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# The US-China Trade War and Global Reallocations[†]

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*The US-China trade war created net export opportunities rather than simply shifting trade across destinations. Many "bystander" countries grew their exports of taxed products into the rest of the world (excluding the United States and China). Country-specific components of tariff elasticities, rather than specialization patterns, drove large cross-country variation in export growth of tariff-exposed products. The elasticities of exports to US-Chinese tariffs identify whether a country's exports complement or substitute the United States or China and its supply curve's slope. Countries that operate along downward-sloping supplies whose exports substitute (complement) the United States and China are among the larger (smaller) beneficiaries of the trade war.* (*JEL* F13, F14, O19, P33)

In 2018 and 2019, the United States and China engaged in a trade war, mutually escalating tariffs that ultimately covered approximately $450 billion in trade flows. These policies upended a decades-long trend toward lower global trade barriers and, unsurprisingly, reduced trade between the United States and China, with escalated tariffs persisting until today.[1] While the US-China trade war can be seen as a turning point in the globalization era, it has also presented "bystander" countries with the opportunity to grow exports to the world's biggest economies and, potentially, among themselves.

Did other countries take over the US and Chinese markets? Did they reallocate exports away from the rest of the world? Affirmative answers would be consistent with substitution elasticities across exporters above one and with standard upward-sloping export supply curves. However, importers in the United States and China may perceive products from certain origins as substitutes to Chinese or US

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[1] See Amiti, Redding, and Weinstein (2019); Cavallo et al. (2021); Fajgelbaum et al. (2020); Flaaen, Hortaçsu, and Tintelnot (2020); Flaaen and Pierce (2019); and Waugh (2019). Fajgelbaum and Khandelwal (2022) survey research on the economic impacts of the trade war.

varieties, respectively, and others as complements; in parallel, greater demand from the United States or China could have raised global exports for bystander countries if supply curves slope downward. In addition, countries specialized in sectors with more elastic supplies may have responded more strongly. The trade war provides an opportunity to inspect these forces.

The empirical analysis is guided by a Ricardian-Armington trade model allowing substitution elasticities to be country-pair specific and above or below one, and for country- and sector-specific supply elasticities that may be downward sloping. Our first proposition derives, from a first-order approximation around an arbitrary equilibrium, a formula for the reduced-form elasticity of a bystander's product-level exports (to the United States, China, and the rest of the world) to US and Chinese tariffs. This elasticity captures the effects of demand shifts due to tariff changes, conditioning on indirect demand and supply shifters through general equilibrium adjustments. Our second proposition shows that, properly controlling for these indirect effects, the estimated tariff elasticities of exports jointly identify (i) whether a country's exports substitute or complement the United States or China and (ii) whether it operates along downward- or upward-sloping supply curves.

We implement the empirical analysis on global bilateral HS6-level trade data. We first estimate product-level export responses from exporters other than the United States or China assuming common tariff elasticities across countries. The first takeaway is that, on average, bystanders increased their exports to the United States, barely changed their exports to China, and *increased* their exports to the rest of the world in products with higher US-Chinese tariffs. So, while the United States and China taxed each other, the average country increased its global exports in targeted products relative to untargeted products. Therefore, the trade war created net trade opportunities rather than simply shifting trade across destinations.[2]

This initial approach assumes common tariff elasticities across countries, but these elasticities may vary by exporter, importer, sector, and size of the trade flow, as implied by the model. Our main estimation allows for this flexibility. Aggregating the predicted product-level export responses using pretrade war export shares, we obtain, for each country, the predicted export growth in targeted products compared to nontargeted ones.

This flexible specification reveals a second takeaway: there is substantial cross-country heterogeneity in export growth in targeted products compared to nontargeted products. Moreover, this heterogeneity is largely driven by countries' export responses to the rest of world. Some countries, such as Vietnam, Thailand, Korea, and Mexico, were among the largest export "winners" in the sense that they better exploited trade opportunities in product markets with declining US or Chinese participation. The average export growth in taxed products across countries is 6.4 percent with a standard deviation across countries of 6.2 percent (compared to a standard deviation of just 1.4 percent implied by a specification with homogeneous tariff elasticities).

[2]The regressions isolate relative export growth in taxed products. Raw aggregate exports from the bystanders to the rest of the world grew by 10 percent from 2016/2017 to 2018/2019. Consistent with others, we find that the United States and China reduced bilateral exports in products with larger tariff increases.

These cross-country differences in export growth in targeted products result from (i) tariff elasticities that differ by country and (ii) tariff elasticities that differ by sector and size of the trade flow, combined with prewar specialization patterns across products. Our third key takeaway is that the country-specific component explains the bulk—75.8 percent—of the cross-country variation in export growth in targeted products. The combination of prewar specialization and size-dependent or sector-specific tariff elasticities explain the remaining variation.

Having isolated the country-specific component as the key driver of heterogeneous export growth, we exploit our theoretical proposition to identify supply and demand channels. We find a subset of countries where the pattern of country-specific components across destinations suggest downward-sloping supplies. Moreover, many countries responded as complements to US and Chinese production, while others responded as substitutes. Importantly, the interaction of demand and supply heterogeneity in the elasticities matters: due to different patterns of demand substitution, countries operating along downward-sloping supplies can be found among those with the strongest and the weakest export growth. For example, Mexico, Thailand, Colombia, and Ukraine operate along downward-sloping supplies; however, the former two are strong beneficiaries of the war because, as revealed by our estimates, they export products that substitute China in the United States, while the latter are not because their products complement US or Chinese exports.

Our first result—that the average country increases global exports in products taxed by the United States or China—suggests an interdependency across export destinations. We rationalize this finding through downward-sloping supply curves at the product level. Mau (2017) and Albornoz-Crespo, Brambilla, and Ornelas (2021) both show third-market effects after tariff reforms faced by Chinese and Argentinean firms, respectively, that are consistent with scale effects. Morales, Sheu, and Zahler (2019) and Alfaro-Ureña et al. (2023) provide firm-level evidence consistent with complementarities via trade costs, such that exporting to a destination lowers the costs of exporting to similar destinations. Almunia et al. (2018) show that Spanish firms export more when the domestic market shrinks. The result is also consistent with reallocations of supply chains under particular input-output structures.[3] Flaaen, Hortaçsu, and Tintelnot (2020) show that, for washing machines, product-specific capital migrates from China to other countries serving as export platforms to the United States in order to avoid the tariffs. Our result suggests that these export platforms may also increase exports to the rest of the world.

