Modeling U.S. Sorghum Export Destinations During Multiple Trade Shocks of the U.S.-China Trade War

Alan Hinds [1] Nelson Villoria [2]

[1]Dyson School of Applied Economics and Management — Cornell University

[2]Department of Agricultural Economics — Kansas State University

March 24, 2026

CornellCALS College of Agriculture and Life Sciences

Dyson Cornell SC Johnson College of Business

Roadmap

1. Background & Motivation
2. Data & Methods
3. Results
4. Q&A
5. Appendix

Grain Sorghum

- **Near-substitute for corn** in animal rations
- Gluten-free alternative to other cereal grains
- Can be distilled to create the Chinese spirit *baiju*

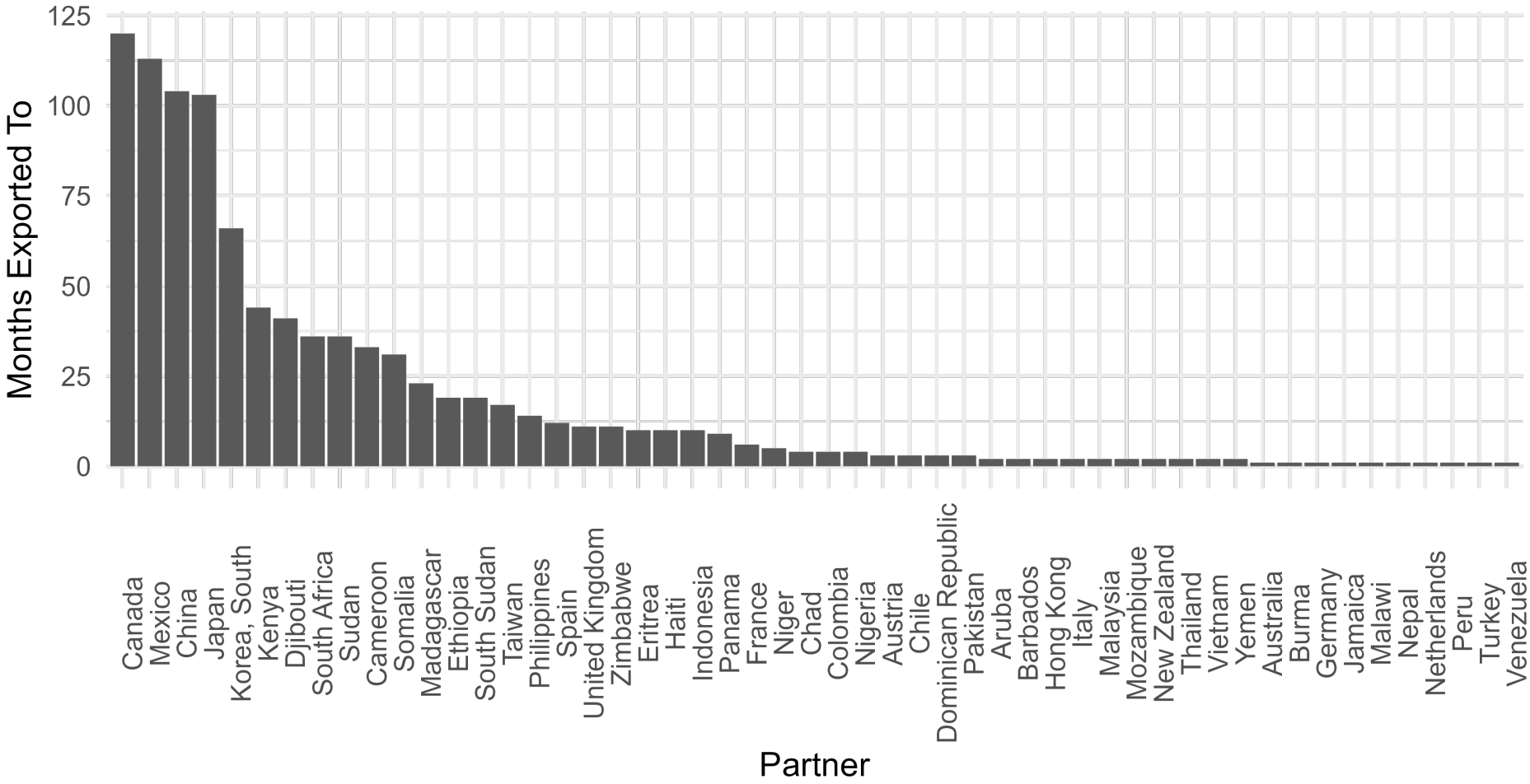
From 2018-2022:

