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 heterogenous 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

- Global bilateral trade data, 2014:1–2019:6 (2019:12 coming soon) International Trade Centre

- Statutory tariff schedules, 2018:2–2019:12
    - $\Delta\tau_{US,CH}$: U.S. tariff changes on China U.S. ITC
    - $\Delta\tau_{US,i}$: U.S. tariffs changes on exporter i U.S. ITC
    - $\Delta\tau_{CH,US}$: China tariffs changes on U.S. China MoF
    - $\Delta\tau_{CH,RW}$: 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

- Long differences: 2018:1-2019:6 export growth
    - pre-2018 data controls for pre-trends

Sector Classication

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

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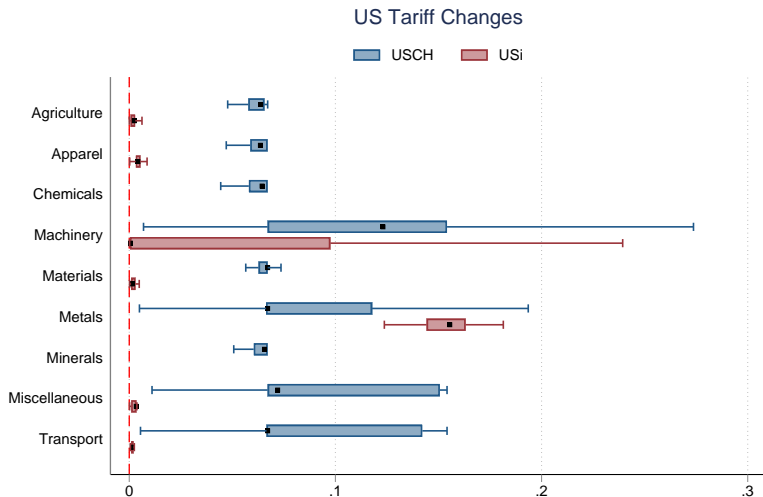
Countries' Pre-War Export Baskets

Pre-War Export Shares

U.S. Tariff Changes

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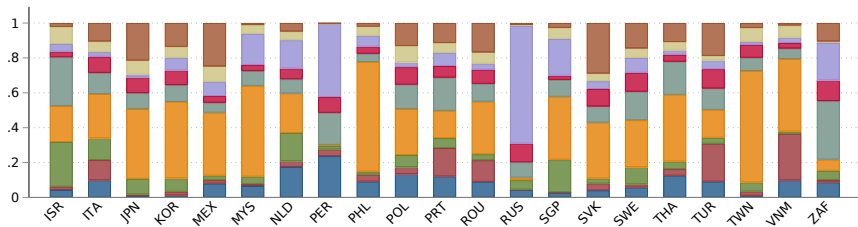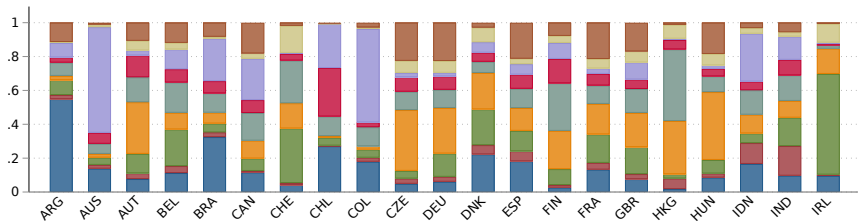
US Tariff Changes

USCH   USi

- Note: tariffs are average changes over 18m period

China Tariff Changes

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

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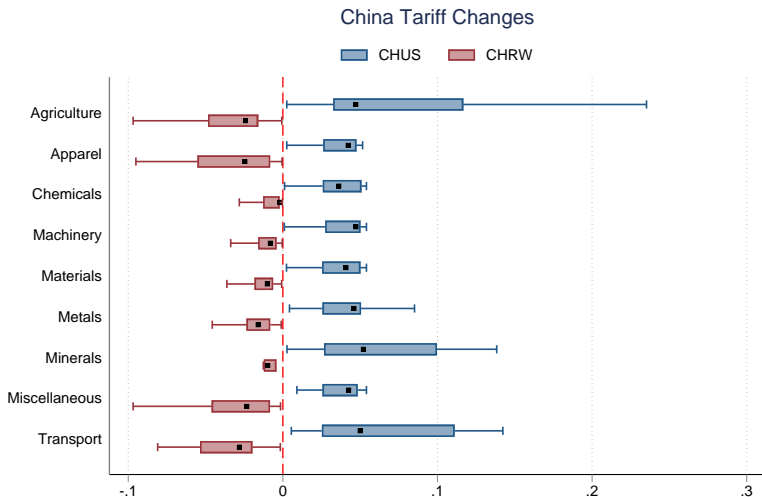
- Note: tariffs are average changes over 18m period