Our subsequent results, which reveal substantial cross-country heterogeneity in export growth consistent with country-specific demand and supply elasticities, are surprising given that trade or scale elasticities are typically assumed to vary across sectors rather than across countries. On the demand side, standard gravity models such as Anderson and van Wincoop (2003) and Eaton and Kortum (2002), and multisector models such as Costinot, Donaldson, and Komunjer (2012) or Caliendo and Parro (2015), impose elasticities of substitution between imports from different origins that may be sector specific but common across country pairs, with typical estimates revealing substitution greater than one. In contrast, our trade-war responses

[3] Increasing exports to the rest of the world could reflect that supply chains of tariffed HS6 products become more dispersed across countries and heavily use their own output as input.

are consistent with exporter-specific substitution elasticities with the United States or China that may be above or below one. These empirical results are also broadly consistent with, and could be explained by, frameworks that feature flexible patterns of substitution across imports, such as Adao, Costinot, and Donaldson (2017) and Lind and Ramondo (2023).[4]

On the supply side, identifying scale economies has been a focus of empirical research; see Antweiler and Trefler (2002) and, more recently, Costinot et al. (2019); Farrokhi and Soderbery (2020), with whom we share an identical supply-side structure; and Breinlich et al. (2022).[5] In standard applications, these scale elasticities vary by sector but not across countries, providing a rationale for industrial policies (Bartelme et al. 2019; Lashkaripour and Lugovskyy 2023). We show that, in addition, a country-specific and often downward-sloping component of supply curves plays an important role, providing an additional basis for potentially country-varying optimal subsidies. Computing these subsidies would require the exact parameters values and modeling additional general-equilibrium aspects, which could be a path for future research.

## I. Framework

This section presents the framework that guides the empirical analysis.

### A. *Environment*

*Demand*.—There is a set $\mathcal{I}$ of countries (indexed by $i$ for exporters and $n$ for importers) and a set $\Omega^j$ of products (indexed by $\omega$) in sector $j = 1, \ldots, J$. Each product $\omega$ is differentiated by origin $i$; a variety is $i\omega$. We let $p_{i\omega}$ be the price received by competitive producers of the variety. In each country, imported and domestic varieties are aggregated, through a translog aggregator, into a nontraded good used either as input or for consumption. Hence, in destination $n$, the share of (tariff-inclusive) spending in product $\omega \in \Omega^j$ imported from origin $i$ is

$$s^n_{i\omega} = a^n_{i\omega} + \sum_{i' \in \mathcal{I}} \sigma^j_{i'i} \ln p^n_{i'\omega}, \tag{1}$$

where $p^n_{i\omega}$ is the tariff-inclusive price in country $n$.

The parameter $a^n_{i\omega}$ captures an idiosyncratic demand of country $n$ for the variety $i\omega$. The semielasticities $\sigma^j_{i'i}$ are common across importing countries and capture the substitutability between products from $i$ and $i'$. When $\sigma^j_{i'i} > 0$ ($\sigma^j_{i'i} < 0$), varieties $i$ and $i' \neq i$ are substitutes (complements) within sector $j$, in the sense that an increase in the price of goods from $i$ leads to increase (reduction) in the

[4] Reyes-Heroles, Traiberman, and Van Leemput (2020) show that a framework with capital accumulation and input-output linkages predicts heterogeneous impacts of tariffs depending on factor intensities. Devarajan et al. (2021) use a CGE model to examine trade diversion from the trade war.

[5] Like Costinot et al. (2019), we do not quantitatively estimate the scale parameters but rather check whether supplies are downward sloping. They show that the elasticities of exports to domestic and foreign demand reveal the slope of supply relative to the own-price demand elasticity. We show that the elasticity of exports to the country imposing a tariff and to the rest of the world identify the slope signs of supply and of cross-price demand elasticity with respect to the country imposing tariffs.

expenditure share (and quantity) purchased in goods from $i'$.[6] We impose a common substitution elasticity within the sector: $\sigma^j_{ii'} = \sigma^j_{RW}$ for $i' \neq i$ and $i, i' \neq US, CH$.

A key feature of this demand system is that Chinese and American goods command country-specific substitution patterns. Goods from a given exporter $i$ can substitute Chinese goods and complement American goods ($\sigma_{i,CH} > 0$ and $\sigma_{i,US} < 0$, while the opposite may be true for goods from another exporter.[7]

*Supply*.—Due to trade costs, $\tau^n_{i\omega}$ units of variety $i\omega$ must be shipped to $n$ for one unit to arrive. Also, country $n$ imposes ad valorem tariffs $t^n_{i\omega}$ on imports of good $\omega$ from $i$. Letting $p_{i\omega} \equiv p^i_{i\omega}$ be the domestic price of variety $i$ and assuming competitive pricing, the tariff-inclusive prices faced by consumers in country $n$ are

$$p^n_{i\omega} = T^n_{i\omega}\tau^n_{i\omega}p_{i\omega}, \tag{2}$$

where $T^n_{i\omega} \equiv 1 + t^n_{i\omega}$ is one plus the ad valorem tariff. Total sales of $\omega$ in sector $j$ from country $i$ are

$$X_{i\omega} \equiv A^j_i p^{\frac{1}{b^j_i}}_{i\omega} Z_{i\omega}, \tag{3}$$

where $b^j_i$ is the inverse supply elasticity, defined as the elasticity of price to total sales, and $p_{i\omega}$ is the domestic price of variety $i$. The supply shifters are partitioned into an endogenous country-sector component $A^j_i$ and an exogenous cost shifter $Z_{i\omega}$. The former captures factor and input prices common across products within a sector. Changes in these costs due to tariffs are absorbed by fixed effects in our estimation. The supply curve is potentially downward sloping ($b^j_i < 0$).

Online Appendix B.1 shows a microfoundation where $b^j_i$ combines returns to scale and an elasticity of factor mobility across products and sectors.[8] In particular, $b^j_i = 1/\varepsilon^j_i - \gamma^j_i$, where $\varepsilon^j_i \geq 1$ is a factor supply elasticity and $\gamma^j_i$ captures returns to scale. Although we do not attempt to separately identify the components of $b^j_i$, within this framework, $b^j_i < 0$ implies that $\gamma^j_i > 0$. At the same time, the more flexible is factor substitution across products (the higher is $\varepsilon^j_i$), the more likely it is to observe $b^j_i < 0$.

*Equilibrium*.—The price of variety $i\omega$ in importer $n$ is $p^n_{i\omega} = \left(1 + \tau^n_{i\omega}\right)t^n_{i\omega}p_{i\omega}$, where $\tau^n_{i\omega}$ is the ad valorem tariff and $t^n_{i\omega}$ is the trade cost. A world equilibrium is given by prices $\{p_{i\omega}\}$ such that markets clear; that is, the aggregate sales $X_{i\omega}$ given by (3) must equal aggregate expenditures:

$$X_{i\omega} = \sum_{n \in \mathcal{I}} \frac{s^n_{i\omega}}{T^n_{i\omega}} E^n_\omega, \tag{4}$$

[6] Additivity and symmetry of the substitution matrix require that $\sum_{i=1}^N a^n_{i\omega} = 1$ for all $n$ and $\omega$, as well as $\sigma^j_{i'i} = \sigma^j_{ii'}$ for all $i, i', j$ and $\sum_{i' \in \mathcal{I}} \sigma^j_{ii'} = 0$ for all $i, j$.

[7] Studies using a translog or almost-ideal demand system with symmetric substitution elasticities include Novy (2013); Kee, Nicita, and Olarreaga (2008); Fajgelbaum and Khandelwal (2016); and Feenstra and Weinstein (2017).