- **75%** of global imports from U.S.
- **80%** of global exports to China

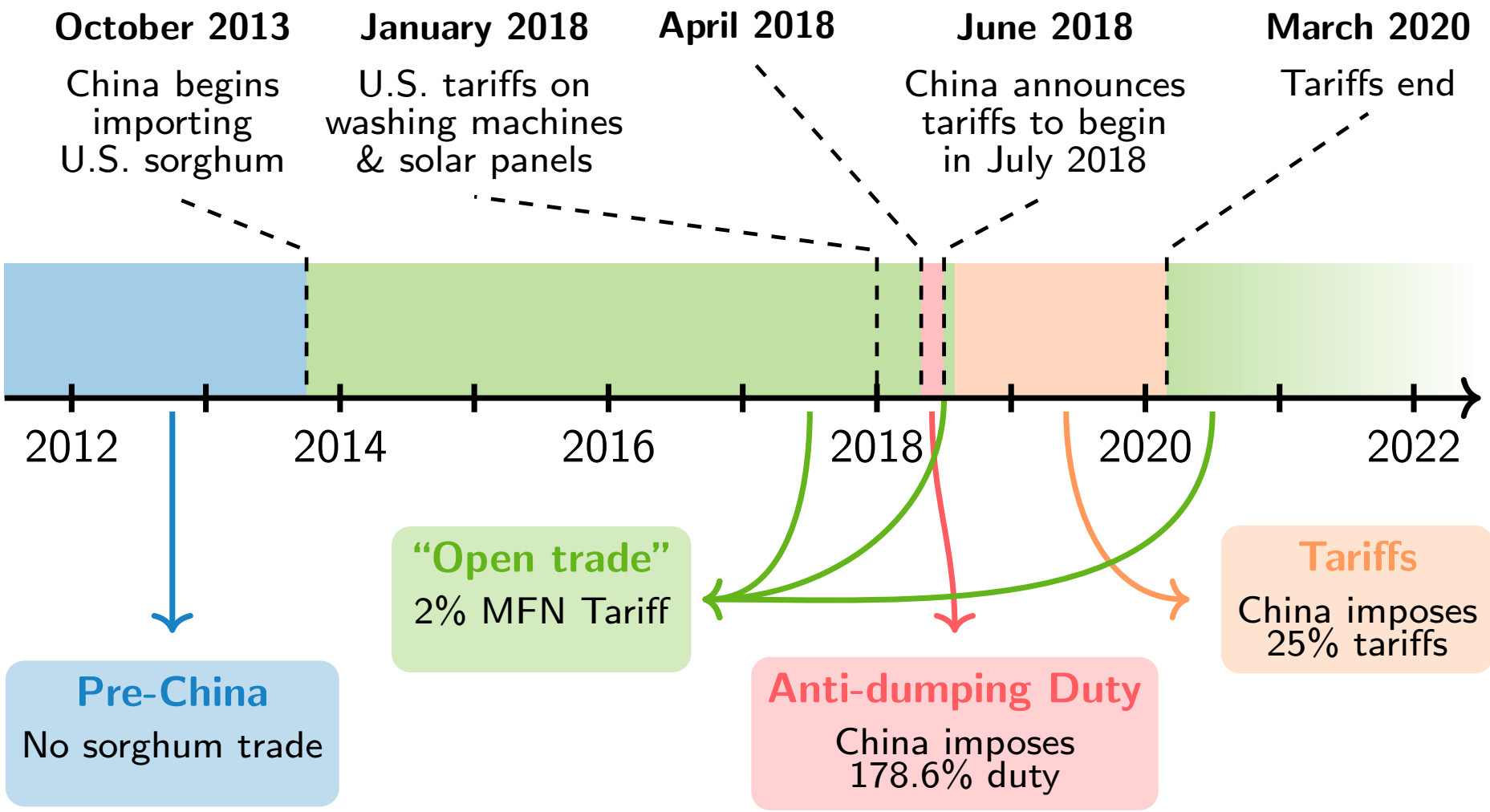
Source: National Park Service

