Global Reallocations in the 2018-2019 Trade War

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Motivation

- Early papers analyze the impact of the trade war on U.S. and China

- How are other countries affected?
  - Policymakers are keenly interested in their responses to the trade war
  - Particularly so in smaller/developing countries where trade is quite important

- Trade war is a natural experiment to understand the key forces driving world trade
  - country substitutions, capacity to reallocate factors, sectoral economies of scale
This Paper

1. *Reduced-form analysis*. Use US-China tariffs to estimate heterogeneous impacts on “bystander” countries
   - Export volumes to US+China
   - Export volumes to Rest of World
   - Export unit values
   - (Medium-run responses, 18m)

2. *Structural analysis*. Use US-China tariffs to estimate
   - Demand substitution between each country and U.S., China
   - Scale economies
   - Reallocation capacity within each country
Preliminary Findings

- **Country-specific responses to US and CH tariffs are quite heterogeneous**
  - Heterogeneity can come from pre-war sectoral specialization, sector-specific responses, and/or country-specific responses
  - Surprisingly, country heterogeneity matters quite a bit for overall responses

- **Evidence of External Economies of Scale**
  - Exports to RW typically increase in response to US/CH tariffs on each other
  - Evidence that unit values to WD decline

- **In progress:**
  - Exploit tariff variation to estimate substitution parameters, country reallocation capacity, sector-specific supply curves
  - Welfare assessments, counterfactuals
Literature Review

- 2018-2019 Trade War:
  - Huang et al 18, Freund et al 18, Altig et al 18, Amiti et al 19, Fetzer & Schwarz 19, Flaaen et al 19, Cavallo et al 19, Fajgelbaum et al. 20,..

- Flexible substitution patterns
  - Non-CES gravity: Adao et al. 17, Arkolakis et al. 19, ...
  - Translog/AIDS: Kee et al. 08, Novy 13, Fajgelbaum & Khandelwal 15, Feenstra & Weinstein 17,..

- Scale economies and export interdependencies
  - Antweiler & Trefler 02, Lashkaripour & Lugovsky 18, Bartelme et al. 19, Costinot et al. 19
  - Morales 19, Antras & Morales 20

- Factor specificity and trade adjustment
  - Grossman & Levinsohn 89, Galle et al. 18, Burstein et al. 19
Road Map

- Summary Statistics
- Export Responses
- Identification of Structural Parameters
Data


- Statutory tariff schedules, 2018:2–2019:12
  - $\Delta T_{US,CH}$: U.S. tariff changes on China U.S. ITC
  - $\Delta T_{US,i}$: U.S. tariffs changes on exporter $i$ U.S. ITC
  - $\Delta T_{CH,US}$: China tariffs changes on U.S. China MoF
  - $\Delta T_{CH,RW}$: China MFN tariffs (ex USA) Bown et al. 2019

- Definitions
  - $i$: 43 top exporters, rest of the world (RW)
  - $j$: HS6 products
  - $s$: 9 sectors

  - pre-2018 data controls for pre-trends
## Sector Classification

<table>
<thead>
<tr>
<th>Industry</th>
<th>Examples</th>
<th>USD 2017</th>
<th>Share</th>
<th># HS6</th>
<th>Share</th>
</tr>
</thead>
<tbody>
<tr>
<td>Machinery</td>
<td>Engines, computers, cell phones</td>
<td>3,736</td>
<td>0.27</td>
<td>903</td>
<td>0.15</td>
</tr>
<tr>
<td>Minerals</td>
<td>Oil, coal, salt, electricity</td>
<td>1,744</td>
<td>0.13</td>
<td>166</td>
<td>0.03</td>
</tr>
<tr>
<td>Materials</td>
<td>Plastics, lumber, stones, glass</td>
<td>1,579</td>
<td>0.11</td>
<td>807</td>
<td>0.13</td>
</tr>
<tr>
<td>Transport</td>
<td>Vehicles, airplanes, parts</td>
<td>1,564</td>
<td>0.11</td>
<td>153</td>
<td>0.02</td>
</tr>
<tr>
<td>Chemicals</td>
<td>Medications, cosmetics, vaccines</td>
<td>1,448</td>
<td>0.10</td>
<td>988</td>
<td>0.16</td>
</tr>
<tr>
<td>Agriculture</td>
<td>Soy beans, wine, coffee, beef</td>
<td>1,235</td>
<td>0.09</td>
<td>1,106</td>
<td>0.18</td>
</tr>
<tr>
<td>Metals</td>
<td>Copper, steel, iron, aluminum</td>
<td>954</td>
<td>0.07</td>
<td>609</td>
<td>0.10</td>
</tr>
<tr>
<td>Apparel</td>
<td>Footwear, t-shirts, hand bags</td>
<td>778</td>
<td>0.06</td>
<td>1,062</td>
<td>0.17</td>
</tr>
<tr>
<td>Miscellaneous</td>
<td>Medical devices, furniture, art</td>
<td>894</td>
<td>0.06</td>
<td>431</td>
<td>0.07</td>
</tr>
</tbody>
</table>