[8] Other standard microfoundations of returns to scale include increasing returns with monopolistic competition as in Krugman (1980); reorganization (Caliendo and Rossi-Hansberg 2012); or division of labor (Chaney and Ossa 2013). The microfoundation for factor mobility is the same as Burstein, Morales, and Vogel (2019) or Galle, Rodríguez-Clare, and Yi (2023), among others.

where $E^n_\omega \equiv \zeta^n_\omega E^n$ are country $n$'s expenditure in product $\omega$, which is a constant share $\zeta^n_\omega$ of national expenditure $E^n$. To complete the description of the general equilibrium model, we need additional assumptions to determine the country-sector supply shifters $A^j_i$ and the country expenditures $E^n$. Rather than imposing additional model structure, we flexibly control for importer-exporter-sector fixed effects and for model-implied measures of the size of the trade flows in our empirical specifications.

### B. *Impact of US-Chinese Tariffs on Bystanders' Exports*

The following proposition summarizes how tariff changes imposed by the United States or China impact exports to each destination:

PROPOSITION 1: *Around an arbitrary initial equilibrium, to a first-order approximation, exports $X^n_{i\omega}$ of product $\omega$ from exporter $i$ to importer $n$ change according to*[9]

$$\begin{aligned}(5)\quad \Delta \ln X^n_{i\omega} \;=\; & \beta^n_{1i\omega}\Delta \ln T^{US}_{CH,\omega} + \beta^n_{2i\omega}\Delta \ln T^{CH}_{US,\omega} + \beta^n_{3i\omega}\Delta \ln T^{US}_{i\omega} + \beta^n_{4i\omega}\Delta \ln T^{CH}_{i,\omega} \\ & + \beta^n_{5i\omega}\sum_{j\neq CH,US,i}\Delta \ln T^{US}_{j\omega} + \beta^n_{6i\omega}\sum_{j\neq CH,US,i}\Delta \ln T^{CH}_{j,\omega} + \eta^n_{i\omega} + \eta^n_{i\omega},\end{aligned}$$

*where, letting $E_\omega \equiv \sum_{n'} E^{n'}_\omega$ be world expenditures in product $\omega$,*

$$(6)\qquad \beta^n_{1i\omega} \equiv \left(\mathbf{1}\{n = US\} + \frac{E^{US}_\omega}{E_\omega}\frac{\frac{b^j_i\sigma^j_{ii}}{X_{i\omega}/E_\omega}}{1-\frac{b^j_i\sigma^j_{ii}}{X_{i\omega}/E_\omega}}\right)\frac{\sigma^j_{CHi}}{s^n_{i\omega}}.$$

*$\beta^n_{2i\omega}$ to $\beta^n_{6i\omega}$ are given by* (B.31)–(B.35) *in the online Appendix and*

$$(7)\qquad \eta^n_{i\omega} \equiv \frac{b^j_i\sigma^j_{ii}\left(\sum_{n'\in\mathcal{I}}\frac{X^{n'}_{i\omega}}{X_{i\omega}}\hat{E}^{n'} - \hat{A}^j_i\right) + \hat{p}_{-i\omega}}{1-\frac{\sigma^j_{ii}b^j_i}{X_{i\omega}/E_\omega}}\frac{1}{s^n_{i\omega}} + \hat{E}^n,$$

*where $\hat{p}_{-i\omega} \equiv \sum_{i'\neq i}\sigma^j_{i'i}\hat{p}_{i'\omega}$.*

Equation (5) partitions the total change in sales of product $\omega$ from country $i$ to destination $n$ into two distinct components. The first two lines, an inner product $\beta\Delta T$ of elasticities and tariff changes, captures the demand shocks from tariffs such that the price of variety $i\omega$ changes to clear its global market. The last line, the term $\eta^n_{i\omega}$ defined in (7), captures the indirect effects of tariffs through endogenous demand shifters for each buying country (national expenditure shares, $\hat{E}^{n'}$, and average price changes of competing varieties, $\hat{p}_{-i\omega}$) and of supply shifters for the exporter (endogenous changes in sector-level factor prices $\hat{A}^j_i$).

We will implement equation (5) to estimate tariff elasticities using across-product variation in export responses. We include all the terms suggested by (5), but our focus

[9] $\Delta\ln(Y) \equiv \ln(Y') - \ln(Y)$ is the log difference in $Y$ after the change in tariffs.

is on the first two coefficients, $\beta^n_{1i\omega}$ and $\beta^n_{2i\omega}$. Equation (6) shows the expression for $\beta^n_{1i\omega}$, the elasticity of variety $i\omega$ exports to destination $n$ in response to US tariffs (with a similar expression for $\beta^n_{2i\omega}$, corresponding to Chinese tariffs, in (B.31)). The tariff elasticities may vary by exporter $i$ and sector $j$ due to heterogeneous $\sigma^j_{CHi}$ or $b^j_i \sigma^j_{ii}$. Due to size dependence, the tariff elasticity is also variety specific, decreasing with the export flow's size and increasing with the size of the United States or China as buyers.

Naturally, higher substitution or scale elasticities imply stronger responses. The next proposition shows that the tariff elasticities $\beta$ of variety $i\omega$ to the United States and to the rest of the world, as defined in (5), jointly identify the signs of $\sigma^j_{CHi}$ and $b^j_i \sigma^j_{ii}$.

PROPOSITION 2: *When the United States imposes a tariff on China in product* $\omega$, *then*,

(*i*) *if* $\sigma^j_{CHi} > 0$ $(\sigma^j_{CHi} < 0)$, *then exports from i to the United States increase* (*decrease*) *if and only if* $\left(b^j_i \sigma^j_{ii}\right)/(X_{i\omega}/E_\omega) \in (-\infty, 1] \cup \left[1/\left(1 - E^{US}_\omega/E_\omega\right), \infty\right)$; *and*,

(*ii*) *assuming that* $\sigma^j_{ii} < 0$: *if* $\sigma^j_{CHi} > 0$ *and exports increase* (*decrease*) *from i to the rest of the world, then* $b^j_i < 0$ $(b^j_i > 0)$, *while if* $\sigma^j_{CHi} < 0$ *and exports increase* (*decrease*) *from i to the rest of the world, then* $b^j_i > 0$ $(b^j_i < 0)$.

When the United States taxes China, the responses of a bystander's exports to the United States and to the rest of the world reveal both the sign of the substitutability between that country's products and Chinese varieties *and* the sign of the supply curve slope. Online Appendix Table A.1 shows the possible cases. A downward-sloping supply $(b^j_i < 0)$ is consistent with observing export responses with equal sign to both the United States and the rest of the world. Conversely, upward-sloping supply $(b^j_i < 0)$ is consistent with observing export responses with opposite sign to the two destinations. The same logic applies for Chinese tariffs on US imports.

For example, consider the China-substitutes case in the right column. As implied by part (i) of the proposition, this column corresponds to estimating $\beta^{US}_{1i\omega} > 0$ (an increase in variety $i\omega$ exports to the United States in response to the US tariff on China).[10] As implied by part (ii), given negatively sloped demand, further estimating an increase in exports to countries other than the United States $(\beta^{RW}_{1i\omega} > 0)$ reveals a downward-sloping supply $(b^j_i < 0)$. In this case, the gain in scale due to increased US demand leads to an increase in exports to the rest of the world.[11] Conversely, estimating $\beta^{RW}_{1i\omega} < 0$ would be consistent with upward-sloping supply,

[10] Part (i) holds for a range of values of the parameters, and it is guaranteed to hold as the number of countries grows large or if the United States does not command a very large share of the global market of product $\omega$.