Frequency of U.S. Grain Sorghum Exports

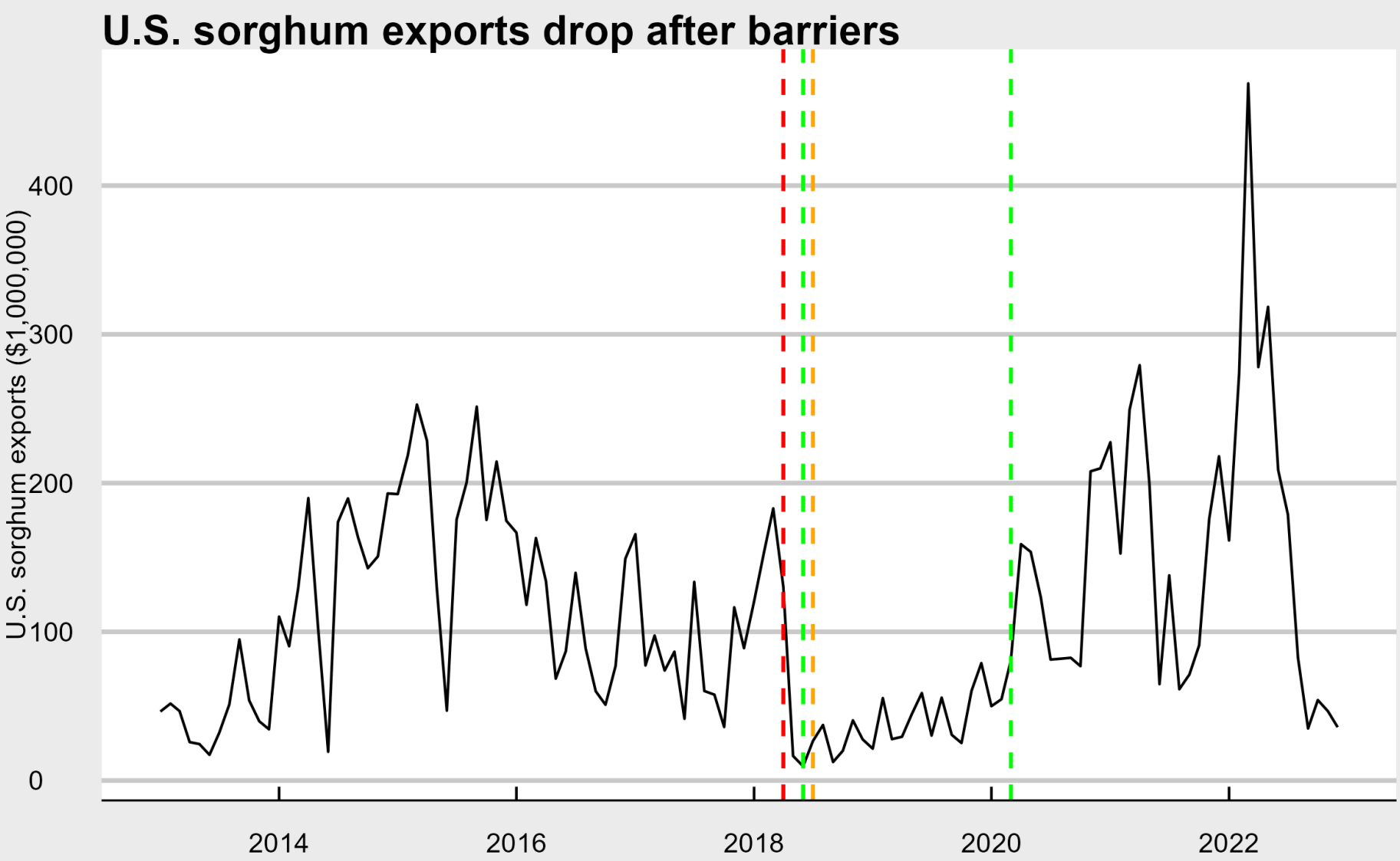
2013-2022

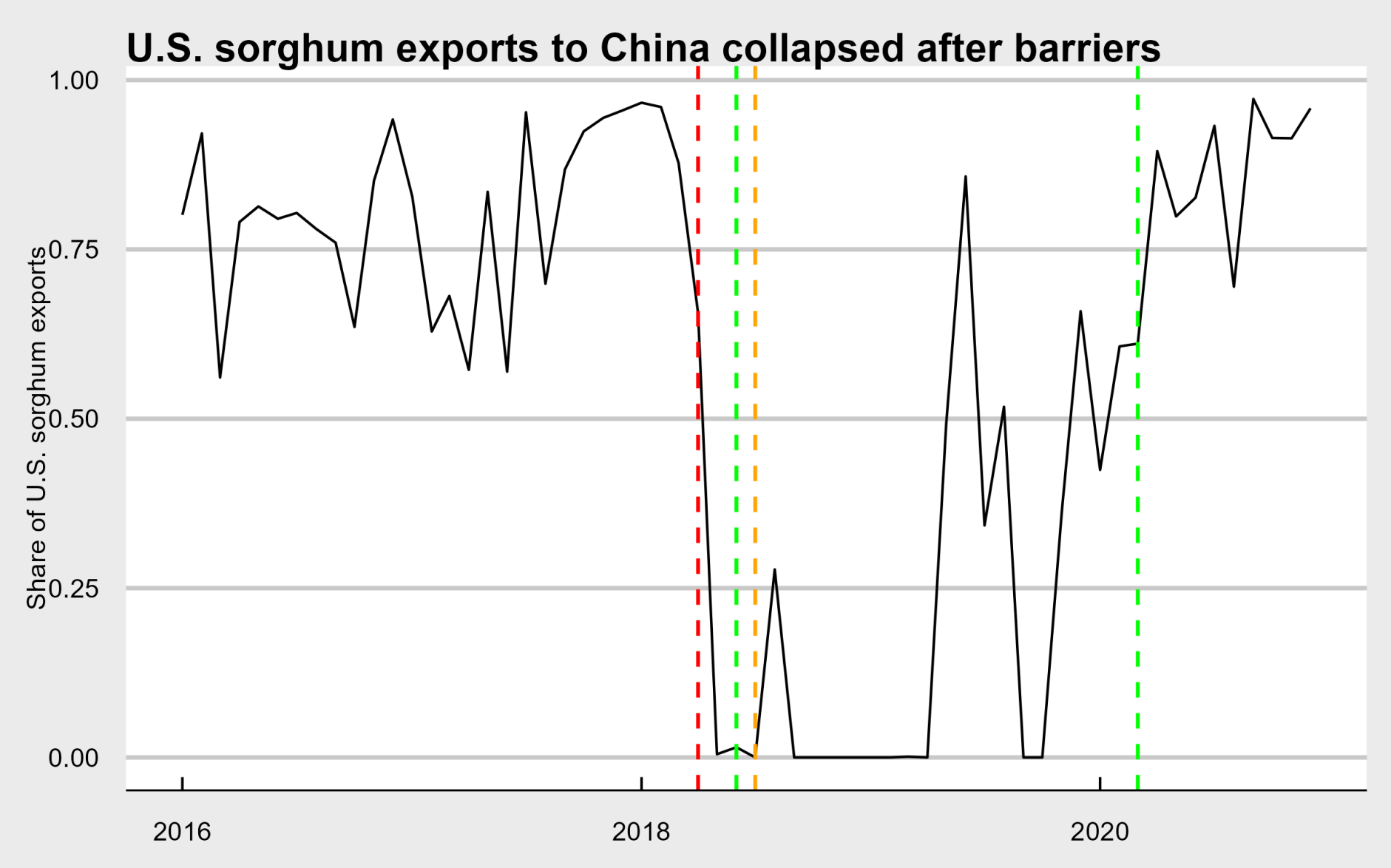


History of U.S. - China Grain Sorghum Trade



U.S. Monthly Grain Sorghum Exports




U.S. sorghum exports to China collapsed after barriers
Share of U.S. sorghum exports
1.00
0.75
0.50
0.25
0.00
2016
2018
2020