- 6215 HS6 products classified into 9 sectors
Countries’ Pre-War Export Baskets

Pre-War Export Shares

- Agriculture
- Apparel
- Chemicals
- Machinery
- Materials
- Metals
- Minerals
- Miscellaneous
- Transport

Graph showing the pre-war export shares for various countries.

List of countries:
- ARG
- AUS
- AUT
- BEL
- BRA
- CAN
- CHE
- CHL
- COL
- CZE
- DEU
- DNK
- ESP
- FIN
- FRA
- GBR
- HKG
- HUN
- IDN
- IND
- IRL
- ISR
- ITA
- JPN
- KOR
- MEX
- MYS
- NLD
- PER
- PHL
- POL
- PRT
- ROU
- RUS
- SGP
- SVK
- SWE
- THA
- TUR
- TWN
- VNM
- ZAF
U.S. Tariff Changes

$\Delta \tau_{US,CH} \& \Delta \tau_{US,i}$

Note: tariffs are average changes over 18m period
China Tariff Changes

Note: tariffs are average changes over 18m period
Road Map

- Data and Summary Statistics
- Export Responses
- Identification of Structural Parameters
Homogeneous Responses


\[
\Delta \ln Y_{ij} = \alpha_{is} + \beta_1 \Delta \ln \tau_{US,CH} + \beta_2 \Delta \ln \tau_{US,i} \\
+ \beta_3 \Delta \ln \tau_{CH,US} + \beta_4 \Delta \ln \tau_{CH,RW} + \pi \Delta \ln Y_{i,pre} + \epsilon_{ij}
\]

- Where \( Y_{ij} \) stands for exports of product \( j \) from \( i \) to destination:
  1. \( \text{US+CH} \)
  2. \( \text{RW (excludes US+CH)} \)

- \( i \) exporting country, \( i \neq \text{US, CH} \)
- \( j \) HS6 product
- \( \alpha_{is} \) country-sector trends
- \( \Delta \ln Y_{i,pre} \) pre-trend control (pre-period growth 2014:1-2017:12)
- Two-way cluster by \( i \) and \( j \)
- Identification: across products within country-sector
Exports to $US + CH$

Higher USCH and CHUS tariffs raise exports to $US + CH$

Notes: Regression controls for pre-existing trends of the outcome and country-sector fixed effects. 90%/10% error bars. N = 267,675
Exports to $US + CH, RW$

...and also to $RW$!

Notes: Regression controls for pre-existing trends of the outcome and country-sector fixed effects. 90%/10% error bars. N = 267,675

Change in Quantity

Log Change

USCH

CHUS

USi

CHRW

Notes: Regression controls for pre-existing trends of the outcome and country-sector fixed effects. 90%/10% error bars. N = 267,675

US, CH separately
Predicted “Winners” (Homogeneous Responses)

- Foreign shocks that increase exports are welfare-enhancing in standard models
  - More nuanced here due to suggestive evidence of scale economies

- Predicted export growth of product $j$ from $i$ (relative to country-sector effect):
  \[
  \hat{\Delta \ln Y_{ij}} = \hat{\beta}_1 \Delta \ln \tau_{US,CH}^j + \hat{\beta}_2 \Delta \ln \tau_{US,i}^j + \hat{\beta}_3 \Delta \ln \tau_{CH,US}^j + \hat{\beta}_4 \Delta \ln \tau_{CH,RW}^j
  \]
  - for $Y_{ij} = \{US + CH, RW\}$