[11] As shown in Proposition 2 (ii), this statement holds assuming $\sigma^j_{ii} < 0$. Otherwise, an increase in exports would reveal a pathological case where inverse demand is positively sloped and even more so than a positively sloped supply.

so that higher demand in one destination reallocates sales away from others. By this logic, in the China-complements case of the first column, the downward-sloping supply is revealed by a reduction in exports to the rest of the world.

## II. Data and Summary Statistics

We use UN Comtrade (2022) data recording bilateral exports in 5,203 HS6 products. We aggregate into 24-month intervals (2014/2015; 2016/2017; 2018/2019) and refer to each 24-month period by its ending year. We restrict our sample to the top exporting countries, excluding oil exporters. The resulting sample covers 95.9 percent of global trade (or 70.5 percent excluding the United States and China). We analyze exports from each of these countries to three destinations: the United States (*US*), China (*CH*), and the aggregate of all destinations except the United States and China (*RW*). We classify products into nine sectors: agriculture, apparel, chemicals, materials, machinery, metals, minerals, transport, and miscellaneous. Online Appendix Figure A.1 reports countries' export shares by sector prior to the trade war.

We consider four sets of tariff changes as part of the US-China trade war: (i) imposed by the United States on China (the "US tariffs"), denoted as $T^{US}_{CH,\omega}$, where $\omega$ denotes an HS6 product code; (ii) imposed by China on the United States, $T^{CH}_{US,\omega}$ (the "Chinese tariffs"); (iii) imposed by the United States on each country $i$ other than China, $T^{US}_{i,\omega}$ (e.g., steel tariffs on Mexico); and (iv) most-favored-nation (MFN) tariffs imposed by China on all countries but the United States, $T^{CH}_{i,\omega}$. Bown, Jung, and Zhang (2019) argue that China's MFN tariff cuts were likely influenced by the trade war with the United States, so we include them in our analysis. The first three sets of tariffs are taken from Fajgelbaum et al. (2020) and extended through the end of 2019, and the last set is from Bown, Jung, and Zhang (2019). We use census data (US Census Bureau 2020) to compute dollar-weighted averages of tariffs at the HS6 level and scale tariff changes in proportion to their duration within each 24-month interval. This scaling generates variation in tariff changes across products due to both the timing and magnitude of rate changes.

Online Appendix Figure A.2 illustrates the tariff variation. The United States substantially raised tariffs on China, but, except for two sectors (machinery and metals), it did not significantly raise tariffs on other partners. Panel B shows that China's tariffs increased across all sectors for the United States and decreased for non-US partners. For both the United States and China, we observe substantial variation within sectors.

## III. Average Export Responses

Figure 1 presents binscatters that examine the exports of the bystander countries to the United States, China, and the rest of the world (henceforth, RW) against the US-Chinese tariffs. Each panel plots linear relationships of the form

$$\Delta \ln X = \alpha + \beta \Delta \ln T + \varepsilon. \tag{8}$$

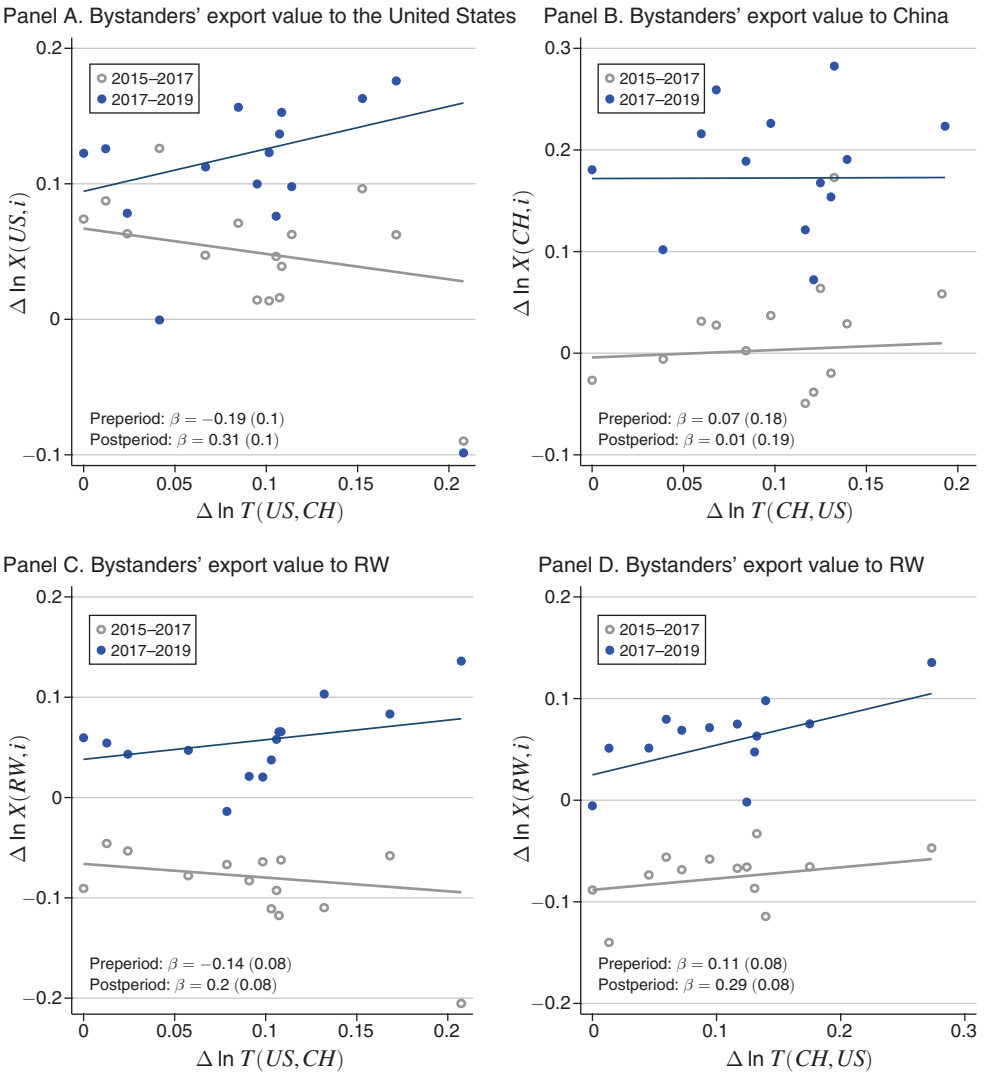


FIGURE 1. TRADE WAR TARIFFS AND EXPORT GROWTH

*Notes:* The panels show binscatter plots of the regression in (8), $\Delta \ln X = \alpha + \beta \Delta \ln T + \varepsilon$. This is a regression of bystanders' export growth (on the *y*-axes) against changes in tariffs due to the trade war (on the *x*-axes). Panel A is bystanders' exports to the United States ($X_{i\omega}^{US}$) against the US tariffs ($T_{CH,\omega}^{US}$). Panels B is bystanders' exports to China ($X_{i\omega}^{CH}$) against the Chinese tariffs ($T_{US,\omega}^{CH}$). Panels C and D show bystanders' exports to RW ($X_{i\omega}^{RW}$) against the US ($T_{CH,\omega}^{US}$) and Chinese tariffs ($T_{US,\omega}^{CH}$), respectively. Also shown are the binscatters of the regressions with exports prior to the trade war from 2015 to 2017. At the bottom of each panel are OLS coefficients, with standard errors clustered by product shown in parentheses. Panels A and B of online Appendix Table A.2 report the corresponding regression tables.

