-0.001
	(0.017)	(0.019)	(0.001)
$Shock_{CH} \times K/L \times Prior\ Investment$	-0.062	-0.063	-0.003
	(0.061)	(0.067)	(0.004)
No. of obs.	444	443	444
Within R-sq	0.081	0.164	0.166

Note: All specifications include two-digit industry fixed effects and control for the lagged dependent variable. Standard errors clustered at the two-digit level are in parentheses. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively. Variables not explicitly shown in the table are included in the estimation but not displayed.

Source: Author's calculation.

Export Intensity

Table 14 reports how the effects of tariff shocks vary with industries' export readiness, measured as export intensity. For U.S. tariffs, the interaction terms show that export-intensive industries experience larger gains in value added and significant reductions in unit costs, while the effects on output are not statistically significant. For Chinese tariffs, the heterogeneous effects are even clearer: industries with higher export intensity levels record significant gains in both output and value added, though without accompanying cost reductions.

These results suggest that export-oriented industries were better positioned to capture substitution opportunities created by the trade war. Industries with high export intensity levels are more likely to possess the distribution channels, logistical capacity, and organizational readiness to redirect exports quickly.[32] One notable point is that the interaction with export intensity is stronger and more significant for $Shock^{CH}$ than in the capital-intensity specifications. In other words, export readiness appears especially crucial in the Chinese channel. A possible explanation is that the Chinese market is more challenging to penetrate, with higher regulatory barriers and greater reliance on established distribution and logistics networks. Industries that had already built such networks were therefore better positioned to take advantage when Chinese buyers turned away from U.S. goods. This provides one plausible interpretation of the results.

TABLE 14—HETEROGENEOUS EFFECTS BY EXPORT INTENSITY

	(1)	(2)	(3)
Dependent variable:	Δ ln(output)	Δ ln(VA)	Δ (costs/output)
$Shock^{US}$	1.941	-0.926	0.757***
	(1.373)	(1.279)	(0.218)
$Shock_{US} \times Ex/Y$	0.063	**0.477***	**-0.123****
	(0.306)	(0.257)	(0.042)
$Shock^{CH}$	-2.889***	-2.472***	-0.039
	(1.011)	(0.804)	(0.137)
$Shock_{CH} \times Ex/Y$	**0.300*****	**0.268*****	-0.001
	(0.099)	(0.078)	(0.013)
No. of obs.	444	443	444
Within R-sq	0.071	0.072	0.093

Note: All specifications include two-digit industry fixed effects and control for the lagged dependent variable. Standard errors clustered at the two-digit level are in parentheses. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively. Variables not explicitly shown in the table are included in the estimation but not displayed.

Source: Author's calculation.

[32]Industries with higher export intensity levels are more experienced exporters, with established logistics, distribution networks, and compliance infrastructure. These capabilities are largely transferable across markets and thus relevant for capturing substitution opportunities in both the U.S. and Chinese markets.

Overall, the evidence indicates that export intensity was a key factor conditioning Korean industries' ability to benefit from both U.S. and Chinese tariff shocks, with its role particularly important in the Chinese market. These findings complement the capital-intensity analysis by underscoring how both production capacity and export readiness were central to determining which industries could exploit economy-of-scale mechanisms in the wake of the trade war.

D. Summary of Results

The results point to two complementary mechanisms in how Korean industries responded to the U.S.–China trade war. First, U.S. tariffs on Chinese goods created broad opportunities for growth and cost reductions, producing positive average effects across industries, with particularly strong gains in capital-intensive sectors with sufficient prior investments. Second, Chinese retaliation generated limited opportunities on average, but industries with high export intensity were able to take advantage of them, resulting in significant heterogeneous effects despite weak average impacts.

The common element is that industries positioned to expand their scale benefitted most. Capital- and investment-intensive industries could increase production without proportionate increases in costs, consistent with economies of scale. Export-intensive industries, in turn, were able to leverage their organizational infrastructure and global networks to redirect sales, and this channel was particularly stronger for trade shocks created by Chinese tariff changes. In both cases, the pattern of rising value added accompanied by reductions in average production costs clearly indicates that the ability to scale up production efficiently was the critical determinant of gains.

The findings here suggest that countries facing external trade shocks may benefit by strengthening industries with the capacity to expand their scale and exploit export opportunities. For Korea, policies that facilitate pre-emptive investments and support export readiness can enhance resilience to future episodes of great-power trade conflicts. The next section discusses these implications in greater detail.

V. Conclusion

This study examined tariff elasticities to analyze how the U.S.–China trade war affected third-country exports to the United States and China, focusing specifically on Korean industries. In Section II, I investigated the drivers of heterogeneous tariff elasticities across Korean industries using a model-consistent framework of demand- and supply-side explanations. The results show that lower tariff rates and higher technological intensity levels are associated with greater elasticity, suggesting that such products are more effective substitutes for Chinese or U.S. goods. Capital intensity and export intensity also matter: industries with these traits exhibit greater tariff elasticities, pointing to the potential role of economies of scale.

Building on these findings – particularly the supply-side factors – I examine in Section III how Korean industries were affected by the trade shocks. The evidence shows that industries positioned to scale benefitted most: capital-intensive industries with prior investments realized higher growth in value added and investment along with cost reductions in response to U.S. tariff shocks, while export-intensive industries recorded higher output growth and cost declines following Chinese tariff shocks.

The results suggest several policy implications. Trade shocks create uneven opportunities, and industries positioned to expand their scale captured the gains. Policies should therefore aim to help more industries reach such a position. This means encouraging pre-investment and capital deepening and strengthening export infrastructure, networks, and readiness. Importantly, policy support should be targeted and differentiated: a one-size-fits-all approach will not work, as some industries benefit from trade shocks while others are harmed. By aligning support with the characteristics that make industries more responsive – such as capital accumulation and export readiness – Korea can enhance its resilience to future trade conflicts and better leverage shifting levels of global demand.

Finally, several areas remain open for future research. For instance, analyzing firm-level dynamics of entry, exit, and reallocation would deepen our understanding of the medium- and long-run impacts of trade war shocks on Korea's industrial base. In particular, investigating whether firms that expanded their U.S. market share also entered or grew in other markets, or whether firms primarily exporting to China successfully reallocated capacity to new destinations, would inform better-targeted export-promotion strategies.

APPENDIX

A. *Appendix Figures*

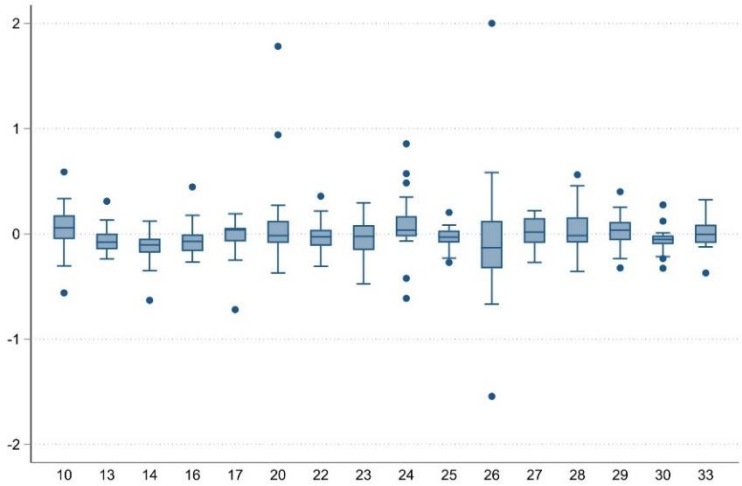


FIGURE A1. WITHIN VARIATION OF OUTPUT

Note: The figure includes the 2-digit industries that have at least 10 observations of 5-digit industries. Box shows median and interquartile range (25th-75th percentiles); whiskers extend to furthest points within 1.5×IQR from box edges; dots represent outliers beyond whiskers.