Road Map

- Data and Summary Statistics

- Export Responses

- Identification of Structural Parameters

Homogeneous Responses

Tariff impacts on 2018:1-2019:6 export quantity growth

$$\Delta \ln Y_i^j = \alpha_{is} + \beta_1 \Delta \ln \tau_{US,CH}^j + \beta_2 \Delta \ln \tau_{US,i}^j$$
$$+ \beta_3 \Delta \ln \tau_{CH,US}^j + \beta_4 \Delta \ln \tau_{CH,RW}^j + \pi \Delta \ln Y_{pre,i}^j + \epsilon_i^j$$

- Where Y_i^j stands for exports of product j from i to destination:
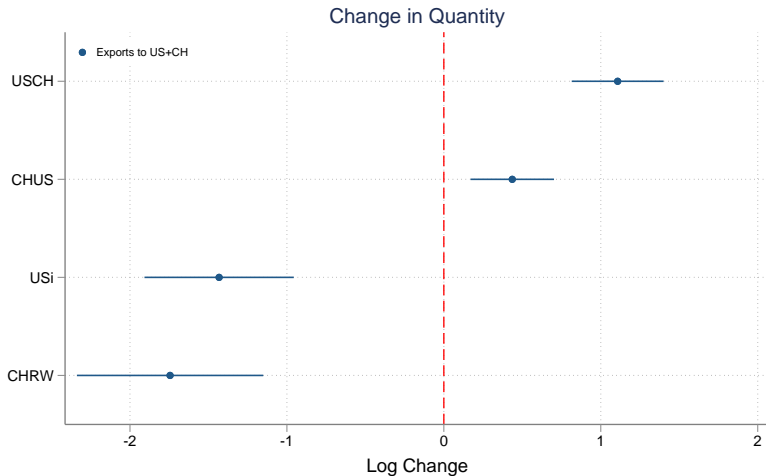 1. US+CH
  2. RW (excludes US+CH)

- i exporting country, $i \neq US, CH$
- j HS6 product
- α_{is} country-sector trends
- $\Delta \ln Y_{pre,i}^j$ pre-trend control (pre-period growth 2014:1-2017:12)
- Two-way cluster by i and j

- Identification: across products within country-sector
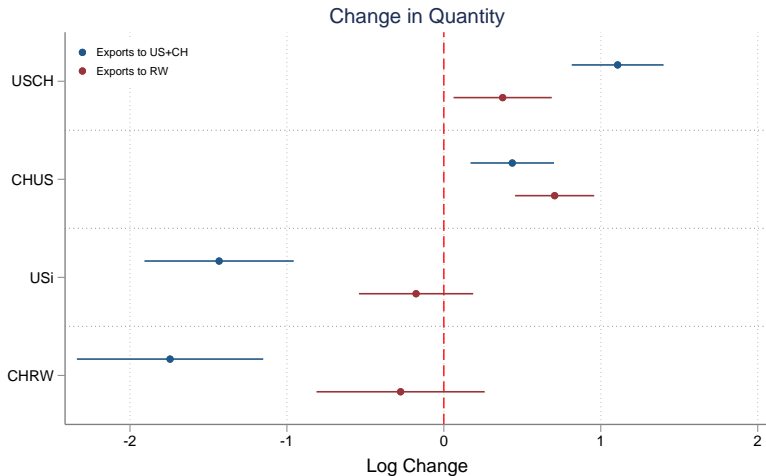
Exports to $US + CH$

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

Change in Quantity

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

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

▸ 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):

$$\widehat{\Delta \ln Y_i^j} = \hat{\beta}_1 \Delta \ln \tau_{US,CH}^j + \hat{\beta}_2 \Delta \ln \tau_{US,i}^j + \hat{\beta}_3 \Delta \ln \tau_{CH,US}^j + \hat{\beta}_4 \Delta \ln \tau_{CH,RW}^j$$

  - for $Y_i^j = \{US + CH, RW\}$

- Report export value-weighted average across products: $\sum_j w_i^j \widehat{\Delta \ln Y_i^j}$
  - w_i^j : product j share in country $i's$ export value to $\{US + CH, RW\}$
  - Heterogeneity across countries comes only from w_i^j

- Block bootstrap to obtain errors

Predicted "Winners" (Homogeneous Responses)

(Limited) Heterogeneity due to pre-war export composition (and $\tau_{US,i}$)
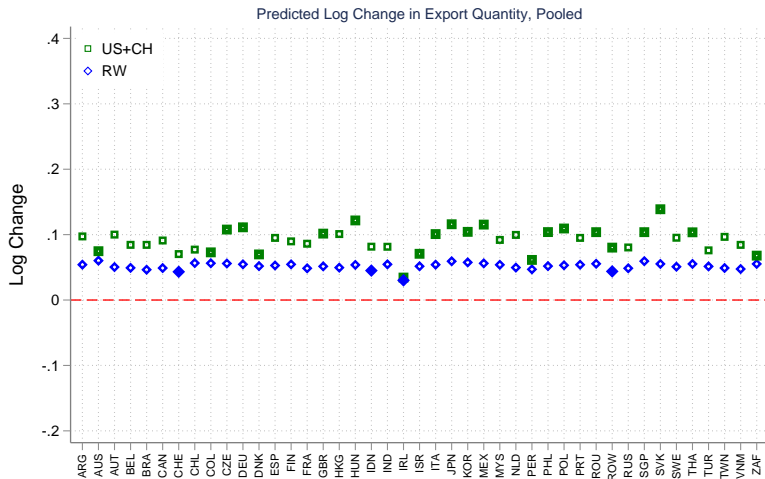
Predicted Log Change in Export Quantity, Pooled

