

The impact of non-tariff trade measures on labor outcomes: lessons from the US-China trade war

Sionegael Ikeme¹
Amanda Countryman²
Dale Manning³
Diane Charlton⁴

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¹Colorado State University

²Colorado State University

³University of Tennessee

⁴Montana State University

Introduction

Context:

- ▶ Rising U.S.–China trade tensions over the past decade.
- ▶ 2018 trade war cut trade volumes, raised prices, and reduced welfare (Amiti, Redding, and Weinstein, 2019; Fajgelbaum et al., 2020; Carter and Steinbach, 2019; Cavallo et al., 2021).
- ▶ Chinese retaliatory tariffs negatively affected U.S. labor markets (Autor et al., 2024).

Ag sector in the Trade War:

- ▶ \$26.9B U.S. ag exports tariffed (Hopkinson, 2018)
- ▶ \$14.4B export loss to China (Carter and Steinbach, 2019)
- ▶ \$23B Market Facilitation Program aid (region/crop dependent) (Autor et al., 2024)

▶ Timeline

Non-Tariff Measures (NTMs) in China

NTMs and China:

- ▶ NTMs: Trade restrictions other than official tariffs (administrative hurdles and levies) that impede foreign products from entering a market.
- ▶ Examples during U.S.-China trade war:
 - ▶ May 3, 2018: Extra pest inspections imposed on U.S. apples and lumber.
 - ▶ Oct 26, 2018: Soybean content in pig feed cut from 20% to 12%.
- ▶ Responsible for 50% of U.S. export decline during U.S.–China trade war (Chen, Hsieh, and Song, 2022).
- ▶ NTMs: less transparent, often unofficial, harder to measure their effects.
- ▶ NTMs quantified via Ad-valorem equivalents (AVEs): tariffs with equivalent impact on trade.

Research Questions

Gap:

- ▶ Prior studies examine the effects of Chinese and U.S. tariffs and U.S. subsidies on U.S. labor market outcomes, but overlook the effects of Chinese NTMs.
- ▶ Effects of agricultural tariffs and subsidies typically examined at aggregated product levels.

Research Questions:

- ▶ How did Chinese NTMs affect regional employment and wages in the U.S. during the 2018 U.S.-China trade war?
- ▶ Are there heterogeneous effects across industries and U.S. regions?

Objectives:

- ▶ **Quantify Chinese NTMs by measuring effects on U.S. exports to China. Focus for now on the agricultural sector.**
- ▶ Examine the effects of these NTMs on labor market outcomes.

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Contribution

- ▶ **Incorporates NTMs** into trade policy and labor market studies (Autor et al., 2024; Benguria and Saffie, 2020; Autor, Dorn, and Hanson, 2013).
- ▶ Builds on Leonardi and Meschi (2024) by analyzing NTM impacts on labor market outcomes within **trade war context**.
- ▶ New **Ag employment data** to examine trade effects on jobs and wages at a more disaggregated level (Charlton et al., 2025).
- ▶ New evidence on how hidden trade barriers shape labor outcomes (Niu, 2018; Leonardi and Meschi, 2024; Chen, Hsieh, and Song, 2022).
- ▶ More comprehensive assessment of trade policy impacts on U.S. ag.

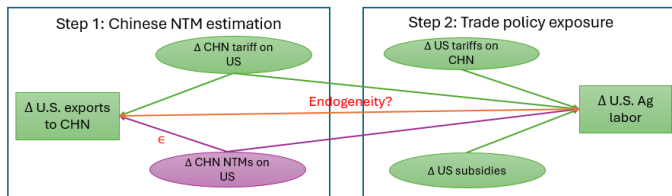
Estimation Strategy

Step 1: Estimating Chinese NTM AVEs

- ▶ Limited reliable NTM data for China during the trade war.
- ▶ Use unobserved changes in U.S. exports to China to infer the effects of Chinese-imposed NTMs, while controlling for tariffs.