Source: Author's calculations based on the Census of Mining and Manufacturing and Fajgelbaum *et al*. (2024) data.

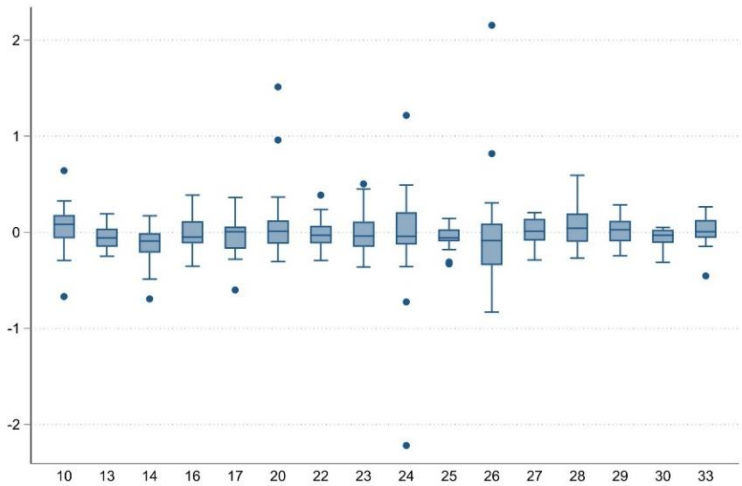


FIGURE A2. WITHIN VARIATION OF VA

Note: The figure includes the 2-digit industries that have at least 10 observations of 5-digit industries. Box shows median and interquartile range (25th-75th percentiles); whiskers extend to furthest points within 1.5×IQR from box edges; dots represent outliers beyond whiskers.

Source: Author's calculations based on the Census of Mining and Manufacturing and Fajgelbaum *et al*. (2024) data.

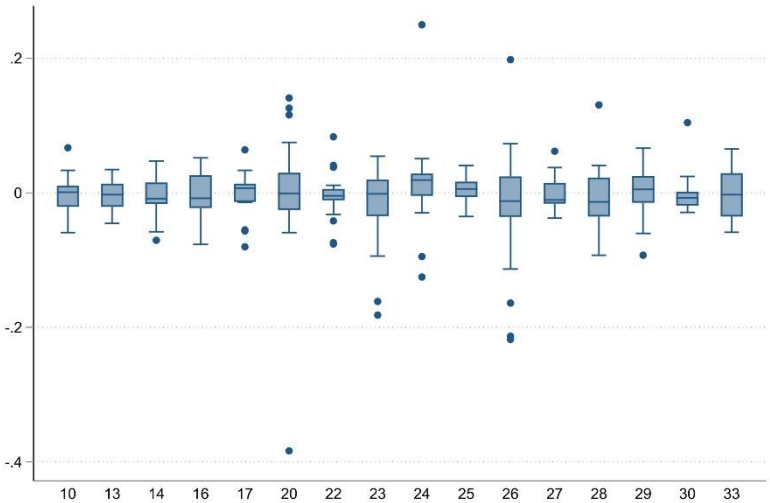


FIGURE A3. WITHIN VARIATION OF COST/OUTPUT

Note: The figure includes the 2-digit industries that have at least 10 observations of 5-digit industries. Box shows median and interquartile range (25th-75th percentiles); whiskers extend to furthest points within 1.5×IQR from box edges; dots represent outliers beyond whiskers.

Source: Author's calculations based on the Census of Mining and Manufacturing and Fajgelbaum *et al*. (2024) data.

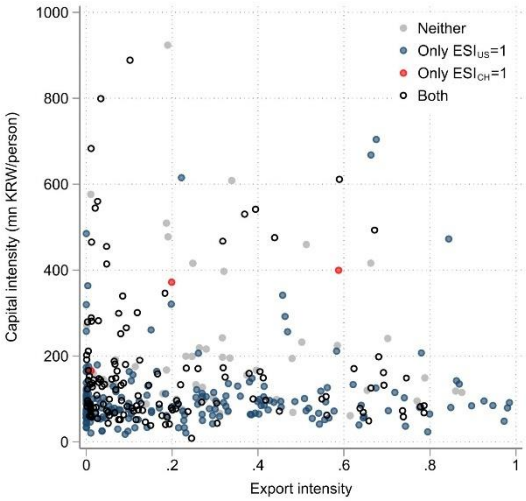


FIGURE A4. CAPITAL INTENSITY AND EXPORT INTENSITY (2-DIGIT)

Note: The graph plots capital intensity and export intensity at 5-digit industries. It omits outliers (capital intensity over 1000 and export intensity over 1) for readability.

Source: Author's calculation.

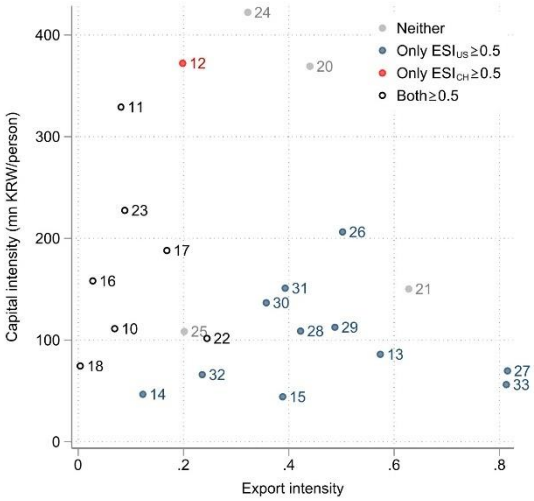


FIGURE A5. CAPITAL INTENSITY AND EXPORT INTENSITY (2-DIGIT)

Note: The graph plots capital intensity and export intensity at 5-digit industries. It omits outliers (capital intensity over 2000) for readability.

Source: Author's calculation.