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: $K_i^j \propto \left(p_i^j z_i^j \right)^{\varepsilon_i}$ Galle et al 18, Burstein et al 19
  - Scale economies: $z_i^j = Z_i^j \left(K_i^j \right)^{\eta_s}$ 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 $\tau_{US,CH}^j$, 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

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

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 $\frac{1}{\varepsilon_i} < \eta_s < \frac{1}{\varepsilon_i} + \frac{1}{(-\sigma_{ii}) \sum_n \lambda_n^j}$ (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 ε_i, η_s, σ_{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

$$\Delta \ln Y_i^j = \alpha_{is} + (\beta_{1i} + \gamma_{1s}) \, \Delta \ln \tau_{US,CH}^j + \beta_{2i} \Delta \ln \tau_{US,i}^j$$
$$+ (\beta_{3i} + \gamma_{3s}) \, \Delta \ln \tau_{CH,US}^j + (\beta_{4i} + \gamma_{4s}) \, \Delta \ln \tau_{CH,i}^j + (\pi_i + \pi_s) \, \Delta \ln Y_{pre,i}^j + \epsilon_i^j$$

- As before, Y_i^j 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 $\Delta \ln \tau_{US,i}^j$ 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 $US + CH$
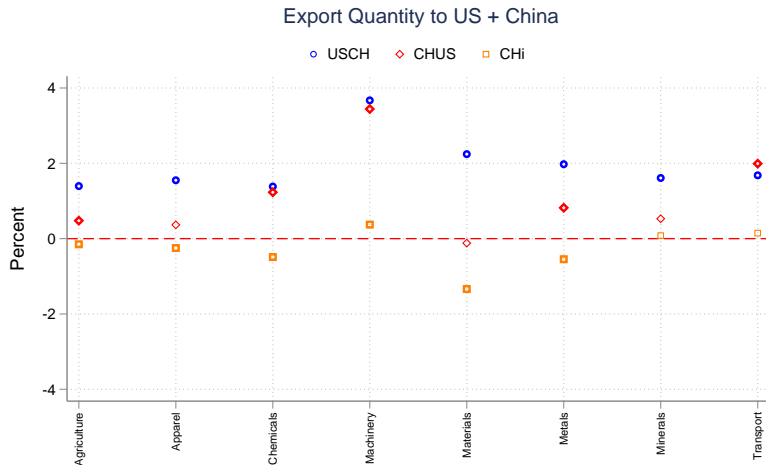
Export Quantity to US + China

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.
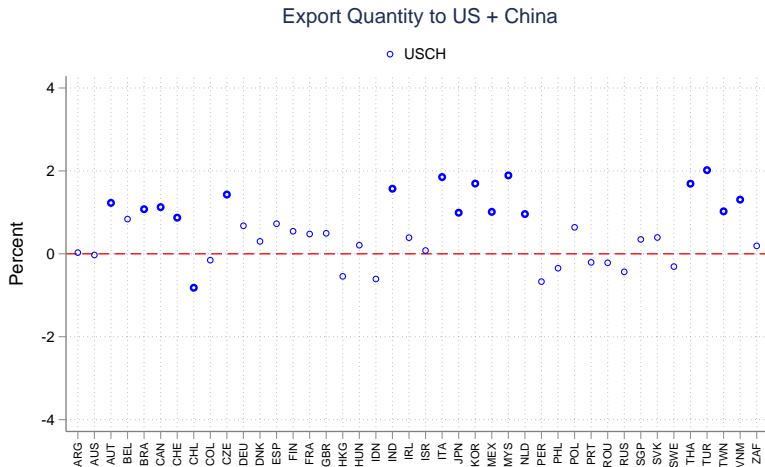
Sector Coefficients, Exports to *RW*