- Report export value-weighted average across products: $\sum_j w_j^i \hat{\Delta \ln Y_{ij}}$
  - $w_j^i$: product $j$ share in country $i$’s export value to $\{US + CH, RW\}$
  - Heterogeneity across countries comes only from $w_j^i$

- Block bootstrap to obtain errors
Predicted “Winners” (Homogeneous Responses)

(Limited) Heterogeneity due to pre-war export composition (and $\tau_{US,i}$)

Medium and thick bold denotes statistically significant from 0 and avg country response, respectively, at the 10% level.
Heterogeneous Responses

- Given tariff shock and pre-war composition, additional heterogeneity due to:
  - Country heterogeneity
    - demand-side substitution with China/US products
    - reallocation capacity (e.g., factor specificity, institutions, trade networks)
  - Sector heterogeneity
    - economies of scale

- Simple framework with these forces motivates the reduced-form analysis
  - Ricardian productivity, iceberg trade costs, ad-valorem tariffs
  - Factor supply: \( K_i^j \propto (p_i^j z_i^j)^{\varepsilon_i} \) \text{ Galle et al 18, Burstein et al 19}
  - Scale economies: \( z_i^j = Z_i^j \left( K_i^j \right)^{\eta_s} \) \text{ Lashkaripour & Lugovsky 18, Bartelme et al 19}
  - Flexible Translog: \( s_{ni}^j = a_{ni}^j + \sum_{i'} \sigma_{i'i} \ln \left( \tau_{ni'}^j p_{ni'}^j \right) \)
Effects of Tariffs on Exports to RW

Thought experiment: change in $\tau_{US,CH}^i$, hold all prices fixed except $p_i^j$

- First-order approx of exports to RW:

$\Delta \ln Y_i^j = \beta_i^j \Delta \ln \tau_{US,CH}^j$

where

$\beta_i^j \equiv \frac{1 - \sigma_{ii} \sum_{n \neq i,US,CH} \lambda_{ni}^j \lambda_{USi}^j \sigma_{CHi}}{(\eta_s - 1/\varepsilon_i)^{-1} + \sigma_{ii} \sum_n \lambda_{ni}^j}$

with $\lambda_{ni}^j \equiv \frac{\text{country } n \text{ share in } i\text{'s global sales of } j}{\text{country } i \text{ share in } n\text{'s total expenditures in } j}$

- If $\frac{1}{\varepsilon_i} < \eta_s < \frac{1}{\varepsilon_i} + \frac{1}{(-\sigma_{ii}) \sum_n \lambda_{ni}^j}$ (supply negatively sloped, but less than demand)

  1. $p_i^j$ falls with $\Delta \ln \tau_{US,CH}^j$, so export to RoW increases
  2. and more so the larger are $\varepsilon_i$, $\eta_s$, $\sigma_{CHi}$

- In this model, tariff variation can identify all the elasticities (later)

  ▶️ Today: explore this heterogeneity in reduced form
  ▶️ Reduced form captures total impacts due to direct/indirect price changes
Heterogenous Responses

Estimate the following specification

\[ \Delta \ln Y^j_i = \alpha_{is} + (\beta_1i + \gamma_{1s}) \Delta \ln \tau^j_{US,CH} + \beta_2i \Delta \ln \tau^j_{US,i} \\
+ (\beta_3i + \gamma_{3s}) \Delta \ln \tau^j_{CH,US} + (\beta_4i + \gamma_{4s}) \Delta \ln \tau^j_{CH,i} + (\pi_i + \pi_s) \Delta \ln Y^j_{pre,i} + \epsilon^j_i \]

- As before, \( Y^j_i \) stands for exports of product \( j \) from \( i \) to \( \{US + CH, RW\} \)

- Interact tariffs with country and sector dummies
  - less flexible than running separately by \( is \)
  - don’t allow sector-specific \( \Delta \ln \tau^j_{US,i} \) since tariffs only really hit in 2 sectors