B. *Appendix Tables*

TABLE B1—ISTANS-3-LEVEL VALUES

ISTANS-3		β_1^{US}	β_1^{RW}	β_2^{CH}	β_2^{RW}	ln(K/L)	Ex/Y	Inv_{t-1}
3101	Pharmaceuticals	0.223	-0.660	0.260	0.758	5.3	0.17	14.2
3102	Semiconductors	0.293	-0.053	-1.139	0.762	5.8	0.90	17.4
3103	Displays	0.470	-0.066	-1.724	0.900	5.5	0.35	15.6
3104	Computers	0.398	-0.007	-0.831	0.399	4.3	2.18	10.7
3105	Telecom. Equipment	0.331	-0.020	-0.622	0.404	4.2	0.58	15.8
3106	Home Electronics	0.325	-0.054	-0.431	0.348	4.4	0.24	16.4
3107	Precision Instruments	0.722	-0.064	-1.254	0.345	4.2	0.66	12.6
3108	Batteries	0.205	-0.062	-0.451	0.365	5.1	0.60	
3109	Aerospace	0.412	0.511	-1.057	0.600	4.7	0.50	
3201	Petrochemicals	0.696	-0.135	-0.743	0.889	6.2	0.50	14.6
3202	Fine Chemicals	0.237	-0.677	0.169	0.908	5.1	0.31	13.5
3203	Other Electronic Components	0.440	-0.063	-0.735	0.409	4.4	0.33	
3204	Electrical Equipment	0.350	-0.021	-0.650	0.340	4.6	0.61	13.6
3205	General-Purpose Machinery	0.308	-0.028	-0.643	0.339	4.7	0.49	12.7
3206	Special-Purpose Machinery	0.243	0.026	-1.111	0.585	4.7	0.52	12.9
3207	Automotive	0.296	0.732	-1.021	0.637	4.9	0.43	15.1
3208	Railway Equipment	0.431	0.757	-1.042	0.621	5.1	0.21	
3209	Other Transport Equipment	0.436	0.757	-1.030	0.619	5.1	0.11	12.0
3301	Petroleum Refining	0.829	-0.428	1.083	0.006	7.3	0.40	14.7
3302	Rubber	1.509	0.547	-1.339	-0.368	4.6	0.40	11.9
3303	Plastics	1.546	0.543	-1.272	-0.291	4.6	0.20	12.8
3304	Glass	1.614	0.539	-1.835	0.057	5.5	0.16	8.3
3305	Ceramics	1.472	0.492	-1.119	-0.143	4.6	0.16	8.4
3306	Cement	1.207	0.073	-0.951	-0.383	5.4	0.02	11.2
3307	Other Non-Metallic	1.532	0.523	-1.289	-0.348	4.9	0.20	
3308	Steel	0.470	-1.203	0.116	0.373	6.1	0.29	12.1
3309	Non-Ferrous Metals	0.836	-0.704	-0.746	0.469	5.5	0.34	13.1
3310	Casting	0.846	-1.059	-0.161	0.301	4.8	0.07	12.2
3311	Fabricated Metal Products	0.687	-0.924	-0.231	0.357	4.6	0.23	13.3
3312	Shipbuilding	-0.609	0.613	-0.620	0.615	5.0	0.70	13.2
3401	Food & Beverage	-0.158	-0.240	-0.272	0.058	4.8	0.08	12.2
3402	Tobacco	-0.213	-0.238	-0.287	-0.019	5.8	0.26	8.2
3403	Textiles	-0.148	-0.199	-0.491	0.283	4.5	0.55	11.1
3404	Apparel	0.017	-0.143	-0.487	0.221	3.8	0.13	4.6
3405	Leather & Footwear	0.028	-0.148	-0.849	0.389	3.8	0.36	9.6
3406	Wood Products	1.632	0.564	-1.441	-0.352	5.0	0.02	9.8
3407	Paper & Pulp	1.396	0.517	-1.461	-0.305	5.2	0.16	11.6
3408	Printing	1.598	0.556	-1.685	-0.308	4.3	0.06	9.0
3409	Furniture	0.761	-0.017	-0.480	0.005	4.2	0.14	9.9
3410	Other Manufacturing	0.817	0.043	-0.810	0.071	3.8	0.58	11.1

TABLE B2—RESULTS ON THE CORRELATIONS WITH TARIFF ELASTICITIES ($\hat{\beta}$)

Dependent variable: $\hat{\beta}$	(1)	(2)	(3)
$X_{i\omega} / E_{\omega}$	0.177	-0.057	-0.011
	(0.140)	(0.143)	(0.148)
$E_{\omega}^{n} / E_{\omega}$	-0.206***	-0.089	-0.190**
	(0.076)	(0.078)	(0.078)
$s_{i\omega}^{n}$	0.827***	0.759***	0.788***
	(0.077)	(0.076)	(0.077)
$\ln(1+Tariff_{KR})$	-0.289**		-0.249**
	(0.122)		(0.114)
Tech Level	0.092***		0.067***
	(0.005)		(0.006)
Capital Intensity		0.063*	0.069**
		(0.032)	(0.033)
$\ln(Investment_{t-1})$		0.009***	-0.003
		(0.003)	(0.003)
Capital Intensity $\times \ln(Investment_{t-1})$		0.002	0.001
		(0.002)	(0.002)
Export Intensity		0.027***	0.010**
		(0.004)	(0.004)
No. of Observations	9322	9240	9052
Within R-squared	0.065	0.102	0.116

Note: All columns include the trade-pattern variables ($X_{i\omega} / E_{\omega}$, $E_{\omega}^{US} / E_{\omega}$, $s_{i\omega}^{US}$) and exporter–country (U.S. or China) fixed effects; for readability, their coefficients are omitted from the table. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively. Robust standard errors are shown in parentheses.

Source: Author's calculations.

TABLE B3—CORRELATION WITH EXPORT ELASTICITIES (USING R&D)

Dependent variable: $\hat{\beta}$	(1)	(2)	(3)
$\ln(1+Tariff_{KR})$	-1.113***		-0.345***
	(0.139)		(0.113)
R&D/output	-0.021***		0.023***
	(0.004)		(0.005)
Capital Intensity		0.063*	0.063*
		(0.032)	(0.034)
$\ln(Investment_{t-1})$		0.009***	0.007**
		(0.003)	(0.003)
Capital Intensity $\times \ln(Investment_{t-1})$		0.002	0.002
		(0.002)	(0.002)
Export Intensity		0.027***	0.013***
		(0.004)	(0.004)
No. of Observations	9518	9240	9044
Within R-squared	0.036	0.102	0.109

Note: All columns include the trade-pattern variables ($X_{i\omega} / E_{\omega}$, $E_{\omega}^{US} / E_{\omega}$, $s_{i\omega}^{US}$) and exporter–country (U.S. or China) fixed effects; for readability, their coefficients are omitted from the table. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively. Robust standard errors are shown in parentheses.

Source: Author's calculations.

TABLE B4—LIST OF KSIC 2-DIGIT INDUSTRIES

KSIC10 2-digit		N. of 5-digit
10	Food products	40
11	Beverages	9
12	Tobacco products	1
13	Textiles, except apparel	26
14	Wearing apparel, clothing accessories and fur articles	15
15	Leather, luggage and footwear	7
16	Wood and products of wood and cork; except furniture	13
17	Pulp, paper and paper products	17
18	Printing and reproduction of recorded media	8
19	Coke, briquettes and refined petroleum products	4
20	Chemicals and chemical products; except pharmaceuticals and medicinal chemicals	30
21	Pharmaceuticals, medicinal chemical and botanical products	5
22	Rubber and plastics products	23
23	Other non-metallic mineral products	32
24	Basic metals	24
25	Fabricated metal products, except machinery and furniture	32
26	Electronic components, computer; visual, sounding and communication equipment	31
27	Medical, precision and optical instruments, watches and clocks	17
28	Electrical equipment	23
29	Other machinery and equipment	42
30	Motor vehicles, trailers and semitrailers	13
31	Other transport equipment	9
32	Furniture	6
33	Other manufacturing	18

TABLE B5—COEFFICIENTS OF VARIATION AT THE 2-DIGIT LEVEL

	$Shock_{US}$	$Shock_{CH}$ _cn	Δ ln(output)	Δ ln(VA)	No. of 5-digit
10	1.95	3.06	4.45	4.48	40
11	1.41	1.47	-2.71	-3.17	9
12					1
13	1.58	1.82	-1.82	-2.13	26
14	1.46	2.38	-1.22	-1.72	15
15	2.04	0.86	-1.16	-3.40	7
16	2.93	1.80	-4.36	-11.30	13
17	3.31	1.25	-4.92	-4.53	17
18	1.20	1.60	5.60	3.94	8
19	1.95	1.94	3.06	0.65	4
20	3.39	2.53	4.47	4.11	30
21	2.23	1.61	1.17	1.72	5
22	1.52	1.42	-4.49	-6.40	23
23	4.35	3.27	-5.21	-33.24	32
24	2.12	1.31	3.49	-12.58	24
25	1.57	2.29	-2.79	-2.30	32
26	2.72	2.56	-6.08	-12.14	31
27	1.92	1.95	8.40	9.63	17
28	2.24	1.71	4.82	2.87	23
29	1.15	1.21	5.48	8.63	42
30	1.42	1.86	-2.68	-1.73	13
31	1.81	1.60	-2.68	-6.05	9
32	0.99	1.78	0.95	1.17	6
33	2.57	3.68	21.23	10.95	18

TABLE B6—AVERAGE EFFECTS OF U.S.–CHINA TRADE WAR ON INPUT AND PER-FIRM OUTCOMES

	(1)	(2)	(3)	(4)
Dependent variable:	Δ ln(labor)	Δ ln(capital)	Δ (output/firm)	Δ (VA/firm)
$Shock^{US}$	1.511	1.953	**1.454***	0.884
	(0.889)	(1.430)	(0.794)	(0.836)
$Shock^{CH}$	-0.137	-0.046	-0.166	0.103
	(0.168)	(0.408)	(0.236)	(0.160)
No. of obs.	443	443	443	442
Within R-sq	0.040	0.020	0.015	0.014

Note: All specifications include two-digit industry fixed effects and control for the lagged dependent variable. Standard errors clustered at the two-digit level are in parentheses. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively. Variables not explicitly shown in the table are included in the estimation but not displayed. Constant estimates are omitted from the table.