Step 2: Linking NTMs to U.S. Agricultural Labor

- ▶ **Shift–share (Bartik-style)** design: shifts = 2018 trade policy changes; shares = pre-trade industry employment by region.
- ▶ Estimate effects of trade policy exposure on agricultural labor outcomes across regions and industries.



Step 1: Estimating Chinese NTM AVEs

Why we need to estimate NTMs:

- ▶ China's NTMs are largely informal or unreported.
- ▶ Need to infer NTMs from observed trade.

Two approaches to identify NTM-induced trade costs:

- ▶ **Structural approach:** Nested CES with tariffs/NTMs as price wedges; identify elasticities from price–tariff–quantity variation and infer NTMs from residual wedges (Chen, Hsieh, and Song, 2022).
- ▶ **Reduced-form approach:** Gravity equations with tariffs and controls; residual fixed effects or inefficiency interpreted as NTM trade costs (Fontagné, Guillin, and Mitaritonna, 2011)

Step 1: Reduced-Form Approach

(1) Fixed-Effects Specification (FE) Exporter–hs4 product–time FEs capture time-varying bilateral trade frictions attributed to Chinese NTMs:

$$Y_{j,CHN,k,t} = \exp(\alpha' X_{j,CHN,k,t} + \beta \ln(1 + tar_{j,CHN,k,t}) + \gamma_{j,h,t} + \nu_{j,CHN,k,t}) \quad (1)$$

$$\Delta \ln(1 + T_{j,CHN,h,t}) = \ln(1 + T_{j,CHN,h,t}) - \ln(1 + T_{j,CHN,h,2017}) = \frac{1}{1 - \sigma} (\gamma_{j,h,t} - \gamma_{j,h,2017}) \quad (2)$$

(2) Stochastic Frontier Specification (SF) Separates random noise from systematic inefficiency, interpreted as trade frictions attributable to Chinese NTMs.

$$\ln Y_{j,CHN,k,t} = \alpha' X_{j,CHN,k,t} + \beta \ln(1 + tar_{j,CHN,k,t}) + \gamma_{k,m} - u_{j,CHN,k,t} + \nu_{j,CHN,k,t}$$

where $u_{j,CHN,k,t} \sim N^+ \left(\mu_{j,CHN,k,t}, \sigma_\mu^2 \right)$, $\mu_{j,CHN,k,t} = \alpha_0 + \alpha_1 \ln(1 + tar_{j,CHN,k,t})$ (3)

$$\Delta \ln(1 + T_{j,CHN,k,t}) = \frac{1}{1 - \sigma} (-u_{j,CHN,k,t} + u_{j,CHN,k,2017}) \quad (4)$$

- ▶ $Y_{j,CHN,k,t}$: exports of product k (HS6) from exporter j to China at time t .
- ▶ $X_{j,CHN,k,t}$: controls (GDPs, distance, gravity characteristics, etc.).
- ▶ $tar_{j,CHN,k,t}$: Chinese tariffs on exporter j on product k .
- ▶ $\gamma_{j,h,t}$: exporter–HS4–year–month fixed effects, $\gamma_{k,m}$: month–HS6 fixed effects.
- ▶ $T_{j,CHN,k,t}$: NTMs AVE, and σ trade elasticities from Chen, Hsieh, and Song (2022).

Step 1: Benefits and Limits of Each Approach

	Structural Model	Reduced Form: FE	Reduced Form: SF
Benefit	Identifies demand and supply elasticities during the trade war.	Fewer assumptions than structural. Allows tariff-NTM correlation . Account for 0 trade flows .	Fewer assumptions than structural. Allows tariff-NTM correlation . Models distribution of NTMs' effect (inefficiency).
Limits	Assumes tariffs and NTMs are orthogonal . Assumes supply shifts and tariffs are orthogonal. Elasticities capture trade variation. Endogeneity : imports may reflect U.S. shocks, not only Chinese policy.	Assumes MRTs constant over time. FE may capture variation unrelated to NTMs. Potential omitted-variable bias. Same endogeneity concern as above.	Assumes MRTs constant over time. Don't account zero trade flows. Captures only negative NTM effects (inefficiency). Potential omitted-variable bias. Same endogeneity concern as above.