Stongest evidence for scale in machinery, materials, metals, minerals; less so in other sectors
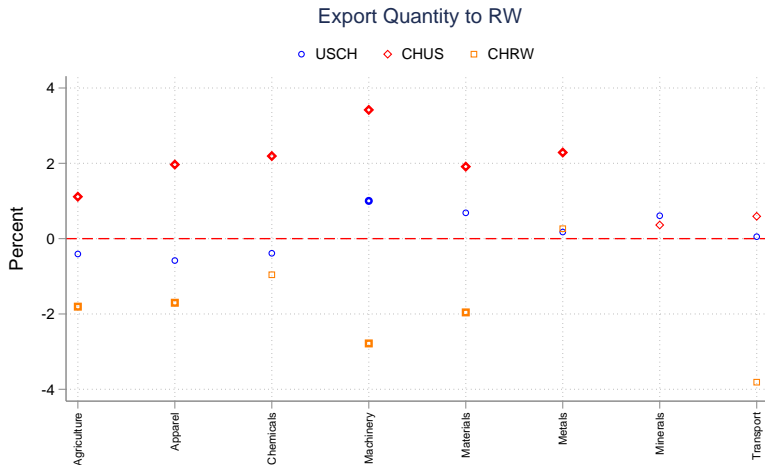
Export Quantity to RW

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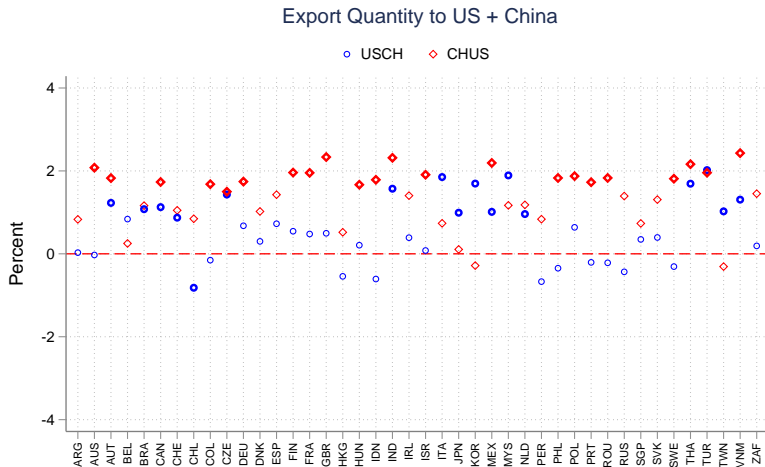
Country Coefficients, Exports to $US + CH$

EAsia, MEX, IND have strong response to USCH tariff
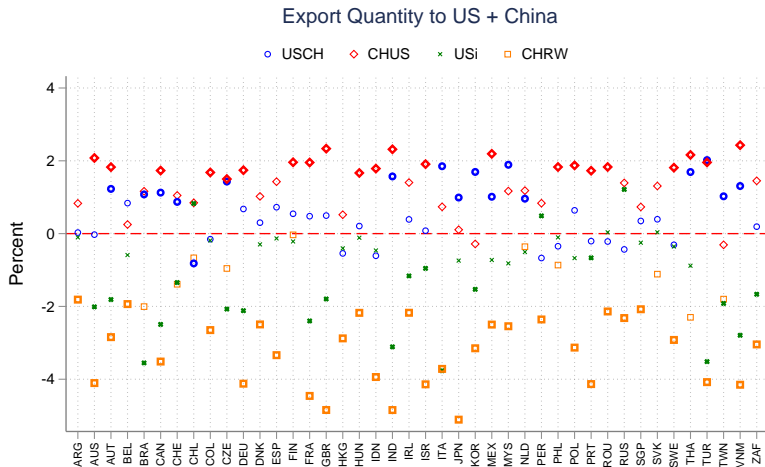

Export Quantity to US + China

○ USCH

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 $US + CH$

Relative to τ_{USCH}, advanced countries appear to have a stronger τ_{CHUS} response

Export Quantity to US + China

○ USCH   ◇ CHUS

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.
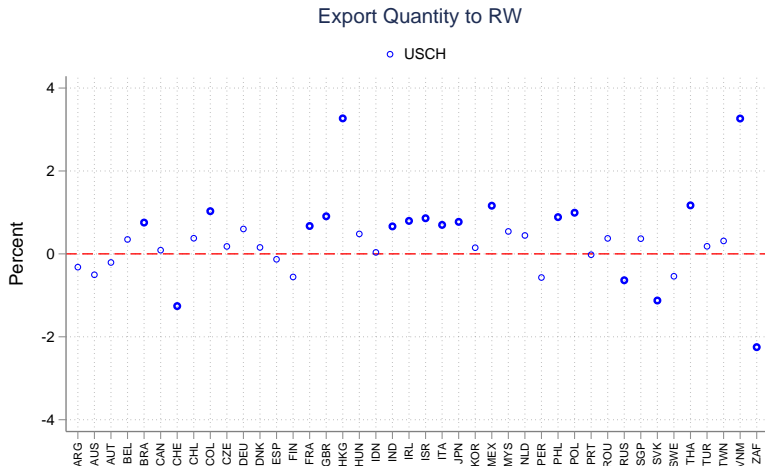
Country Coefficients, Exports to $US + CH$

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

Export Quantity to US + China

○ USCH   ◇ CHUS   ✕ USi   □ CHRW

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 *RW*

RW exports ↑ due to τ_{USCH} for many; a few reallocate out of *RW*, suggestive of internal frictions