Source: Author's calculation.

TABLE B7—HETEROGENEOUS EFFECTS BY ECONOMIES OF SCALE ON INPUT AND PER-FIRM OUTCOMES

	(1)	(2)	(3)	(4)
Dependent variable:	Δ ln(labor)	Δ ln(capital)	Δ (output/firm)	Δ (VA/firm)
$Shock_{US}$	1.644	3.863	6.041	3.117
	(1.788)	(2.982)	(4.731)	(4.743)
$Shock^{US} \times ESI^{US}$	-0.292	-2.005	-5.414	-2.668
	(1.877)	(3.291)	(4.811)	(4.832)
$Shock^{CH}$	-0.153	0.047	-0.065	0.132
	(0.177)	(0.368)	(0.189)	(0.183)
$Shock^{CH} \times ESI^{CH}$	0.677	-2.651	-1.839	-0.015
	(1.109)	(2.295)	(1.671)	(0.972)
No. of obs.	443	443	443	442
Within R-sq	0.043	0.041	0.064	0.024

Note: All specifications include two-digit industry fixed effects and control for the lagged dependent variable. Standard errors clustered at the two-digit level are in parentheses. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively. Variables not explicitly shown in the table are included in the estimation but not displayed.

Source: Author's calculation.

TABLE B8—HETEROGENEOUS EFFECTS BY CAPITAL INTENSITY ON INPUT AND PER-FIRM OUTCOMES

	(1)	(2)	(3)	(4)
Dependent variable:	Δ ln(labor)	Δ ln(capital)	Δ (output/firm)	Δ (VA/firm)
$Shock^{US}$	3.054*	7.549***	1.667	5.499***
	(1.666)	(2.285)	(1.797)	(1.907)
$Shock_{US} \times K/L$	-0.012	**-0.045****	0.000	**-0.045****
	(0.011)	(0.014)	(0.010)	(0.012)
$Shock^{CH}$	0.020	0.561*	-0.003	-0.024
	(0.147)	(0.280)	(0.204)	(0.252)
$Shock_{CH} \times K/L$	-0.004	**-0.016****	-0.003	0.001
	(0.004)	(0.006)	(0.004)	(0.005)
No. of obs.	444	444	444	443
Within R-sq	0.069	0.089	0.028	0.060

Note: All specifications include two-digit industry fixed effects and control for the lagged dependent variable. Standard errors clustered at the two-digit level are in parentheses. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively. Variables not explicitly shown in the table are included in the estimation but not displayed.

Source: Author's calculation.

TABLE 9—HETEROGENEOUS EFFECTS BY THE INTERACTION BETWEEN K/L AND INVESTMENTS ON INPUT AND PER-FIRM OUTCOMES

	(1)	(2)	(3)	(4)
Dependent variable:	Δ ln(labor)	Δ ln(capital)	Δ (output/firm)	Δ (VA/firm)
$Shock^{US}$	9.339**	26.271***	6.845	21.758***
	(4.161)	(6.484)	(6.014)	(7.321)
$Shock_{US} \times K/L$	-0.033	**-0.133****	0.005	**-0.212****
	(0.028)	(0.031)	(0.020)	(0.058)
$Shock_{US} \times K/L$ $\times$ Prior Investment	0.099	**0.492****	-0.099	**1.095****
	(0.127)	(0.151)	(0.080)	(0.304)
$Shock^{CH}$	-1.288	-1.829	-1.781	-1.545
	(1.225)	(1.614)	(2.463)	(2.717)
$Shock_{CH} \times K/L$	-0.002	**-0.017****	0.011	0.014
	(0.010)	(0.007)	(0.017)	(0.020)
$Shock_{CH} \times K/L$ $\times$ Prior Investment	-0.009	0.006	-0.066	-0.064
	(0.033)	(0.027)	(0.060)	(0.068)
No. of obs.	444	444	444	443
Within R-sq	0.081	0.120	0.051	0.156

Note: All specifications include two-digit industry fixed effects and control for the lagged dependent variable. Standard errors clustered at the two-digit level are in parentheses. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively. Variables not explicitly shown in the table are included in the estimation but not displayed.

Source: Author's calculation.

TABLE B10—HETEROGENEOUS EFFECTS BY EXPORT INTENSITY

	(1)	(2)	(3)	
Dependent variable:	Δ ln(labor)	Δ ln(capital)	Δ (output/firm)	Δ (VA/firm)
$Shock^{US}$	-0.406	-0.540	1.934	-0.816
	(1.006)	(1.643)	(1.172)	(1.009)
$Shock_{US} \times Ex / Y$	0.323	0.495	-0.021	0.389
	(0.195)	(0.307)	(0.281)	(0.233)
$Shock^{CH}$	-1.859**	-3.077**	-2.377**	-1.926**
	(0.719)	(1.473)	(0.932)	(0.865)
$Shock_{CH} \times Ex / Y$	**0.157****	**0.307****	**0.254****	**0.223****
	(0.067)	(0.131)	(0.096)	(0.092)
No. of obs.	444	444	444	443
Within R-sq	0.102	0.083	0.049	0.059

Note: All specifications include two-digit industry fixed effects and control for the lagged dependent variable. Standard errors clustered at the two-digit level are in parentheses. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively. Variables not explicitly shown in the table are included in the estimation but not displayed.

Source: Author's calculation.

C. *Revisiting the Model and Tariff Elasticity Estimates*

This appendix section revisits the model environment and estimation of tariff cross-elasticities outlined in Fajgelbaum *et al*. (2024). It then replicates their results, presenting tariff cross-elasticity values at the country level for cross-country comparison purposes, and examines whether the predicted export changes align with actual observed export changes.

1. Model Environment

a. Demand

The model comprises I countries and J industries. Within each industry j, there exists a set of varieties $\omega \in \Omega^j$, where each variety is further indexed by its exporting country (i), denoted as $i\omega$.[33] Because the model is structured at the country–industry–variety level, multiple subscripts and superscripts appear simultaneously. Throughout the paper, exporter indices appear as subscripts, while importer and industry indices appear as superscripts. In what follows, I denote the exporting country by i and the importing country by n, except where the context requires otherwise.