Chinese Corn Subsidies

Wang and Malaga (2016)

- China's "temporary reserve program" subsidized domestic corn, increased corn prices, and made grain sorghum a more affordable substitute (2008-2016)
- Predicted that Chinese imports of grain sorghum would decrease in the first year that the temporary reserve program ended
- For subsequent years, excess demand would grow faster than with the program (and larger in magnitude after two years)

What if China exited the global sorghum market?

Hansen et al. (2015)

- Considered and simulated the effects of an import ban on sorghum in China (not U.S. specific) and limited corn area expansion
- If China banned grain sorghum imports:
  - World price would **fall 35%**
  - U.S. exports would **fall 41%**
  - Mexico's imports **increase 846%**

U.S. - China Trade War

Ex Ante Analysis

Zhang and Marchant (2019)

- Simulated three scenarios based on a decrease in quantity of U.S. sorghum imported by China (relative to USDA-ERS baseline projections)
- **Mexico increases imports 25.66%-63.49%**
- **Japan increases imports 1.46%-4.07%** [1]

[1] Not all scenarios were statistically significant

U.S. - China Trade War

Ex Post Analysis

- Sabala and Devadoss (2022) examined the 25% tariff under varying market structures
  - Despite their market shares, bilateral monopoly modeling doesn't represent observed actions
  - However, their model could be calibrated to perfect competition
  - U.S. exports were diverted to Japan $\Delta = 106.55\%$ and Mexico $\Delta = 25.60\%$

- Grant et al. (2021) looked at the 2018/2019 trade war and found that U.S. coarse grains, including sorghum were **highly dependent on Chinese Imports**

- Lohmar (2023) discussed the use of anti-dumping duties, and their investigation, by China during the trade war on U.S. feed products and what big-picture lessons could be learned

Research Questions

How does the type of Chinese trade barrier affect U.S. sorghum export destinations?

Data

We use monthly U.S. export data from Census Bureau (2023)

- The data consists of positive trade flow data, which we balance
- Number of U.S. sorghum export partners by trade barrier status:
  - Anti-dumping duty: 15
  - Tariff : 27
  - No barrier: 48

Linear Probability Model

$$Y_{it} = \alpha_i + \alpha_t + \beta_1 \,\text{Tariff}_{it} + \beta_2 \,\text{Dump}_{it} + \gamma_{1i} \,\text{Tariff}_{it} + \gamma_{2i} \,\text{Dump}_{it} + \varepsilon_{it}$$

$Y_{it} \in [0, 1]$	Trade share for partner i in period t
α_i	Partner fixed effects
α_t	Year $\times$ month fixed effects
β_1, β_2	Average effects of tariffs and dumping
γ_{1i}, γ_{2i}	Partner-specific slopes on tariffs and dumping
$i = 1, \ldots, N$	Trading partner
$t = 1, \ldots, T$	Year $\times$ month time period
ε_{it}	Error term

Standard errors clustered two-way by partner and year.
Weighted by total U.S. sorghum exports.