Export Quantity to RW

○ USCH

Percent

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 *RW*

Scale effects due to τ_{CHUS} are less prevalent, but present in some countries
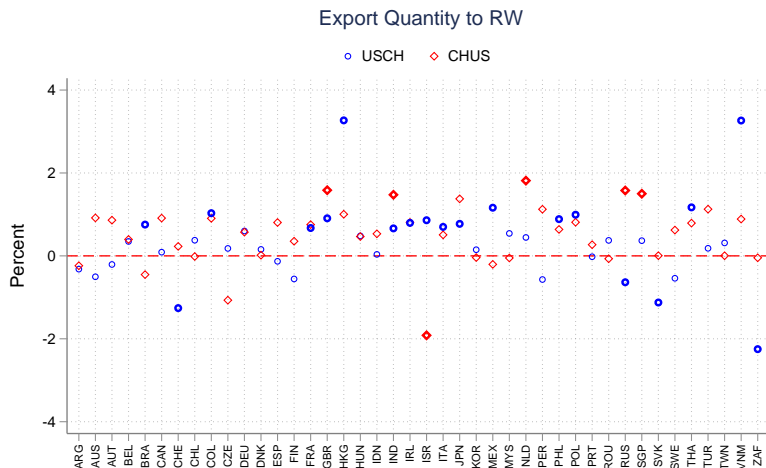
Export Quantity to RW

○ USCH   ◇ CHUS

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.

Predicted "Winners"

Homogenous regression (repeat of previous plot)
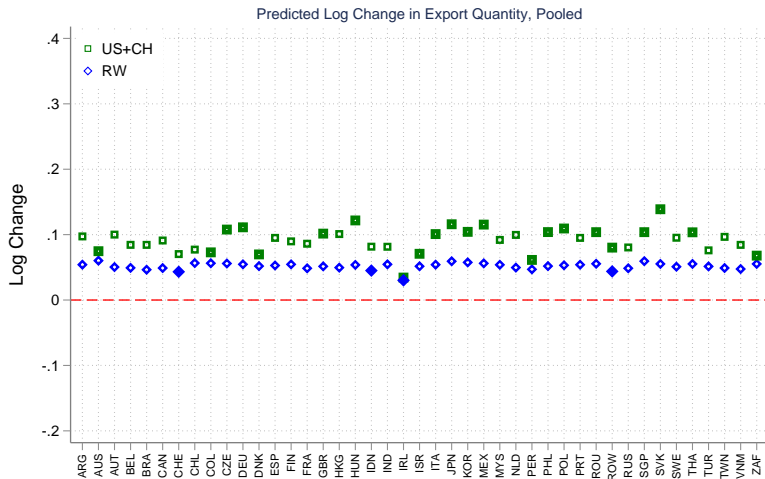
Predicted Log Change in Export Quantity, Pooled

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

Predicted "Winners", Sector Heterogeneity Only

Set β_i's=0. Sector heterogeneity amplifies some countries' responses (e.g., machinery)
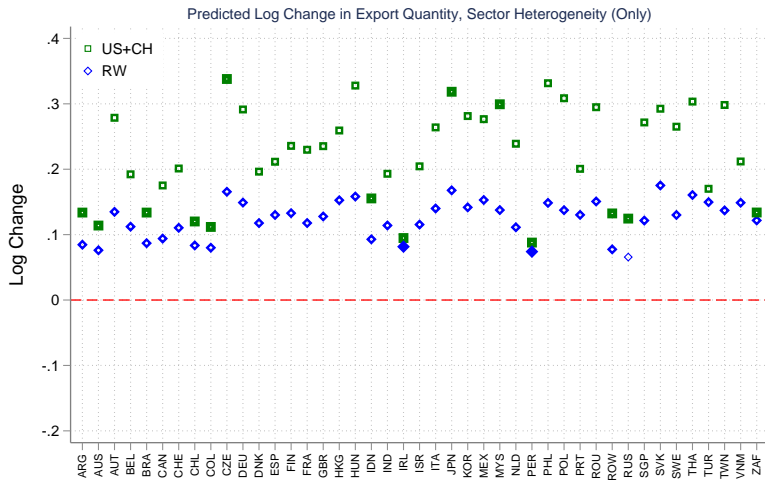
Predicted Log Change in Export Quantity, Sector Heterogeneity (Only)