Each variety $i\omega$ is produced under perfect competition at marginal cost $p_{i\omega}$. Consumers in each destination country n aggregate varieties – both domestic and foreign – via a translog aggregator and then use the composite variety as either an intermediate or a final good. The import share of variety $i\omega$ in country n is expressed as

$$s_{i\omega}^n = a_{i\omega}^n + \sum\nolimits_{i' \in I} \sigma_{i'i}^j \ln p_{i'\omega}^n \tag{C1}$$

where $p_{i\omega}^n = T_{i\omega}^n \tau_{i\omega}^n, p_{i\omega}$ denotes the price of $i\omega$ in country n, including iceberg trade costs and any applied tariffs. Trade costs encompass both tariffs ($T_{i\omega}^n \equiv 1 + t_{i\omega}^n \geq 1$) and iceberg trade costs ($\tau_{i\omega}^n \geq 1$). The term $a_{i\omega}^n$ is a preference shock specific to variety $i\omega$ in country n, and $\sigma_{i'i}{}^j$ is the elasticity of substitution between varieties of industry j produced by countries i' and i. To focus on capturing the U.S.–China trade war effect, I allow $\sigma_{i'i}{}^j$ to differ only when either i or i' is the United States or China; in all other country pairs, I set $\sigma_{i'i}{}^j = \sigma_{RW}^j$, a common "rest-of-world" type of elasticity.

b. Supply

Each exporter i supplies variety $i\omega \in \Omega^j$ according to the technology

[33]The terms "good," "variety," and "product" are used interchangeably.

$$X_{i\omega} \equiv A_i^j \, p_{i\omega}^{1/b_i^j} \, Z_{i\omega} \tag{C2}$$

where b_i^j is the inverse-supply elasticity (i.e., change in the price with respect to the change in the quantity supplied). If $b_i^j > 0$, the supply curve slopes upward; if $b_i^j < 0$, the supply curve slopes downward, reflecting economies of scale.[34] The term A_i^j captures country- and industry-specific factor costs, while $Z_{i\omega}$ represents other exogenous supply shocks.

c. Equilibrium

The equilibrium is defined by prices $p_{i\omega}$ such that markets clear – that is, each variety's output equals total absorption across all destinations:

$$X_{i\omega} = \sum\nolimits_{n \in I} \frac{s_{i\omega}^n}{T_{i\omega}^n} E_\omega^n \tag{C3}$$

Here, E_ω^n denotes total consumption of variety ω in country n, itself a fixed share ζ_ω^n of the country-n total expenditure E^n.[35]

In order to close the general equilibrium model, one must further impose assumptions on A_i^j and E^n. Rather than introducing these additional structural assumptions, Fajgelbaum *et al*. (2024) address them in their empirical framework by incorporating a set of fixed effects and by controlling for various model-implied trade-flow variables.

2. Third-Country Export Responses

Using a first-order approximation, the log change in country i's exports of variety ω to destination n in response to U.S. and Chinese tariff changes can be summarized as follows:

$$\begin{aligned} \Delta \ln X_{i\omega}^n = {} & \beta_{1i\omega}^n \Delta \ln T_{CH\,\omega}^{US} + \beta_{2i\omega}^n \Delta \ln T_{US\,\omega}^{CH} + \beta_{3i\omega}^n \Delta \ln T_{i\omega}^{US} + \beta_{4i\omega}^n \Delta \ln T_{i\omega}^{CH} + \\ & \beta_{5i\omega}^n \sum\nolimits_{j \neq CH,US,i} \Delta \ln T_{j\omega}^{US} + \beta_{6i\omega}^n \sum\nolimits_{j \neq CH,US,i} \Delta \ln T_{j\omega}^{CH} + \eta_{i\omega}^n + \varepsilon_{i\omega}^n \end{aligned} \tag{C4}$$

The parameters $\beta_{1i\omega}^n$ and $\beta_{2i\omega}^n$ capture the effects on the country i's exports to n of U.S. tariffs on Chinese goods and of Chinese tariffs on U.S. goods, respectively.

[34] Fajgelbaum *et al*. (2024) demonstrate in their appendix that this comprises the supply elasticities of production factors and the extent of economies of scale.

[35] In other words, it is assumed that consumer preference for each product ω is exogenously given.

Specifically,

$$\beta_{1i\omega}{}^{n} \equiv \left(1\{n = US\} + \frac{E_{\omega}{}^{US}}{E_{\omega}} \frac{\frac{b_i{}^{j}\sigma_{ii}{}^{j}}{X_{i\omega}/E_{\omega}}}{1-\frac{b_i{}^{j}\sigma_{ii}{}^{j}}{X_{i\omega}/E_{\omega}}} \right) \frac{\sigma_{CHi}{}^{j}}{s_{i\omega}{}^{n}} \tag{C5}$$

represents the tariff elasticity of a variety $i\omega$ exports to destination country n with respect to U.S. tariffs on Chinese variety ω. As shown in Equation (C5), it depends on the U.S. consumption share ($E_{\omega}^{US}/E_{\omega}$), exporter i's share ($X_{i\omega}/E_{\omega}$), the elasticity of substitution with the Chinese good ($\sigma_{CH,i}^{j}$), the share of country i in U.S. spending in product ω ($s_{i\omega}^{US}$), and the exporter's supply curvature ($b_i^j\sigma_{ii}^j$).

Analogously,

$$\beta_{2i\omega}{}^{n} \equiv \left(1\{n = CH\} + \frac{E_{\omega}{}^{CH}}{E_{\omega}} \frac{\frac{b_i{}^{j}\sigma_{ii}{}^{j}}{X_{i\omega}/E_{\omega}}}{1-\frac{b_i{}^{j}\sigma_{ii}{}^{j}}{X_{i\omega}/E_{\omega}}} \right) \frac{\sigma_{USi}{}^{j}}{s_{i\omega}{}^{n}} \tag{C6}$$

is the tariff elasticity of a variety $i\omega$ exports to destination country n with respect to Chinese tariffs on U.S. variety ω, and its structure mirrors that of $\beta_{1i\omega}^{n}$. This study focuses on the elasticities toward the U.S. and China—i.e., on β_1 and β_2—and therefore explains those in detail. For a full description of the remaining β coefficients and $\eta_{i\omega}^{n}$, readers can refer to Fajgelbaum *et al*. (2024).[36]

B. Estimation

1. Estimation Equation

Tariff elasticities are estimated using Equation (C4) from the theoretical model. For empirical implementation, I impose the following additional assumptions:[37]

First, it is assumed that $\beta_{5i\omega}{}^{n} = \beta_{6i\omega}{}^{n} = 0$. During the 2018–19 U.S.–China trade

[36]For example, $\eta_{i\omega}^{n}$ captures the effects of country-specific total expenditure, product-level price indices, factor-cost differences, and other macroeconomic variables that were not parameterized in the theoretical general equilibrium setup; their influences are absorbed in the empirical specification via appropriate fixed effects and controls. Finally, $\epsilon_{i\omega}^{n}$ denotes the residual error term.

[37]I follow Fajgelbaum *et al*. (2024) with regard to these assumptions.

war, the aggregate tariff changes that the United States and China applied to third countries were of similar magnitudes.[38] Consequently, the sum of tariff changes imposed on countries other than a given third country is highly collinear with the tariff change imposed on that third country itself, justifying the exclusion of these terms.[39] Moreover, the principal tariff changes of interest in the trade war were those 'U.S. → China' (U.S. tariffs on Chinese products) and 'China → U.S.' forms (Chinese tariffs on U.S. products), corresponding to elasticities $\beta_{1i\omega}{}^{n}$ and $\beta_{2i\omega}{}^{n}$, respectively. The direct effects of tariffs imposed on country i's products ($\beta_{3i\omega}{}^{n}$, $\beta_{4i\omega}{}^{n}$) remain as essential controls.

Second, each $\beta_{zi\omega}{}^{n}$ is assumed to decompose linearly as shown below.

$$\beta_{zi\omega}{}^{n} = \beta_{zi}{}^{n} + \beta_{zj(\omega)}{}^{n} + \Gamma_{z}{}^{n}\,\mathrm{SIZE}^{n}_{zi\omega} \quad (z = 1,2,3,4) \tag{C7}$$

As observed in Equations (C5) and (C6), $\beta_{zi\omega}{}^{n}$ varies heterogeneously with the exporting country, importing country, industry, and product-level trade size. Accordingly, I decompose $\beta_{zi\omega}{}^{n}$ into three components—an exporter-level term β^{n}_{zi}, an industry-level term $\beta^{n}_{zj(\omega)}$, and a product-scale term $\left(\mathrm{SIZE}^{\mathbf{n}}_{\mathbf{zi\omega}}\right)$—and estimate these separately for each destination market ($\mathrm{n} = \mathrm{US, CH, RW}$). Specifically, $\mathrm{SIZE}^{n}_{zi\omega}$ is constructed as the combination of (a) the share of U.S. or Chinese consumption in the global consumption of product ω ($E^{m}_{\omega} / E_{\omega}$, $\mathrm{m} \in \{\mathrm{US, CH}\}$), (b) the share of country i's exports in the global consumption of ω ($X_{i\omega} / E_{\omega}$), and (c) the share of country i in the product-ω consumption within market n ($s^{n}_{i\omega}$, $\mathrm{n} \in \{\mathrm{US, CH, RW}\}$).