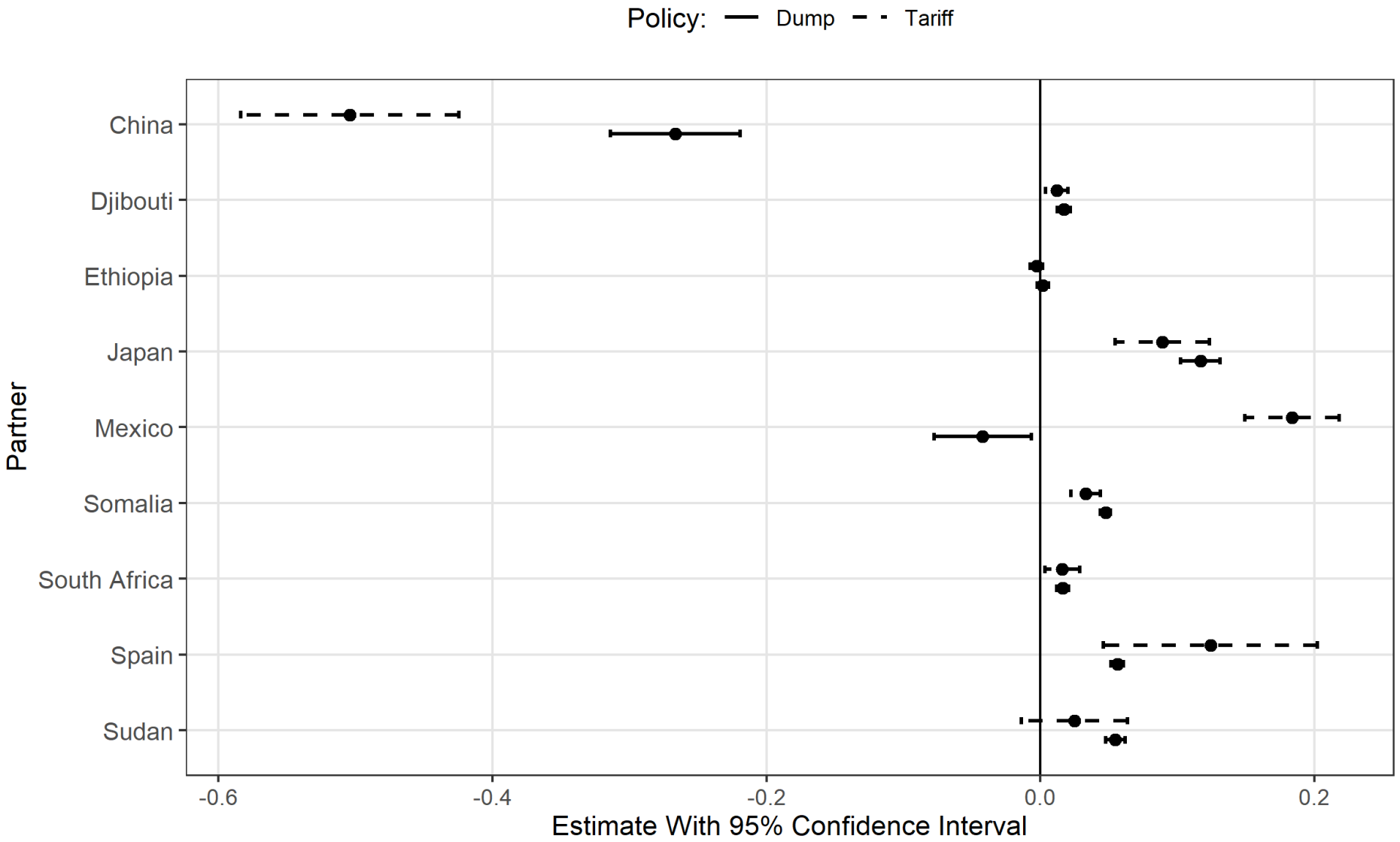
Average Marginal Effects — Selected Partners

	Dump		Tariff	
Partner	**OLS Balanced**	**OLS Positive**	**OLS Balanced**	**OLS Positive**
Canada	0.000	0.002	0.001	0.008
Cameroon	0.000	−0.005	0.004	0.024
China	−0.266***	−0.283***	−0.504***	−0.343***
Djibouti	0.017***	0.003	0.012***	0.038**
Ethiopia	0.002	−0.015	−0.003	0.033**
Japan	0.117***	0.115***	0.089***	0.101***
Korea, South	0.000	0.002	0.001	0.008
Mexico	−0.042**	−0.047***	0.184***	0.184***
Somalia	0.047***	0.428***	0.033***	0.075***
South Africa	0.016***	−0.001	0.016**	0.022
Spain	0.056***	−0.018	0.124***	0.418***
Sudan	0.055***	0.023*	0.025	0.179***