Panel A shows the binscatter of exports of bystander $i$ to the United States ($X_{i\omega}^{US}$) against the US tariffs ($T_{CH,\omega}^{US}$).[12] Panel B shows $i$'s exports to China ($X_{i\omega}^{US}$) against

[12] Each binscatter includes exports from every country in our dataset except for the United States and China. Online Appendix Figure A.3 confirms, as others have found, that the Chinese tariffs reduced US exports to China and vice versa.

the Chinese tariffs ($T^{CH}_{US,\omega}$). Panels C and D report exports to *RW* ($X^{RW}_{i\omega}$) against the US ($T^{US}_{CH,\omega}$) and Chinese ($T^{CH}_{US,\omega}$) tariffs, respectively.

Panel A reveals that, on average, bystanders increased exports to the United States in products with high US tariffs on China, with an elasticity of 0.31 (standard error 0.10). This growth rate is statistically distinct from the prewar export growth rate from 2015 to 2017 (elasticity −0.19 and standard error −0.19). Panel B shows that, on average, countries did not reallocate exports to China in response to China's tariffs on the United States. Panels C and D show that exports to RW increased with both tariffs, with an elasticity of 0.20 (standard error 0.08) for the US tariffs (panel C) and of 0.29 (standard error 0.08) for the Chinese tariffs (panel D).

These results suggest that the trade war created net trade opportunities on average rather than merely prompting reallocations: joint exports to the United States and China in tariff-exposed products increased and so did exports to the rest of the world. However, this average response masks large heterogeneity across countries. For example, the average country is revealed to neither complement nor substitute China, but this null average response may hide that some countries substitute and others complement China. We examine heterogeneity next.[13]

## IV. Heterogeneous Export Responses

To explore heterogeneity in tariff elasticities, we implement a specification motivated by Proposition 1. We now discuss a few aspects of the implementation.

First, we set $\beta^n_{5i}$ and $\beta^n_{6i}$ in equation (5) to zero. While theoretically justified, the tariff summation terms that identify these coefficients are highly correlated with the underlying bilateral tariffs from which they are constructed.[14]

Second, the tariff elasticities $\beta^n_{zi\omega}$ vary by importer, exporter, and measures of variety size according to Proposition 1. For example, from (6), the elasticity $\beta^n_{1i\omega}$ to US tariffs is a nonlinear function of observable variables $SIZE^n_{1i\omega}$ that capture the (prewar) relative size of the variety's trade flow, exporter-sector components ($b^j_i \sigma^j_{ii}$ and $\sigma^j_{CHi}$), and an importer component (the indicator $\mathbf{1}\{n = US\}$).[15] We capture this heterogeneity by imposing a linear structure:

$$\beta^n_{zi\omega} = \beta^n_{zi} + \beta^n_{zj(\omega)} + \Gamma^n_z SIZE^n_{zi\omega} \quad \text{for} \quad z = 1,2,3,4. \tag{9}$$

So, for each of the four tariffs ($z = 1,\ldots,4$), variation in tariff elasticities across exporters $i$ is captured by the exporter-importer component $\beta^n_{zi}$; variation across sectors $j$ is captured by importer-sector component $\beta^n_{zj(\omega)}$ (where $j(\omega)$ is the sector of

[13] Online Appendix Figure A.4 shows that the patterns, including the sharp response to *RW*, are robust to controlling for country-by-sector fixed effects. The patterns are also robust to including all four tariffs and lagged export growth.

[14] This is because China changed tariffs on an MFN basis to third countries, so the $\sum_{i' \neq CH,US,i} \Delta \ln T^{CH}_{i',\omega}$ term is $\Delta \ln T^{CH}_{i,\omega}$ times the number of exporters (excluding the United States, China, and exporter $i$) in product $\omega$. The correlation between $\sum_{i' \neq CH,US,i} \Delta \ln T^{CH}_{i',\omega}$ and $\Delta \ln T^{CH}_{i,\omega}$ is 0.997. A similar issue arises for the corresponding US term because when the United States changed the tariff rates on third countries, it often did so by a similar amount across trade partners.

[15] For $\beta^n_{1\omega}$, $SIZE^n_{1i\omega}$ includes $E^{US}_{\omega}/E_{\omega}$ (the share US expenditures in global expenditures of product $\omega$), $X_{i\omega}/E_{\omega}$ (the share of exporter $i$ sales in global expenditures of $\omega$), and $s^n_{i\omega}$ (the share of variety $i\omega$ in destination $n$ expenditures). Equations (B.31)–(B.33) show the corresponding variables $SIZE^n_{zi\omega}$ for the remaining $\beta$'s included in the specification.

product $\omega$); and variation across varieties within an exporter-importer-sector cell is due to $SIZE^n_{zi\omega}$.

Third, the term $\eta^n_{i\omega}$ in (5) is not directly observed and may, in principle, correlate with tariffs. If that were the case, our estimated tariff elasticities would still be unbiased estimators of the response of exports to tariffs under the parallel trend assumptions discussed below, but the interpretation of each of the $\beta$'s would include the sum of the corresponding direct effects in (B.30)–(B.33) *and* the correlations between $\eta^n_{i\omega}$ and the respective tariffs. We mitigate this concern by controlling for $\eta^n_{i\omega}$ by origin-destination-sector fixed effects ($\alpha^n_{ij}$) and the $SIZE^n_{zi\omega}$ variables.[16]

Finally, the regressions also include an error term $\varepsilon^n_{i\omega}$ capturing the reduced-form impact of any shock other than tariffs (e.g., variety-level shocks to preferences or productivity) on $X^n_{i\omega}$. We control for these unobserved shocks through the fixed effects and through pre-trends.

We define the structural and reduced-form residuals as follows:

$$\eta^n_{i\omega} + \varepsilon^n_{i\omega} \equiv \alpha^n_{ij(\omega)} + \Omega^n SIZE_{i\omega} + \pi^n \Delta \ln X^n_{i\omega,t-1} + \epsilon^n_{i\omega}.$$

The resulting specification is run separately to each destination, $n = US, CH, RW$ and takes the form

$$(10)\ \Delta \ln X^n_{i\omega} = \beta^n_{1i\omega} \Delta \ln T^{US}_{CH,\omega} + \beta^n_{2i\omega} \Delta \ln T^{CH}_{US,\omega} + \beta^n_{3i\omega} \Delta \ln T^{US}_{i,\omega} + \beta^n_{4i\omega} \Delta \ln T^{CH}_{i,\omega}$$
$$+ \alpha^n_{ij(\omega)} + \Omega^n SIZE_{i\omega} + \pi^n \Delta \ln X^n_{i\omega,t-1} + \epsilon^n_{i\omega},$$

where $\beta^n_{zi\omega}$ for $z = 1, \ldots, 4$ is defined in (9). The identifying assumption underlying this empirical strategy is that, within origin-destination-sector, potential export growth across products would have been the same in the absence of the trade war tariffs. We assess the plausibility of this parallel trends assumption by testing for differential trends in export growth in the years prior to the trade war. Figure 1 shows that bystander countries' prewar export growth is largely uncorrelated with the future changes in tariffs. To further mitigate concerns of preexisting trends, we include lagged export growth.