Finally, I control for $\eta_{i\omega}{}^{n}$, which captures the effects of national total expenditure, average price indices, factor-cost conditions in each exporting country, and other macroeconomic factors, by including exporter–importer–industry fixed effects and the existing trade-pattern terms $\left(\mathrm{SIZE}^{\mathbf{n}}_{\mathbf{zi\omega}}\right)$. Unobserved shocks to export growth $\left(\boldsymbol{\varepsilon}_{i\omega}{}^{n}\right)$ are further absorbed by these fixed effects and by pre-treatment trends.[40]

In summary, I estimate the tariff elasticities in response to tariff changes by importing market n using Equation (C8). The main identifying assumption is that, absent the U.S.–China trade war tariff changes, the growth rates of exports across products within each exporter–importer industry would have

[38]China adjusted its tariffs on third countries via modifications to its MFN rates at that time, and the United States implemented comparable adjustments to its own third-country tariffs.

[39]For example, Fajgelbaum *et al*. (2024) show that the correlation between $\sum_{\mathrm{j}\neq\mathrm{CH,US,i}} \Delta \ln \mathrm{T}^{\mathrm{CH}}_{\mathrm{j}\omega}$ and $\Delta \ln \mathrm{T}^{\mathrm{CH}}_{\mathrm{i}\omega}$ is 0.997.

[40]In other words, $\eta^{\mathrm{n}}_{\mathrm{i}\omega} + \epsilon^{\mathrm{n}}_{\mathrm{i}\omega} \equiv \alpha^{\mathrm{n}}_{\mathrm{ij}(\omega)} + \Omega^{\mathrm{n}} \mathrm{SIZE}_{\mathrm{i}\omega} + \pi^{\mathrm{n}} \Delta \ln \mathrm{X}^{\mathrm{n}}_{\mathrm{i}\omega,\mathrm{t}-1} + \epsilon^{\mathrm{n}}_{\mathrm{i}\omega}$.

been the same.[41]

$$\Delta \ln X_{i\omega}^{\ n} = \beta_{1i\omega}^{\ n} \Delta \ln T_{CH\omega}^{\ US} + \beta_{2i\omega}^{\ n} \Delta \ln T_{US\omega}^{\ CH} + \beta_{3i\omega}^{\ n} \Delta \ln T_{i\omega}^{\ US} + \beta_{4i\omega}^{\ n} \Delta \ln T_{i\omega}^{\ CH} + \alpha_{ij(\omega)}^{\ n} + \Omega^n SIZE_{i\omega} + \pi^n \Delta \ln X_{i\omega,t-1}^{\ n} + \varepsilon_{i\omega}^{\ n} \quad \text{(C8)}$$

As $\beta_{zi\omega}^{n}$ is assumed to follow the structure in Equation (C7), I substitute it into Equation (C8) and estimate the resulting Equation (C8′).

$$\begin{aligned} \Delta \ln X_{i\omega}^{\ n} = & \left(\beta_{1i}^{\ n} + \beta_{1j(\omega)}^{\ n} + \Gamma_1^{\ n} SIZE_{1i\omega}^{\ n}\right) \Delta \ln T_{CH\omega}^{\ US} \\ & + \left(\beta_{2i}^{\ n} + \beta_{2j(\omega)}^{\ n} + \Gamma_2^{\ n} SIZE_{2i\omega}^{\ n}\right) \Delta \ln T_{US\omega}^{\ CH} \\ & + \left(\beta_{3i}^{\ n} + \beta_{3j(\omega)}^{\ n} + \Gamma_3^{\ n} SIZE_{3i\omega}^{\ n}\right) \Delta \ln T_{i\omega}^{\ US} \\ & + \left(\beta_{4i}^{\ n} + \beta_{4j(\omega)}^{\ n} + \Gamma_4^{\ n} SIZE_{4i\omega}^{\ n}\right) \Delta \ln T_{i\omega}^{\ CH} \\ & + \alpha_{ij(\omega)}^{\ n} + \Omega^n SIZE_{i\omega} + \pi^n \Delta \ln X_{i\omega,t-1}^{\ n} + \varepsilon_{i\omega}^{\ n} \end{aligned} \quad \text{(C8′)}$$

In particular, for each $z \in \{1,2,3,4\}$ first I estimate $\hat{\beta}_{zi}^{\ n}$, $\hat{\beta}_{zj(\omega)}^{\ n}$, $\hat{\Gamma}_z^{\ n}$, after which I compute $\hat{\beta}_{zi\omega}^{\ n}$ via Equation (C7).[42] The term $SIZE_{zi\omega}^{n}$ can be calculated directly from the data. I use the data from Fajgelbaum *et al*. (2024), which covers 50 exporting countries and 5,203 HS six-digit products.

2. Review of the Estimates

a. Cross-country Comparisons

By estimating Equation (C8), I obtain country–product–market tariff elasticities, β, for exports directed to the United States, China, and the rest of the world (RW). In what follows, I summarize the country-level averages of these elasticities, with a particular focus on how Korea's estimates compare to those of other countries.

To aggregate the country-product-level estimates into country-level averages, I compute a weighted mean of $\hat{\beta}$ using each country–product's share in its total exports to China, the United States, and the rest of the world during 2016–17.

[41]Figure 1 in Fajgelbaum *et al*. (2024) demonstrates that third-country export changes prior to the U.S. – China trade war are uncorrelated with export changes during the trade war.

[42]For example, the tariff elasticity to the U.S. of a Korean ($i = KOR$) industry j product ω can be calculated as $\beta_{1KOR\omega}^{US} = \beta_{1KOR}^{US} + \beta_{1j}^{US} + \Gamma_1^{US} SIZE_{1KOR\omega}^{US}$. Specifically, the country-level component β_{1KOR}^{US} is estimated as the coefficient of the interaction between the country $1\{i = KOR\}$ dummy and the tariff change $\Delta \ln T_{CH\omega}^{US}$; the industry-level component β_{1j}^{US} is estimated as the coefficient on $1\{j(\omega) = J\} \times \Delta \ln T_{CH\omega}^{US}$; and the product-level component is obtained by estimating Γ_1^{US} as the coefficient of $SIZE_{1KOR\omega}^{US} \times \Delta ln T_{CH\omega}^{US}$ and then computing $\Gamma_1^{US} \times \text{SIZE}_{1KOR\omega}^{US}$.

Appendix Figure C1 plots each country's average tariff elasticity toward China, β_{2i}^{CH} (vertical axis), against its average elasticity toward the United States, β_{1i}^{US} (horizontal axis).[43] The mean of β_{2i}^{CH} across 49 countries is –0.043 and the median is 0.126; values range from –4.905 (Philippines) to 4.772 (Egypt), indicating substantial cross-country dispersion. Twenty-three countries exhibit a negative value of β_{2i}^{CH}, implying that average, their exports to China fell when China imposed additional tariffs on U.S. products. Korea's β_{2i}^{CH} is –0.364, meaning that a 1 percent increase in China's tariff on U.S. goods is associated with a 0.364 percent decrease in Korea's exports to China, relative to a no-tariff-change scenario.[44]

In contrast, β_{1i}^{US} ranges from –2.284 (Ukraine) to 1.604 (Malaysia), exhibiting less dispersion than β_{2i}^{CH}. The mean is 0.123 and the median is 0.250, both higher than the corresponding elasticity toward China. Korea's β_{1i}^{US} is 0.763, ranking ninth among 49 countries.[45] Thus, a 1 percent increase in U.S. tariffs on Chinese imports is associated with a 0.763 percent increase in Korea's exports to the United States.