Step 2: NTMs effect on U.S. labor

- ▶ Build on Autor et al. (2024), who analyze the effects of U.S. and Chinese tariffs on U.S. labor.
- ▶ Use a Bartik-style design: local areas face common shocks with varying intensity based on their initial industry composition.
- ▶ **Shock:** Changes in industry-level Chinese retaliatory tariffs, Chinese NTM AVEs (ϕ), U.S. import tariffs, and subsidies before and during the U.S.–China trade war.
- ▶ **Share:** Share of base-year employment in commuting zone that is employed in industry.
- ▶ Construct two industry-level shocks from the theoretical model in Eaton and Kortum (2002): Import tariff exposure (IMP) and Retaliatory tariff exposure (RET).

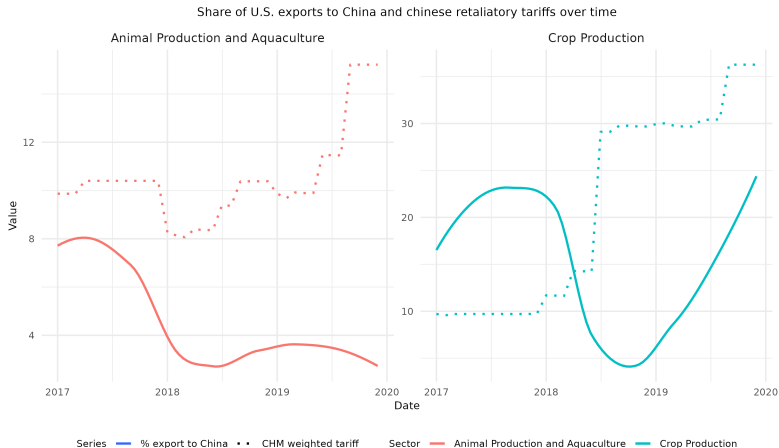
Data

- ▶ **Tariffs and trade:** Monthly HS6 trade and tariff data from Fajgelbaum et al. (2020); Rodríguez-Clare et al.; Chinese import data from S&P GTA.
- ▶ **Domestic output:** U.S. Census and Agricultural Census.
- ▶ **Employment:** QCEW data and agricultural labor data from Charlton et al. (2025).
- ▶ **Industry concordance:** HS–NAICS mappings from Charlton et al. (2025) and Pierce and Schott (2012).

Units of Analysis

- ▶ **Industry:** NAICS 4-digit
- ▶ **Products:** HS 6-digit
- ▶ **Geography:** Commuting Zones (CZs)
- ▶ **Time:** Monthly, 2017–2019

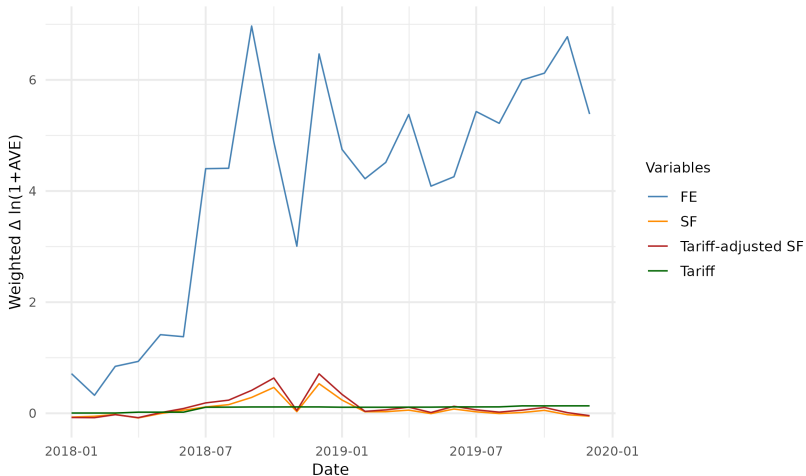
U.S. Export Share by Industry (NAICS 3-digit)