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

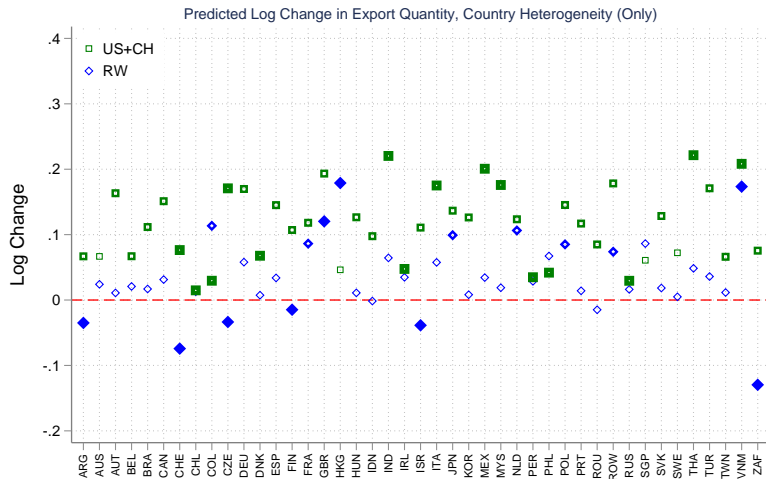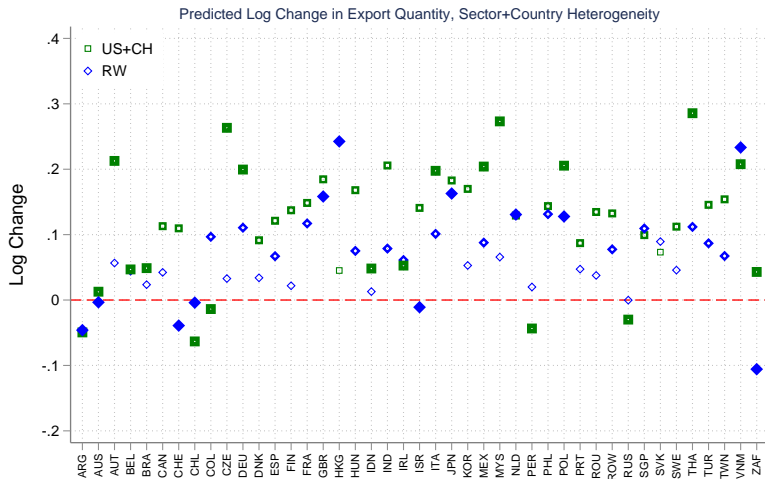# Predicted "Winners", Country Heterogeneity Only

Set γ_s's=0 Country heterogeneity reveals some big swings in aggregate response

Predicted Log Change in Export Quantity, Country Heterogeneity (Only)

US+CH
RW

Log Change

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

Predicted Log Change in Export Quantity, Sector+Country Heterogeneity

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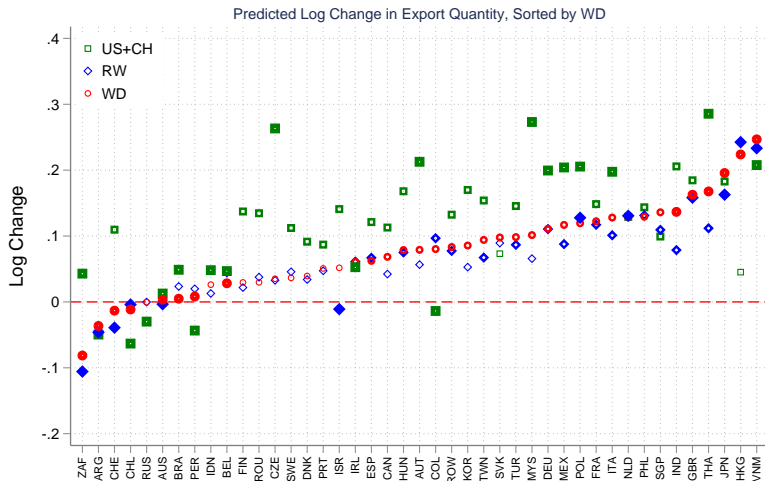
Predicted "Winners", Country+Sector Heterogeneity

Full heterogeneity. Sorted by export response to *WD*

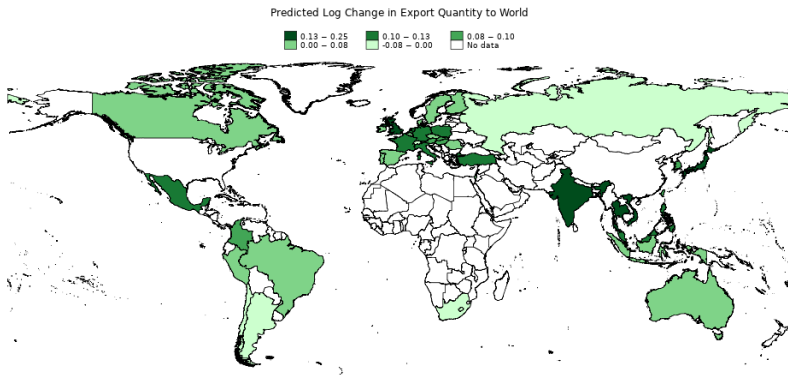Predicted Log Change in Export Quantity, Sorted by WD