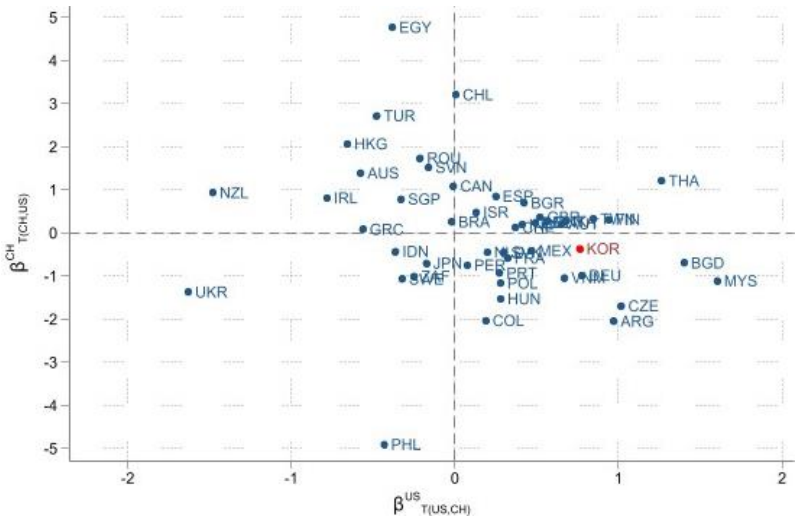


FIGURE C1. TARIFF ELASTICITIES TOWARD CHINA AND THE U.S.

Note: The y-axis shows β_{2i}^{CH}, and the x-axis shows β_{1i}^{US}.

Source: Authors' estimation based on Fajgelbaum *et al*. (2024) data.

[43]Appendix Figures C1 and C2 rearrange the results of Figure 4 in Fajgelbaum *et al*. (2024).

[44]More precisely, this refers to a 1 percent increase in 1+tariff rate (for example, 110 percent when the tariff is 10 percent). In other words, it denotes the change from 110 percent to 111.1 percent, which corresponds to a tariff rise from 10 percent to 11.1 percent. Note, however, that this scenario assumes a uniform tariff increase on all goods—not only on those targeted during the U.S.–China trade war—implying that it differs from cases in which only the originally targeted product lines face higher tariffs.

[45]Excluding the United States, there are 49 countries in the analysis sample.

Appendix Figure C2 displays the elasticities toward the RW market, β_{1i}^{RW} and β_{2i}^{RW}. Their cross-country dispersion value is smaller than the elasticities toward the U.S. or China, likely because the RW aggregate includes many importing countries whose heterogeneous responses may offset one another, and because the largest tariff changes occurred between U.S. and China rather than in third-country markets. Most countries exhibit positive elasticities, indicating that reciprocal tariffs by the U.S. and China tend to boost exports to the RW. For Korea, $\beta_{1i}^{RW} = 0.674$ and $\beta_{2i}^{RW} = 1.061$, implying that a simultaneous 1 percent increase in both U.S. and Chinese tariffs would raise Korea's exports to the RW by approximately 1.735 percent in total relative to no tariff change.

In summary, the estimated tariff elasticities toward the U.S., China, and RW markets show substantial cross-country heterogeneity. This result suggests that the same tariff shocks from the U.S. or China can generate different effects across exporters, reflecting their varied economic characteristics. Korea's elasticities toward the U.S. and RW markets exceed the sample mean, whereas its elasticity toward China lies near the median among the 49 countries analyzed.

Next, I compute the export changes implied by the estimated $\hat{\beta}$ and compare them with the actual export outcomes during the U.S.–China trade war. Appendix Figure C3 plots, for each country, the weighted average change in total exports of the tariff-affected products (the "treated group").[46] The horizontal axis shows the actual observed change in exports, while the vertical axis shows the fitted change obtained by applying each country–product's estimated $\hat{\beta}$ to the observed tariff changes. The total export change rate is constructed as the weighted average of country–product export growth rates, where the weights are each product's share in total exports during the pre-treatment period (2016–17) within the treated group.

As shown in Appendix Figure C3, most countries' fitted values fall below their actual export changes, indicating a systematic underestimation. This pattern suggests the presence of negative bias in the empirical model, likely reflecting omitted variables that amplified real export growth. For example, newly created export opportunities in the U.S. and Chinese markets may have stimulated production expansions in some countries, which then propagated additional output and exports elsewhere through input–output linkages and global value chains. Note that the divergence between fitted and actual changes reported here refers to averages across all treated products; at the product level, offsetting omitted-variable biases in the opposite direction may also have affected some products. One such offsetting factor could be the broader uncertainty induced by the trade war—beyond the specific tariffs actually imposed—across bilateral and multilateral trade and the global economy, which may have depressed overall exports.[47]

[46]Market-specific figures are also available upon request.

[47]For instance, work by Benguria *et al*. (2022) demonstrates that trade policy uncertainty (TPU) experienced by Chinese exporters during the U.S.–China trade war increased sharply, which had a broadly negative effect on firms' investment and R&D activities. Handley and Limão (2017) similarly show that TPU between the United States and China influenced firms' export market entry and investment decisions. Although these studies focus on

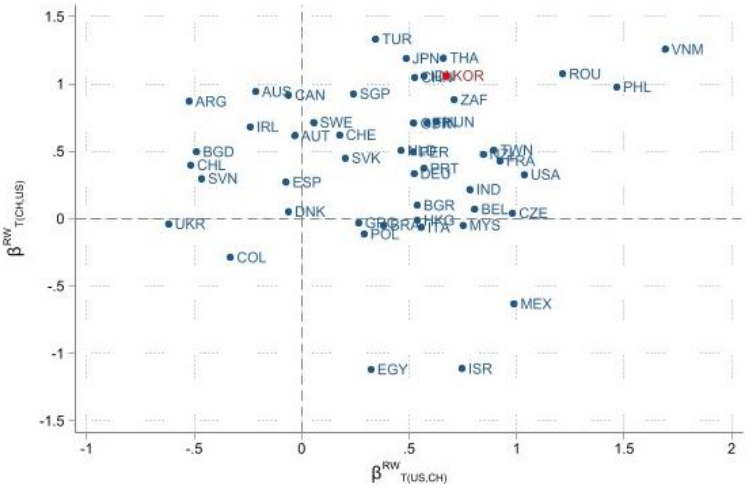


FIGURE C2. TARIFF ELASTICITIES TOWARD THE REST OF THE WORLD

Note: The y-axis shows β_{2i}^{RW}, and the x-axis shows β_{1i}^{RW}.

Source: Authors' estimation based on Fajgelbaum *et al*. (2024) data.

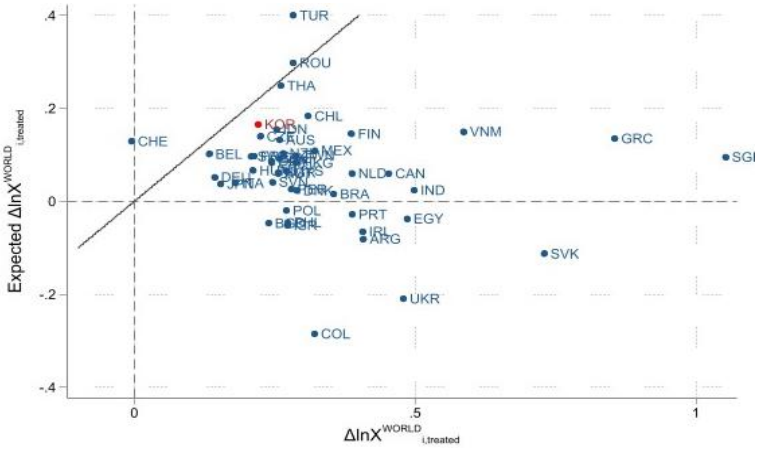


FIGURE C3. TOTAL CHANGE IN EXPORTS – EXPECTED AND ESTIMATED

Note: The horizontal axis depicts the actual export change rate between 2016–17 and 2018–19 ($\Delta \ln X_i$), while the vertical axis depicts the fitted export change rate ($\Delta \ln X_i$) based on the empirical model results. The unit of export change is the log difference, and the dark gray line represents the $y = x$ line.