Note: Tariffs remained high through late 2019, yet U.S. exports began to recover.
 ⇒ Possible explanation: **gradual removal of NTMs.**

Estimated NTM AVEs within U.S. agricultural exports

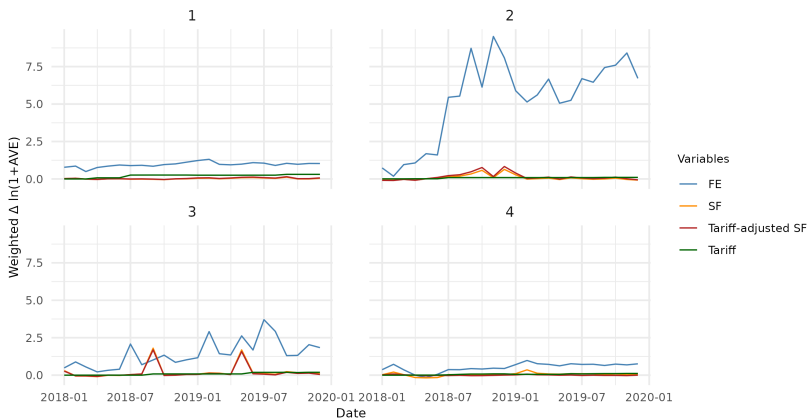
Weighted average $\Delta \ln(1 + \text{AVE})$ for agricultural sector (relative to 2017)



Note: Change in estimated Chinese NTMs AVE (relative to 2017) imposed on U.S. agricultural exports over time across model ($\Delta \ln(1 + T_{US,CHN})$). [▶ Chen](#)

Estimated NTM AVEs at the HS section level

Weighted average $\Delta \ln(1+AVE)$ for agricultural sector by HS section (relative to 2017)



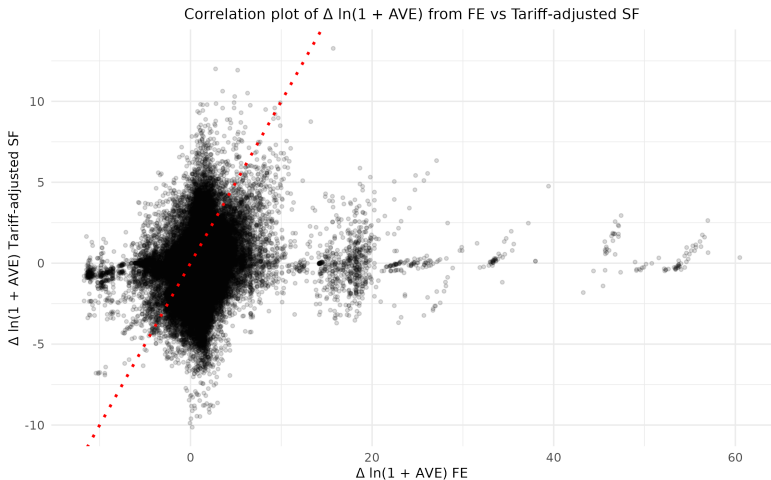
Note: Estimated $\Delta \ln(1 + T_{US,CHN})$ weighted average at the HS sections (2018–2019 vs. 2017).