- Two-way cluster by \( i \) and \( j \)

- Adjust for multiple hypotheses testing  Anderson 08
Sector Coefficients, Exports to $US + CH$

Higher USCH and CHUS tariffs leads to differential sectoral export response to $US + CH$

Export Quantity to US + China

Notes: Regression controls for pre-existing trends of the outcome and country-sector fixed effects. Bold coefficients are statistical significant at 10% level. N = 267,675.
Sector Coefficients, Exports to RW

Strongest evidence for scale in machinery, materials, metals, minerals; less so in other sectors

Export Quantity to RW

Notes: Regression controls for pre-existing trends of the outcome and country-sector fixed effects. Bold coefficients are statistically significant at 10% level. N = 267,675.
Country Coefficients, Exports to $US + CH$

EAsia, MEX, IND have strong response to USCH tariff

Export Quantity to US + China

Notes: Regression controls for pre-existing trends of the outcome and country-sector fixed effects. Bold coefficients are statistically significant at 10% level. $N = 267,675$. Export Quantity to US + China
Country Coefficients, Exports to $US + CH$

Relative to $\tau_{USCH}$, advanced countries appear to have a stronger $\tau_{CHUS}$ response

Export Quantity to US + China

Notes: Regression controls for pre-existing trends of the outcome and country-sector fixed effects. Bold coefficients are statistical significant at 10% level. N = 267,675.
Country Coefficients, Exports to $US + CH$

Tariffs on exporting country lowers export response for all countries, as expected

<table>
<thead>
<tr>
<th>Country</th>
<th>USCH</th>
<th>CHUS</th>
<th>USi</th>
<th>CHRW</th>
</tr>
</thead>
</table>

Export Quantity to US + China

Notes: Regression controls for pre-existing trends of the outcome and country-sector fixed effects. Bold coefficients are statistically significant at 10% level. N = 267,675.
Country Coefficients, Exports to RW

RW exports ↑ due to $\tau_{USCH}$ for many; a few reallocate out of RW, suggestive of internal frictions.

**Export Quantity to RW**

- **Notes:** Regression controls for pre-existing trends of the outcome and country-sector fixed effects.
- Bold coefficients are statistically significant at 10% level. $N = 267,675$.
Country Coefficients, Exports to $RW$

Scale effects due to $\tau_{CHUS}$ are less prevalent, but present in some countries.

Export Quantity to RW

Notes: Regression controls for pre-existing trends of the outcome and country-sector fixed effects. Bold coefficients are statistical significant at 10% level. $N = 267,675$. 

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all tariff coefficients
Predicted “Winners”

Homogenous regression (repeat of previous plot)

Medium and thick bold denotes statistically significant from 0 and avg country response, respectively, at the 10% level.
Predicted “Winners”, Sector Heterogeneity Only

Set $\beta_i$'s=0. Sector heterogeneity amplifies some countries’ responses (e.g., machinery).
Predicted “Winners”, Country Heterogeneity Only

Set $\gamma_{s}'s=0$ Country heterogeneity reveals some big swings in aggregate response

Medium and thick bold denotes statistically significant from 0 and avg country response, respectively, at the 10% level.
Predicted “Winners”, Country+Sector Heterogeneity

Full heterogeneity

Medium and thick bold denotes statistically significant from 0 and avg country response, respectively, at the 10% level.
Predicted “Winners”, Country+Sector Heterogeneity

Full heterogeneity. Sorted by export response to $WD$
Predicted “Winners”, Country + Sector Heterogeneity

Export responses to WD
What Observables Correlate with Response to \( WD \)?