Source: Authors' estimation based on Fajgelbaum *et al*. (2024) data

the effects on Chinese exporters, third-country exporters are likely to be subject to similar pressures. Bloom *et al*. (2007) find that rising uncertainty reduces firms' investment responsiveness; this effect is particularly pronounced when investment decisions involve partial irreversibility—an attribute characteristic of export market entry and expansion investments.

b. Decomposition of Tariff Elasticities

In the previous section, I introduced the concept of country-product-specific tariff elasticities through a theoretical model and reviewed empirical estimates. This section decomposes tariff elasticity into different components, following the theoretical framework outlined earlier.

As discussed earlier, tariff elasticity is decomposed into three components: importer–exporter effects, importer–industry effects, and importer–product effects. Equation (C7), stated here again, expresses this decomposition.

$$\beta_{zi\omega}{}^{n} = \beta_{zi}{}^{n} + \beta_{zj(\omega)}{}^{n} + \Gamma_{z}{}^{n}\mathrm{SIZE}_{zi\omega}{}^{n} \quad (z = 1,2,3,4) \tag{C7}$$

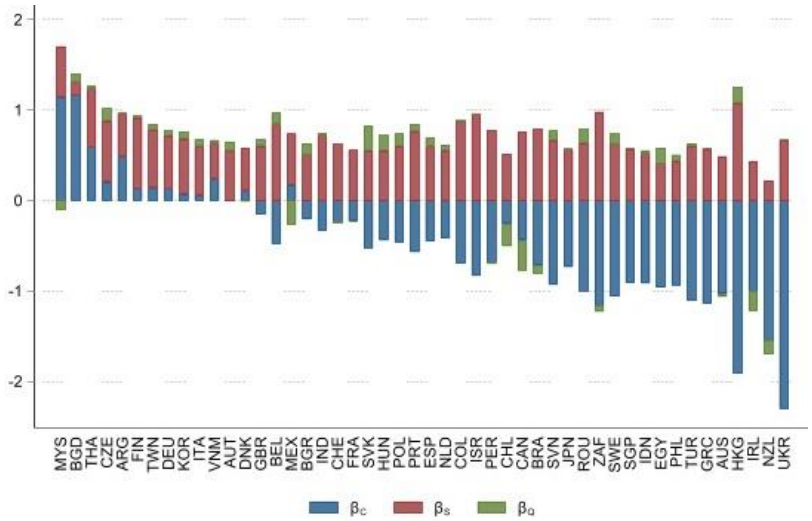
Substituting Equation (C7) into the empirical specification (Equation (C8)) yields estimates of each component. Appendix Figure C4 presents country-average tariff elasticities for the U.S. (Panel A) and for China (Panel B), broken down according to each component.[48] The blue bars represent the importer–exporter ("country") component, the red bars the importer–industry component, and the green bars the importer–product component. In each panel, countries are ordered from highest to lowest total elasticity.

In Panel A, both the country and the industry components account for most of the elasticity toward the U.S. Notably, the industry component is positive for all countries. In contrast, in Panel B, the industry component for tariff elasticities toward China is relatively small. This reflects the choice of agriculture as the reference industry in Equation (C8): each non-agricultural sector's fixed effect is measured relative to agriculture. In the U.S. market, all non-agricultural industries exhibited positive fixed effects—hence uniformly positive industry components—whereas in the Chinese market those fixed effects were divided between positive and negative values.

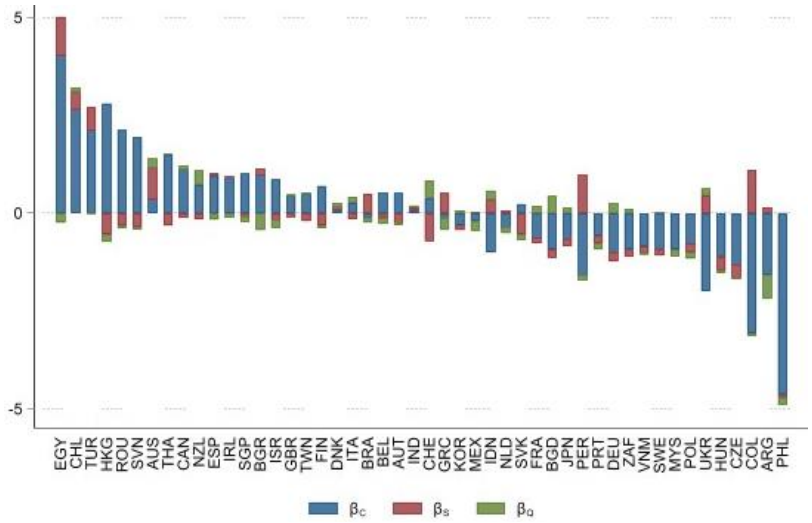
Turning to the country component (i.e., importer-exporter component), it dominates the total elasticity in both panels, and this is especially so for elasticities toward China, where it largely determines both the sign and magnitude of the total. This follows from the relatively small average effect of the importer–industry component across countries. Likewise, for elasticities toward the U.S., the importer–industry component is similar across countries, making the importer–exporter component the principal source of cross-country heterogeneity.

The country component dominates the total tariff elasticity in both panels. Specifically, the country component almost entirely determines both sign and magnitude of the elasticities toward China. Similarly, for elasticities toward the U.S., the industry component is roughly similar across countries, making the country component the stronger driver of cross-country heterogeneity.

[48]I calculate the weighted average using each product's share of pre-war (2016–17) exports in each country's total exports to either market (the U.S. or China).



In certain countries, the country component exerts an especially large influence. A. Tariff elasticities toward the U.S.



B. Tariff elasticities toward China

FIGURE C4. DECOMPOSITION OF TARIFF ELASTICITIES

Note: Country-level average tariff elasticities for the U.S. and China are decomposed into exporter-specific components (β_{Ci}), industry-specific components (β_{Si}), and product-specific components (β_{Qi}). The countries are ordered according to the magnitude of β_i .

Source: Authors' estimation based on Fajgelbaum *et al*. (2024) data.

For instance, regarding elasticities toward the U.S., Malaysia and Bangladesh exhibit large positive country effects, whereas Hong Kong and Ukraine display large negative effects. For elasticities toward China, Egypt, Chile, and Hong Kong show notably positive country components, while the Philippines and Colombia show significant negative components. In Korea's case, while the absolute value of the

country component is modest in both panels, its negative value, combined with the industry component, results in overall negative tariff elasticity toward China.

To understand these variations, recall that the country component captures factors such as economic proximity, bilateral cooperation, and other characteristics that either boost demand in the importing market or enhance an exporter's capacity to supply. For example, following Egypt's 2016 agreement with China to strengthen the Belt and Road cooperation, bilateral economic exchanges intensified and Egypt's exports to China expanded—likely contributing to Egypt's high country fixed effect. In contrast, Hong Kong's traditional role as a transshipment hub for Chinese goods bound for the United States meant that its exports to the U.S. market fell sharply during the trade war, resulting in a large negative country component. Of course, these examples are illustrative, and identifying the precise drivers of cross-country variation in country effects requires further research.

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