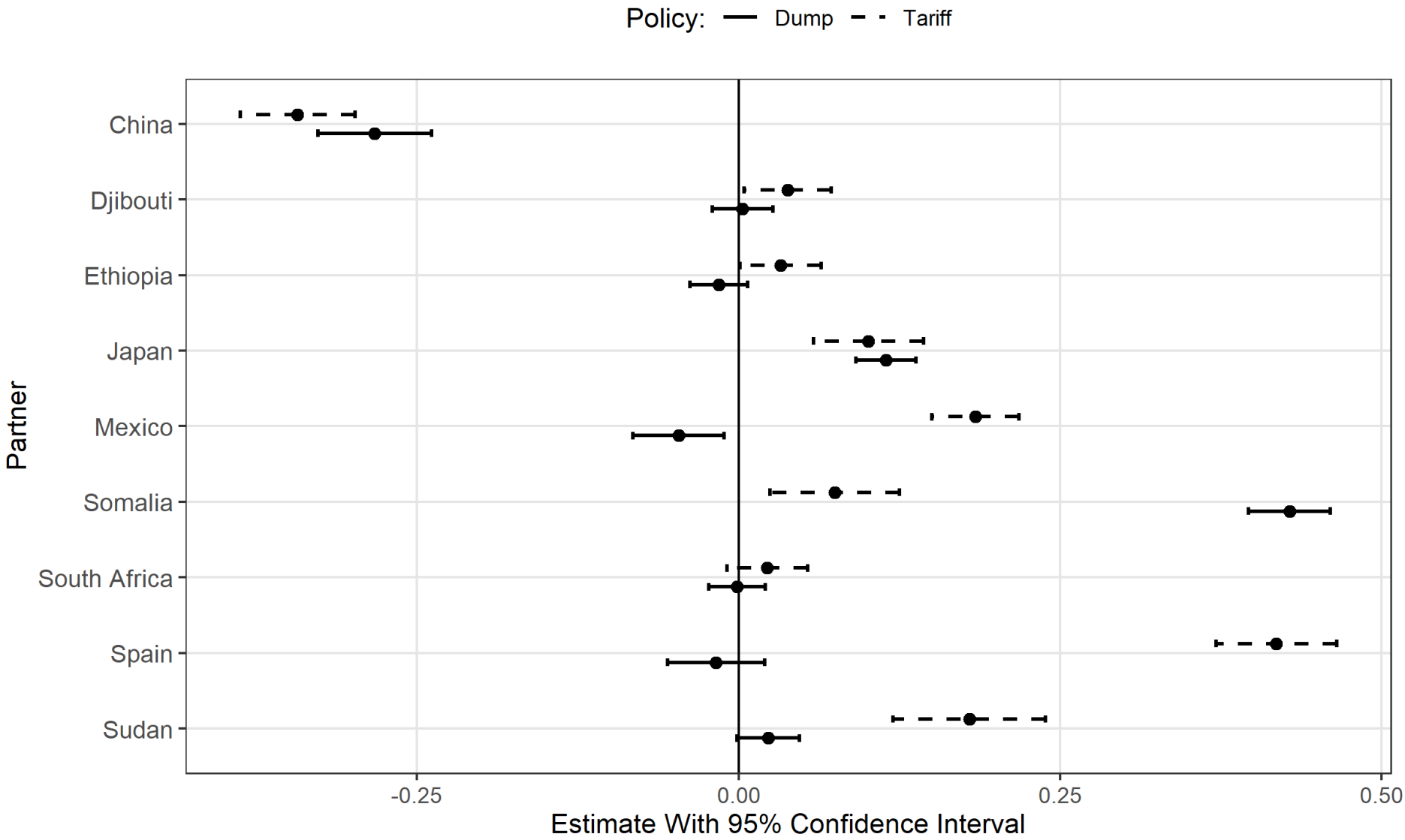
$^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$
Observations: 6,240 (Balanced), 947 (Positive)
Canada is the reference partner.
$\text{AME}_i = {}_i + \gamma_i$
All models include Partner, Year, and Month fixed effects.
Standard errors clustered by Partner and Year.