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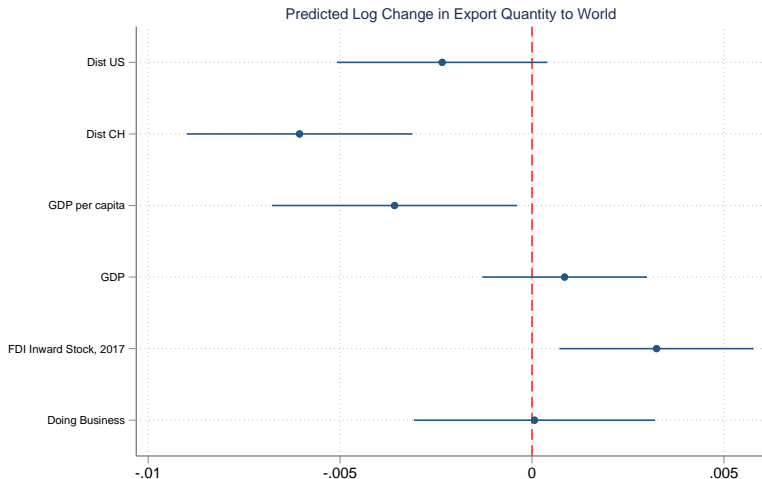
Predicted "Winners", Country+Sector Heterogeneity

Export responses to *WD*

Predicted Log Change in Export Quantity to World

What Observables Correlate with Response to *WD*?

Correlate *WD* export response with country characteristics

Predicted Log Change in Export Quantity to World

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 (η_s), demand substitution (σ's), reallocation capacity (ε_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 σ_{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:

$$\Delta s_{US,i}^j - \Delta s_{CH,i}^j = \sigma_{CHi} \Delta \ln\left(\frac{\tau_{US,CH}^j}{\tau_{US,i}^j/\tau_{CH,RW}}\right) - \sigma_{USi} \Delta \ln\left(\frac{\tau_{CH,US}^j}{\tau_{CH,RW}^j/\tau_{US,i}}\right)$$

$$+ \sigma_{RW} \sum_{i' \neq US,CH,i} \ln\left(\frac{\tau_{US,i'}^j}{\tau_{US,i}^j}\right) + \varepsilon_i^j$$

   ▶ Own price elasticities σ_{ii} obtained from adding up and symmetry
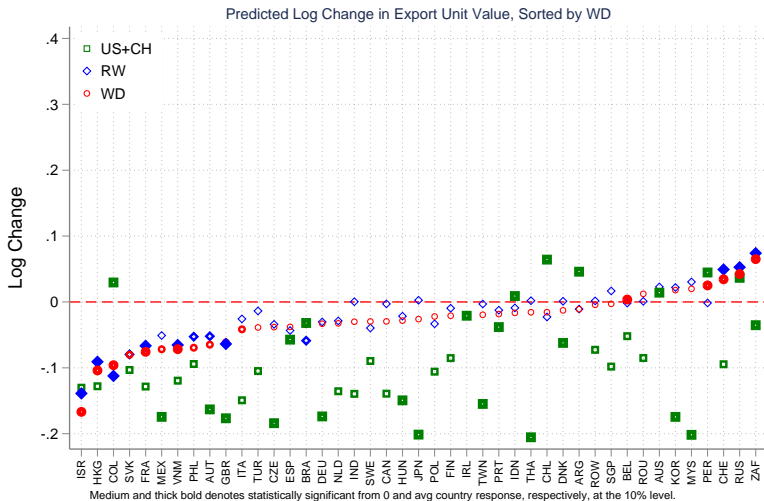
2. Industry supply curves:

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

   where X_i^j is total sales

   ▶ ψ_i^s controls for country factor prices
   ▶ Instrument: $\Delta \ln Z_i^j \equiv w_{US,i}^j \Delta \widehat{\ln\left(s_{US,i}^j\right)} + w_{CH,i}^j \Delta \widehat{\ln\left(s_{CH,i}^j\right)}$

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.

▸ CHN responses   ▸ USA responses

Correlation between Unit Value and Quantity Responses

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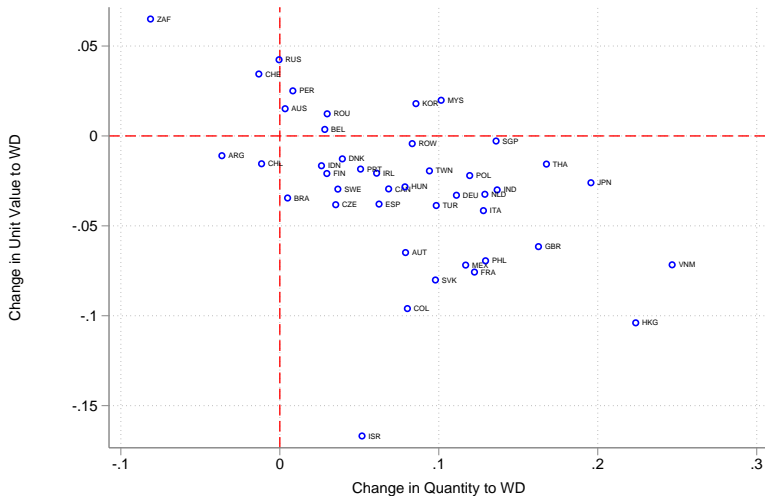
Conclusion