HS2-Level AVE Estimates: FE vs. SF vs. Chen vs. Tariffs

HS 2	Description	FE	SF	SF_tariff	Chen	Tariff
1	Live animals	1.3876	0.0339	0.0763		0.0201
2	Meat and edible meat offal	2.2328			0.149	0.3392
3	Fish and seafood	1.4780	0.0360	0.0573	-0.095	0.1758
4	Dairy, eggs, honey	-3.9220	0.0223	0.0389	0.361	0.1755
7	Vegetables	-0.0538	0.0367	-0.0176	0.220	0.1428
8	Fruits and nuts	0.5992	0.2194	0.2986	-0.402	0.2823
9	Coffee, tea, spices	1.4647	-0.1222	-0.1219		0.1236
10	Cereals	37.5241	0.2381	0.4661	1.413	0.2373
11	Milling products; malt; starch	1.7620	0.3054	0.3224		0.0803
12	Oil seeds and oleaginous fruits	4.5075	0.0569	0.1052	1.192	0.1450
15	Animal & vegetable fats and oils	1.4373	0.1826	0.1486	-0.252	0.1190
16	Prepared meat, fish	3.5787	0.1481	0.1373		0.1792
20	Processed vegetables, fruit, nuts	0.6548	0.0680	0.0679	0.101	0.0362
22	Beverages	0.6364	-0.0252	-0.0455	-0.135	0.1638
23	Animal feed, residues	0.9358	0.2072		0.679	0.1066
24	Tobacco and substitutes	11.3422	-0.0442			0.1648

Note: Estimated $\Delta \ln(1 + T_{US,CHN})$ weighted averages (2018–2019 vs. 2017) for the FE and SF models, compared to the $\Delta \ln(1 + T_{US,CHN})$ estimates at HS2 from Chen, Hsieh, and Song (2022). The table reports the highest observed values across models.

Correlation between NTM AVE Estimates



Note: Correlation between estimated changes in AVEs across models (FE, SF) at the HS2 level.

Findings

So far:

- ▶ Find evidence that several agricultural products faced additional trade barriers, reflected in a positive change in NTMs AVE estimates imposed by China on the U.S.
- ▶ Products most affected include cereals, oilseed, and other animal products.
- ▶ For the FE model, estimated AVEs are often higher than China's applied tariff rates.

Comparing models:

- ▶ FE estimates are generally larger than SF and structural model estimates.
- ▶ FE can incorporate zero-trade observations.
- ▶ SF isolates trade barriers through the inefficiency term and imposes a distribution on inefficiency.
- ▶ Both approaches may absorb omitted-variable effects differently.
- ▶ Chen, Hsieh, and Song (2022) use yearly Chinese custom data.

Limitations and Possible Robustness Checks

Concerns and limitations of the baseline model:

- ▶ Endogeneity concern: U.S. supply shocks vs. Chinese demand shocks.
- ▶ Following Chen, Hsieh, and Song (2022): check whether U.S. exports to the rest of the world move similarly.
- ▶ U.S. agricultural exporters are profit-maximizing firms.
- ▶ Do not account for U.S. Ag. subsidies.

Additional Robustness Checks:

- ▶ Incorporate NTM data (notifications, news-based measures)
(subject to measurement error and limited coverage).
- ▶ Use the share of Chinese state-owned enterprise (SOE) imports by product as an IV. [▶ SOE](#)

Next steps

- ▶ Estimate the structural model and compare results across approaches.
- ▶ Conduct robustness checks.
- ▶ Use the estimated AVEs in the second part of the analysis to study labor-market impacts: quantify how NTM exposure affects agricultural employment and wages.

Thank you!

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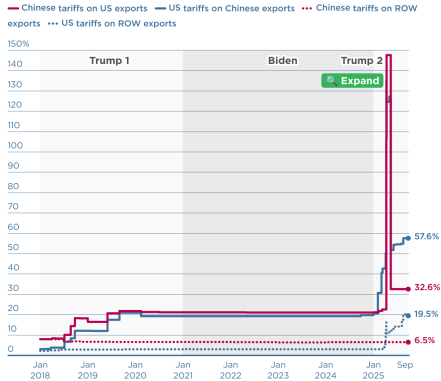
Trade war timeline