Correlate \( WD \) export response with country characteristics

Unit of analysis is country. Covariates standardized. 90%/10% error bars.
Road Map

- Data and Summary Statistics
- Export Responses
- Identification of Structural Parameters
Structural Parameters: Identification

- What drives observed heterogeneity?
  - Scale economies ($\eta_s$), demand substitution ($\sigma$’s), reallocation capacity ($\varepsilon_i$)
  - Impose $\sigma_{ii'} = \sigma_{RW}$ for both $i, i' \neq US, CH$ ($\sigma_{i,CH}$ and $\sigma_{i,US}$ are unrestricted)

- $\Delta\tau_{US,CH}$ lowers the rel. price of imports in US from every $i$: identifies $\sigma_{i,CH}$
- $\Delta\tau_{CH,US}$ lowers the rel. price of imports in CH from every $i$: identifies $\sigma_{i,US}$
- $\Delta\tau_{US,i}$ identifies $\sigma_{RW}$

- Generate tariff-induced export demand shock for each $i$
  - E.g., $\Delta\tau_{US,CH}$ presents a positive demand shock for each $i$
  - Demand shock traces the supply curve of goods from $i$ in each sector
Steps

1. Cross price elasticities \( \{ \sigma_{CHi}, \sigma_{USi}, \sigma_{RW} \} \). Translog implies:

\[
\Delta s_{US,i}^j - \Delta s_{CH,i}^j = \sigma_{CHi} \Delta \ln \left( \frac{\tau_{US,i}^j}{\tau_{US,i}^j / \tau_{CH,RW}} \right) - \sigma_{USi} \Delta \ln \left( \frac{\tau_{CH,US}^j}{\tau_{CH,RW} / \tau_{US,i}} \right) \\
+ \sigma_{RW} \sum_{i' \neq US, CH} \ln \left( \frac{\tau_{US,i'}^j}{\tau_{US,i}^j} \right) + \varepsilon_i^j
\]

- Own price elasticities \( \sigma_{ii} \) obtained from adding up and symmetry

2. Industry supply curves:

\[
\Delta \ln p_i^j = \left( \frac{1}{\varepsilon_i} - \eta^s \right) \Delta \ln X_i^j + \psi_i^s + \varepsilon_i^j
\]

where \( X_i^j \) is total sales

- \( \psi_i^s \) controls for country factor prices
- Instrument: \( \Delta \ln Z_i^j = w_{US,i}^j \Delta \ln \left( s_{US,i}^j \right) + w_{CH,i}^j \Delta \ln \left( s_{CH,i}^j \right) \)
Unit Value Responses

“Winners” plot, but now with predicted changes in unit values to WD

Predicted Log Change in Export Unit Value, Sorted by WD

Medium and thick bold denotes statistically significant from 0 and avg country response, respectively, at the 10% level.
Correlation between Unit Value and Quantity Responses

Positive demand shocks but price declines: suggestive of *downward-sloping* supply curves.

Change in Unit Value to WD

Change in Quantity to WD
Conclusion

- Reduced-form evidence of:
  - Heterogenous responses to US-China tariffs across countries
  - Importance of country and sector-specific heterogeneity
  - Scale economies

- Top “winners”: Vietnam, HK, Japan, Thailand, UK, India

- In progress: additional data, parameter estimation, model-based decompositions of key forces. Stay tuned!
Country Coefficients, Exports to RW

Lots of heterogeneity in RW response to China’s MFN tariffs. Hard to summarize.

Export Quantity to RW

Notes: Regression controls for pre-existing trends of the outcome and country-sector fixed effects. Bold coefficients are statistical significant at 10% level. N = 267,675.
Exports to *US, CH*

Separate regressions to *US* and *CH*

Notes: Regression controls for pre-existing trends of the outcome and country-sector fixed effects. 90%/10% error bars. N = 267,675
China Responses

$$\Delta \ln Y_{\text{CHN}}^j = \alpha_{\text{CHN},s} + \beta_1 \Delta \ln \tau_{US,CH}^j + \beta_2 \Delta \ln \tau_{CH,RW}^j + \epsilon^j_{\text{CHN}}$$

- 18m long difference, not monthly
- Across-product tariff variation, not within product
- FGKK 2020 show China’s before-tariff price increases at 6m horizon
USA Responses

$$\Delta \ln Y^j_{USA} = \alpha_{USA,s} + \beta_1 \Delta \ln \tau^j_{CH,US} + \beta_2 \Delta \ln \tau^j_{US,RW} + \epsilon^j_{USA}$$

- 18m long difference, not monthly
- Across-product tariff variation, not within product
- $$\Delta \ln \tau_{US,RW} = \Delta \ln \tau_{US,i}$$

Regressions control for country-sector FEs. N = 6,225. 90%/10% error bars.