Having estimated the $\beta^n_{zi\omega}$, we predict the growth of variety $i\omega$ to the world (relative to nontargeted varieties) using the four trade war tariffs:

$$(11)\qquad \widehat{\Delta \ln X^{WD}_i} = \sum_{\omega} \sum_{n=US,CH,RW} \lambda^n_{i\omega} \Big( \hat{\beta}^n_{1i\omega} \Delta \ln T^{US}_{CH,\omega} + \hat{\beta}^n_{2i\omega} \Delta \ln T^{CH}_{US,\omega}$$
$$+ \hat{\beta}^n_{3i\omega} \ln T^{US}_{i,\omega} + \hat{\beta}^n_{4i\omega} \Delta \ln T^{CH}_{i,\omega} \Big),$$

[16] Variation in $\eta^n_{i\omega}$ comes from two sources. The first is exporter-sector factor costs, importer-sector expenditures, and sizes of variety-level trade flows, which we control for through fixed effects and size variables. The second is the sum of price changes of product $\omega$ in countries other than $i$: $\hat{p}_{-i\omega} \equiv \sum_{i'=CH,US} \sigma^j_{i'i} \hat{p}_{i'\omega} + \sigma^j_{RW} \sum_{i' \neq i,US,CH} \hat{p}_{i'\omega}$. Fajgelbaum et al. (2020) find that prices of US and Chinese varieties do not respond to tariffs, so the US and Chinese entries in this sum are small. Moreover, a takeaway is that the tariff elasticities are heterogeneous. Thus, export prices would likely decrease for some countries and increase for others without necessarily covarying with tariffs in a systematic way. We checked for a systematic pattern between average price changes of each country's competitors and the tariffs. For example, from country-by-country regressions on the four tariffs and sector fixed effects, we cannot reject that either US or Chinese tariffs have no impact on $i$'s competitors' average price changes, $\sum_{i' \in RW, i' \neq i} \hat{p}^{RW}_{i'\omega}$, in any of the bystanders.

where $\lambda_{i\omega}^{n}$ is the share of variety $i\omega$ to country $n$ in total exports of country $i$. The $\lambda_{i\omega}^{n}$ shares are defined as the (prewar) export values for continuing products divided by total country exports.

### A. *Heterogeneous Export Growth in Targeted Products*

The analysis reveals two key takeaways: (i) substantial cross-country heterogeneity in export growth in targeted products compared to nontargeted products and (ii) a central role for the country-specific component of the tariff elasticities, rather than any other component, in explaining this heterogeneity.

Figure 2 plots the export growth defined in (11) across countries.[17] By export growth, we specifically mean the growth of products taxed by the United States or China relative to other products within each exporter, importer, and sector. Hence, the figure indicates the countries that better exploited global export opportunities in products targeted by the trade war tariffs.

On average, countries' exports in targeted products increase by 6.4 percent, with a standard deviation just as large at 6.2 percent. For example, the increases in exports of targeted relative to untargeted products in Thailand and Mexico are 14.6 percent (standard error 4.9 percent) and 9.1 percent (standard error 6.3 percent), respectively, while Ukraine's exports fall 11.3 percent (standard error 8.6 percent) and Canada's export growth is just 1.2 percent (standard error 5.4 percent).[18]

Through the lens of our model, heterogeneity is expected. By construction of (11), it may be due to the country-specific demand or supply parameters or due to differences in specialization across products with different tariff changes or with different supply elasticities. We find that the bulk of the cross-country variation in Figure 2 comes from the country-specific component of the tariff elasticities (the $\beta_{zi}^{n}$ in (9)) and not from specialization ($\lambda_{i\omega}^{n}$), sectoral tariff elasticities ($\beta_{zj(\omega)}^{n}$), or size-specific tariff elasticities ($\Gamma_{z}^{n}$).

To see this, Figure 3 recomputes the export growth in (11) for different configurations of these components and plots each case against the case with full heterogeneity from Figure 2. First, assuming a homogenous tariff elasticity ($\hat{\beta}_{zi\omega}^{n} = \hat{\beta}_{z}^{n}$ in (10)), the variation only comes from $\lambda_{i\omega}^{n}$ prewar specialization patterns. The grey series reveals virtually no variation across countries, and the standard deviation is just 1.4 percent. Next, the red series recomputes export growth only allowing for sectoral heterogeneity: $\hat{\beta}_{zi\omega}^{n} = \hat{\beta}_{zj(\omega)}^{n}$; the standard deviation is now 4.0 percent, and the correlation with the full heterogeneity case is just 0.37. Similarly, the green series next constructs predicted growth using only the estimated size component, $\hat{\beta}_{zi\omega}^{n} = \hat{\Gamma}_{z}^{n} SIZE_{zi\omega}$, which also yields a low correlation of $-0.00$ with the full heterogeneity benchmark. Finally, the blue series allows for just the country

[17] We report bootstrapped confidence intervals for $\widehat{\Delta \ln X_{i}^{WD}}$. We construct bootstrapped standard errors through a cluster bootstrap of specification (10): we sample with replacement within products, estimate the specifications in (10), construct the aggregate predicted exports for each estimation using (11), and repeat 50 times.

[18] We correlate $\widehat{\Delta \ln X_{i}^{WD}}$ with $i$'s characteristics: GDP (World Bank 2022); distance to the United States and China (Mayer and Zignago 2011); the share of exports covered by "deep" trade agreements (Mattoo, Rocha, and Ruta 2020); and 2017 FDI stock (UNCTAD 2022). These descriptive relationships suggest greater predicted exports for countries that are larger, are farther from the United States, and have more exports covered by trade agreements. This is consistent with Alfaro-Ureña et al. (2023), who find that trade agreements result in cross-country export complementarities for firms.