US-China trade war tariffs: An up-to-date chart

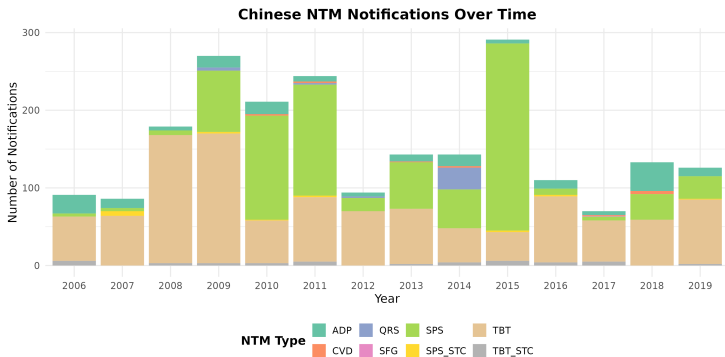
Last updated September 25, 2025

a. US-China tariff rates toward each other and rest of world (ROW)



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Non-Tariff Measures in China



- ▶ Newly implemented Chinese NTMs on the U.S. and other partners, as notified to the WTO.
- ▶ Sanitary and Phytosanitary (SPS) and Technical Barriers to Trade (TBT) measures often target agricultural and food sectors.

Non-tariff measures and Chinese State-owned firms:

State-Owned Enterprises (SOEs) in China

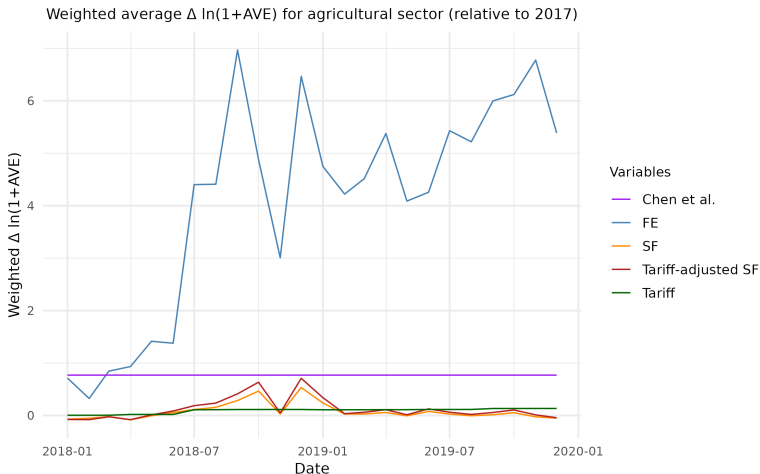
- ▶ Government-controlled firms that combine commercial activity with policy execution (e.g., COFCO in Ag).
- ▶ Account for about one-quarter of China's total industrial output.
- ▶ Handle roughly one-third of China's total imports.
- ▶ Benguria and Saffie (2020) show that U.S. export declines during the trade war were larger in industries with greater exposure to Chinese state-owned enterprises (SOEs), suggesting that SOEs amplified trade reductions beyond tariff effects—accounting for an additional 4% fall in U.S. exports on top of the 8

Why implement NTMs instead of tariff?

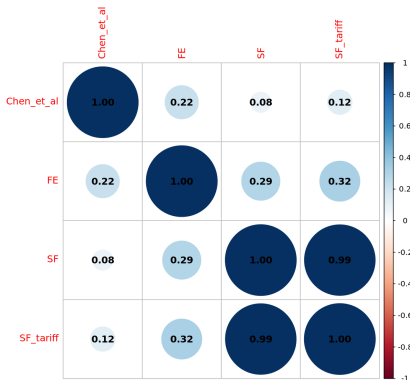
- ▶ Tariffs hurt both **state-owned enterprises (SOEs)** that use imported inputs and private firms, so China applied smaller tariff increases in sectors with high SOE presence.
- ▶ **Non-tariff barriers (NTMs)** could be selectively enforced—targeting private importers while exempting SOEs.
- ▶ This allowed the government to **reduce U.S. imports** without harming SOE profitability.
- ▶ Consequently, sectors with larger SOE shares experienced **higher NTM increases** and **smaller tariff hikes**.