- 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
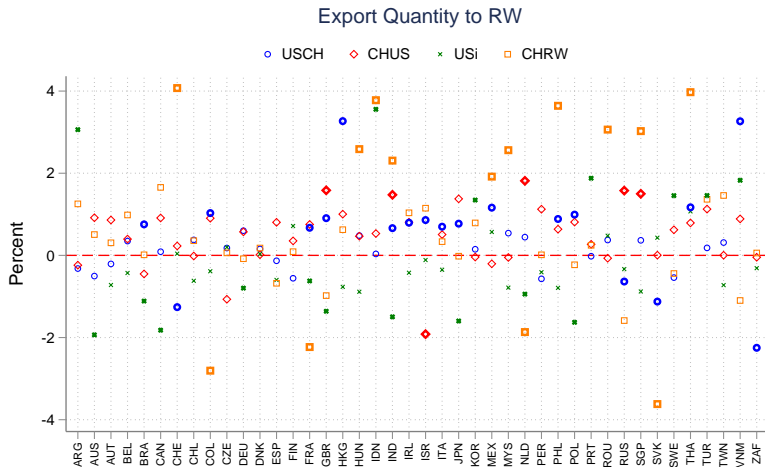
Export Quantity to RW

○ USCH ◇ CHUS × USi □ CHRW

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.
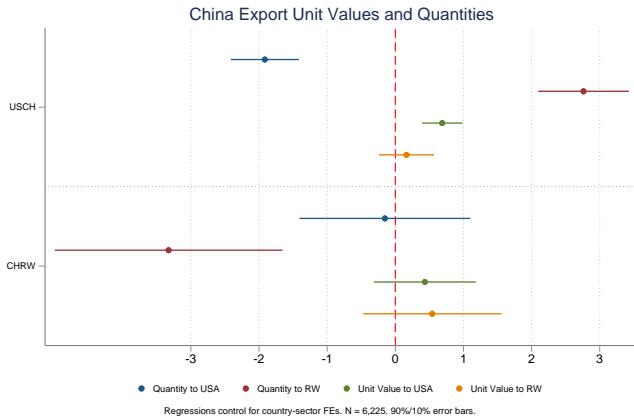
Exports to *US*, *CH*

Separate regressions to *US* and *CH*
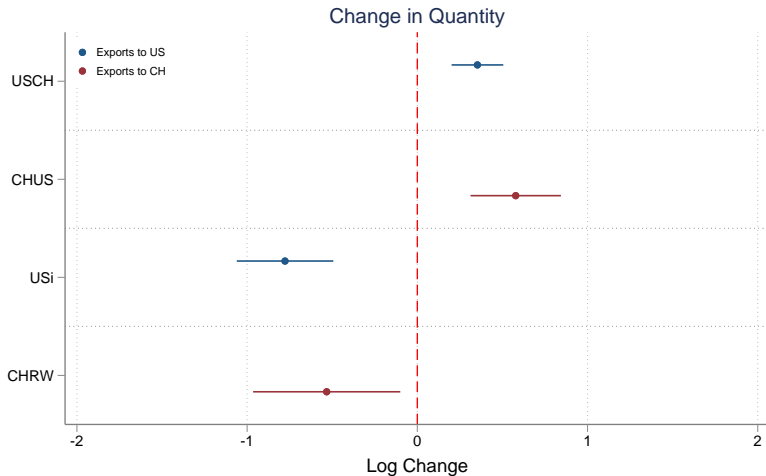
Change in Quantity

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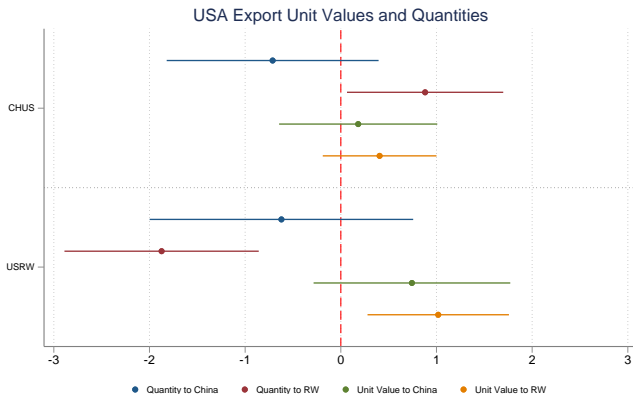
China Responses

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

China Export Unit Values and Quantities

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

- 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

$$\Delta \ln Y_{USA}^j = \alpha_{USA,s} + \beta_1 \Delta \ln \tau_{CH,US}^j + \beta_2 \Delta \ln \tau_{US,RW}^j + \epsilon_{USA}^j$$

USA Export Unit Values and Quantities

- Quantity to China
- Quantity to RW
- Unit Value to China
- Unit Value to RW

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

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