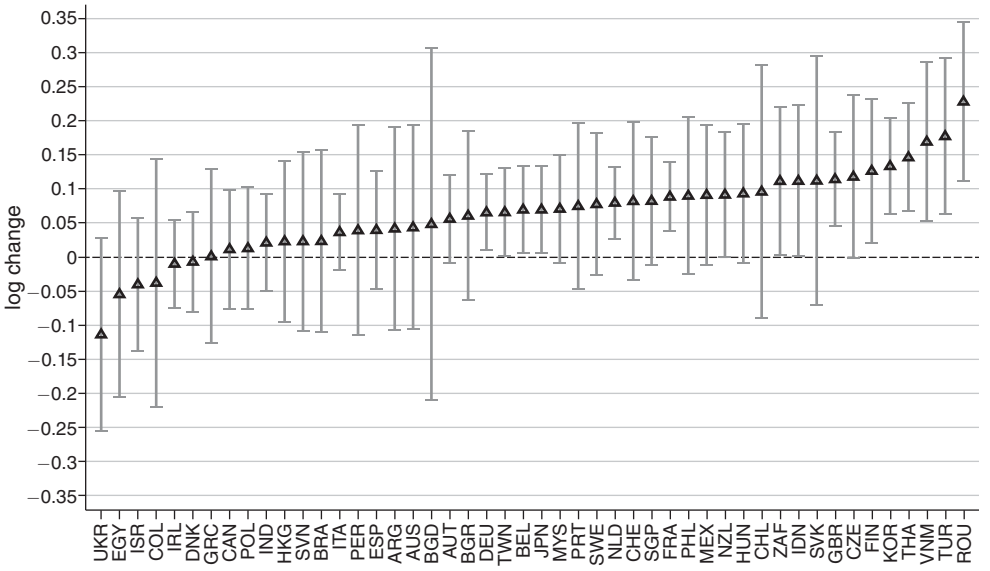


FIGURE 2. RELATIVE EXPORT GROWTH IN TARGETED PRODUCTS ACROSS COUNTRIES

*Notes:* The figure plots changes in predicted exports to the world in taxed relative to untaxed products using (11):

$$\widehat{\Delta \ln X_i^{WD}} = \sum_{\omega} \sum_{n=US,CH,RW} \lambda_{i\omega}^{n} \left( \hat{\beta}_{1i\omega}^{n} \Delta \ln T_{CH,\omega}^{US} + \hat{\beta}_{2i\omega}^{n} \Delta \ln T_{US,\omega}^{CH} + \hat{\beta}_{3i\omega}^{n} \ln T_{i,\omega}^{US} + \hat{\beta}_{4i\omega}^{n} \Delta \ln T_{i,\omega}^{CH} \right).$$

The $\beta$'s are estimated from specification (10):

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

Bootstrapped error bars denote 90 percent confidence intervals. These bands are constructed by implementing (10) on 50 bootstrap samples and calculating countries' predicted exports using (11).

component, $\hat{\beta}_{zi\omega}^{n} = \hat{\beta}_{i}^{n}$. The standard deviation across countries' response is now 6.0 percent, and the correlation with the benchmark rises to 0.78.

A formal decomposition of relative export growth into the three components reveals that country-specific responses explain 75.8 percent of the variation, while the sector and size component explains 24.3 percent and −0.1 percent, respectively.

The importance of the country-specific component of the tariff elasticities, even after allowing the estimated elasticities to vary by sector and size of the trade flow, is surprising given that trade or scale elasticities are typically assumed to vary across sectors rather than across countries. We explore this point next.

## B. *Supply and Demand Forces*

Online Appendix Table A.1 provides a taxonomy to understand the underlying demand and supply forces driving countries' exports from the trade war. We construct an empirical analog to the table by aggregating the variety-level tariff elasticities to the country level:

$$\hat{\beta}_{zi}^{n} = \sum_{\omega} \lambda_{Xi\omega}^{n} \hat{\beta}_{zi\omega}^{n}. \tag{12}$$

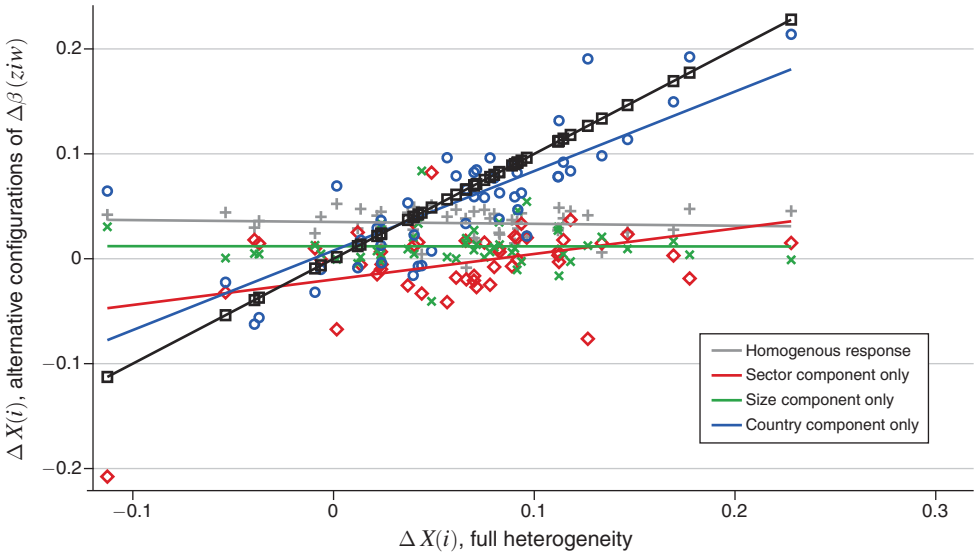


FIGURE 3. DECOMPOSING RELATIVE EXPORTS BY HETEROGENOUS RESPONSE TYPE

*Notes:* The figure reports alternative predictions for exports to the world constructed using (11):

$$\widehat{\Delta \ln X_i^{WD}} = \sum_{\omega} \sum_{n=US,CH,RW} \lambda_{i\omega}^{n} \left( \hat{\beta}_{1i\omega}^{n} \Delta \ln T_{CH,\omega}^{US} + \hat{\beta}_{2i\omega}^{n} \Delta \ln T_{US,\omega}^{CH} + \hat{\beta}_{3i\omega}^{n} \ln T_{i,\omega}^{US} + \hat{\beta}_{4i\omega}^{n} \Delta \ln T_{i,\omega}^{CH} \right),$$

where the $\beta$'s are estimated under alternative configurations of the heterogeneity in tariff responses. The first series (gray) constructs predicted exports assuming a homogenous response to the tariffs across countries. The next three series emphasize each of the three components of the full heterogenous response: sectoral ($\hat{\beta}_{zi\omega}^{n} = \hat{\beta}_{zj(\omega)}^{n}$), size ($\hat{\beta}_{zi\omega}^{n} = \hat{\Gamma}_{z}^{n} SIZE_{zi\omega}$), and country ($\hat{\beta}_{zi\omega}^{n} = \hat{\beta}_{i}^{n}$). The 45-degree line (black) is the benchmark full heterogeneity series.

Panel A of Figure 4 shows the export elasticities to the United States and RW in response to the US tariff ($\hat{\beta}_{1i}^{US}, \hat{\beta}_{1i}^{RW}$), revealing the substitutability/complementarity with Chinese varieties and the slope of supply curves. Panel B reports ($\hat{\beta}_{2i}^{CH}, \hat{\beta}_{2i}^{RW}$), revealing substitutability/complementarity with American varieties and upward-/downward-sloping supplies.