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Compared to Chen, Hsieh, and Song (2022)

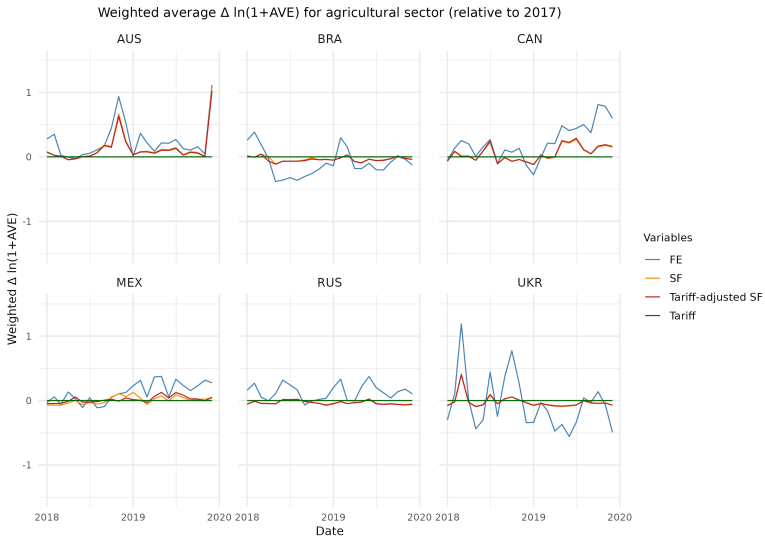
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Correlation between NTM AVE Estimates



Note: Correlation between estimated changes in AVEs across models (FE, SF) and the AVE estimates from Chen, Hsieh, and Song (2022) at the HS2 level.

Other countries estimates:



Note: Change in estimated Chinese NTMs AVE (relative to 2017) imposed on other exporting countries' agricultural exports

Summary statistics of SF and FE models

term	SF Tariff			SF			FE		
	mean	med	Se	mean	med	Se	mean	med	Se
(Intercept)	1.650	1.469	1.469	1.424	1.397	1.397			
Colonial_ties	-1.945	-1.902	-1.902	-1.875	-1.852	-1.852			
comlang_off	-0.637	-0.625	-0.625	-0.591	-0.604	-0.604			
contig	0.199	0.198	0.198	0.230	0.236	0.236			
dist	0.000	0.000	0.000	0.000	0.000	0.000			
fta_and_eia	0.823	0.751	0.751	0.848	0.770	0.770			
rta	-0.389	-0.262	-0.262	-0.363	-0.275	-0.275			
Exp_wto	1.072	0.805	0.805	1.061	0.816	0.816			
Exp_Ag_land	-3.2E-07	-2.8E-07	-2.8E-07	-3.2E-07	-2.9E-07	-2.9E-07	7.02E-07	6.13E-07	6.13E-07
Exp_GDP	2.0E-13	2.0E-13	2.0E-13	2.2E-13	2.1E-13	2.1E-13	1.81E-13	1.96E-13	1.96E-13
Imp_GDP	-9.24E-12	-1.08E-11	-1.08E-11	-4.82E-12	-1.19E-11	-1.19E-11	3.05E-10	3.36E-10	3.36E-10
log_tariff	-8.425	-9.803	-9.803	-8.433	-8.218	-8.218	5.06493	-0.98488	-0.98488
Zmu_(Intercept)	-41.650	-0.046	-0.046	-98.365	-0.954	-0.954			
Zmu_log_tariff	-10.180	-11.181	-11.181						
Zv_(Intercept)	2.569	2.503	2.503	2.778	2.592	2.592			
Zv_(Intercept)	0.542	0.593	0.593	0.578	0.617	0.617			
mean_gamma	0.848			0.857					
share_signif_LR	97%			97%					
pseudo_R2							0.69047		

Table: Summary statistics of obtained coefficients in SF and FE models.