The figure shows that there is considerable variation across countries in the underlying supply and demand forces that drive export responses in Figure 2. To highlight a few examples, consider first the set of countries that lie in the same quadrant in both panels (highlighted in blue). Ukraine and Colombia lie in the southwest quadrants, indicating that they export varieties that complement Chinese and American varieties and that their exports operate along downward-sloping supply curves. These patterns provide a rationale for why Ukraine's and Colombia's global exports fell in response to the trade war, as illustrated in Figure 2: the tariffs reduced exports to the United States and China (because they are complements); because of the downward-sloped supply, the lower scale led exports to RW to decline. In contrast, Thailand, Taiwan, the United Kingdom, Bulgaria, and Finland are the countries whose export responses lay in the northeast quadrant of both panels. This reveals that their exports substitute for the United States and China. As they operate on downward supplies, the expansion into the United States and China led to

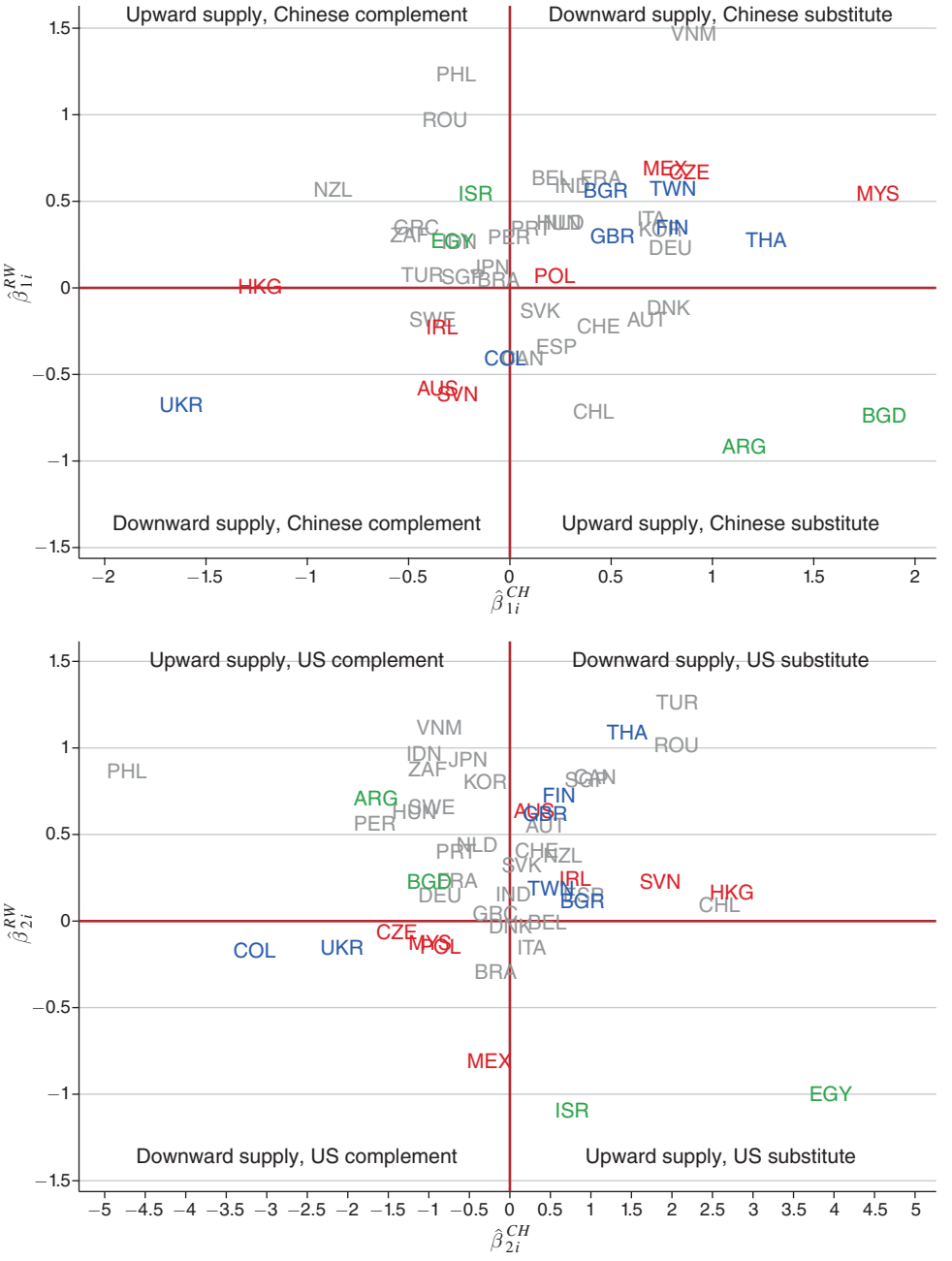


FIGURE 4. SUPPLY AND DEMAND FORCES

*Notes:* The figure plots the tariff responses to the US-Chinese tariffs, $\hat{\beta}_{i\omega}^{n} = \sum_{\omega} \lambda_{i\omega}^{n} \hat{\beta}_{i\omega}^{n}$, using the taxonomy in online Appendix Table A.1. The top panel plots $\left(\hat{\beta}_{1i}^{US}, \hat{\beta}_{1i}^{RW}\right)$. The bottom panel plots $\left(\hat{\beta}_{2i}^{CH}, \hat{\beta}_{2i}^{RW}\right)$. Countries noted in blue operate in the same quadrant in both panels. Countries in red operate along downward-sloping supplies in both panels. Countries in green operate along upward-sloping supplies in both panels.

expanding exports to RW and to an increase in global exports of targeted products, as confirmed by Figure 2.

For countries that lie in different quadrants of panels A and B, it is not possible to immediately sign the direction of their global export changes since it depends on

the importance of the US and Chinese destinations in their export basket. However, the figure does reveal the underlying forces to each market. Countries that lie in the northeast and southwest quadrants (in red) of both panels operate along downward supplies. Mexico, Malaysia, and the Czech Republic lie in the northeast quadrant of panel A and the southwest quadrant of panel B. These countries export varieties that substitute China and complement the United States and operate along downward supplies. The countries highlighted in green lie in the northeast and southwest quadrants of both panels, suggesting that they operate along upward supplies.

Finally, the gray countries flip the diagonal between panels. Their responses suggest a downward-sloping export supply in response to one tariff and an upward-sloping export supply to the other. Our model would require an additional source of heterogeneity to accommodate these cases. Supply elasticities operating at the bilateral level, as in Lind and Ramondo (2023), or bilateral complementarities through trade costs, as in Alfaro-Ureña et al. (2023), are possible explanations.

The downward-sloping supplies could reflect that some countries identified the trade war early as an opportunity and invested in new plants, trade infrastructure, or facilitation, with these investments benefiting exports to all destinations, or that some countries were already well integrated with the global trading system and could take advantage of the new exporting opportunities across multiple sectors. Our data do not allow us to measure these potential explanations, but this is an area for future research.

## V. Conclusion

The US-China trade war was seen as a major turning point in the globalization era. Our results do not support this view, at least for the time horizon we analyze: several countries increased global exports in products with higher US-Chinese tariffs relative to nontaxed products.

While product-level global trade data can uncover broad reallocation patterns, firm-level data can unpack the factors driving the country-specific elasticities—whether they consist of increasing returns to scale, trade war–induced investments in new plants, or participation in trade agreements. Our reduced-form tariff elasticities could also be used to target moments and identify parameters in estimated general equilibrium models.

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