Results w/ SE

Balanced Marginal Effects



Positive Marginal Effects



Key Takeaways

Balanced Panel:

- Mexico imports the most during the tariff (as predicted by literature), but imports less during the anti-dumping duty
- Japan and Spain were reliable partners for U.S. sorghum during both barriers
- Djibouti, Somalia, South Africa, and Sudan were able to increase their share, especially during the anti-dumping duty

Positive Panel:

- During the anti-dumping, Somalia imports a lot (if they import)
- During the tariff, Spain imports a lot (if they import)

References

Thank you! Questions?

Alan Hinds

PhD Student

Cornell Dyson School of Applied Economics and Management

363 Warren Hall — Ithaca, NY

arh245@cornell.edu

alanhinds.github.io

References I

Census Bureau (2023). USA Trade Online.

Grant, J. H., S. Arita, C. Emlinger, R. Johansson, and C. Xie (2021, June). Agricultural exports and retaliatory trade actions: An empirical assessment of the 2018/2019 trade conflict. *Applied Economic Perspectives and Policy 43*(2), 619–640.

Hansen, J., F. Gale, M. Marchant, F. Tuan, F. Zhong, C. Wei, and A. Somwaru (2015, May). Difficulties in Determining the Future of China's Commodity Trade: Policy Issues and Grain Production. *Selected Poster prepared for presentation at the 2015 Agricultural & Applied Economics Association and Western Agricultural Economics Association Joint Annual Meeting, San Francisco, CA, July 26–28*.

Lohmar, B. (2023). China's Antidumping Investigations Against U.S. Feed Products: Lessons from the Trenches.

Sabala, E. and S. Devadoss (2022). Analysis of Chinese Tariff Impacts on the Sorghum Market under Varying Market Structures. *Journal of Agricultural and Resource Economics 47*(1), 145–166.

References II

Wang, H. and J. Malaga (2016). Potential Scenarios for China's Future Grain Sorghum Excess Demand. *Selected Paper prepared for presentation at the 2016 Agricultural & Applied Economics Association Annual Meeting, Boston, Massachusetts, July 31-August 2* (333-2016-14206), 25. Place: 2016.

Zhang, W. and M. A. Marchant (2019). U.S.-China Sorghum Trade Analysis Within the Trade Conflict: Growth, Trends, and Forecast. *Journal of Management Policy and Practice 20*(5), 80–100.

AME — Selected Partners

Results

	Dump		Tariff	
Partner	**OLS Balanced**	**OLS Positive**	**OLS Balanced**	**OLS Positive**
Canada	0.000	0.002	0.001	0.008
	(0.002)	(0.007)	(0.002)	(0.008)
Cameroon	0.000	−0.005	0.004	0.024
	(0.002)	(0.009)	(0.004)	(0.015)
China	−0.266***	−0.283***	−0.504***	−0.343***
	(0.024)	(0.023)	(0.041)	(0.023)
Djibouti	0.017***	0.003	0.012***	0.038**
	(0.002)	(0.012)	(0.004)	(0.017)
Ethiopia	0.002	−0.015	−0.003	0.033**
	(0.002)	(0.011)	(0.002)	(0.016)
Japan	0.117***	0.115***	0.089***	0.101***
	(0.007)	(0.012)	(0.018)	(0.022)
Korea, South	0.000	0.002	0.001	0.008
	(0.002)	(0.009)	(0.002)	(0.007)
Mexico	−0.042**	−0.047***	0.184***	0.184***
	(0.018)	(0.018)	(0.017)	(0.017)
Somalia	0.047***	0.428***	0.033***	0.075***
	(0.002)	(0.016)	(0.005)	(0.026)
South Africa	0.016***	−0.001	0.016**	0.022
	(0.002)	(0.011)	(0.006)	(0.016)
Spain	0.056***	−0.018	0.124***	0.418***
	(0.002)	(0.019)	(0.040)	(0.024)
Sudan	0.055***	0.023*	0.025	0.179***
	(0.004)	(0.012)	(0.020)	(0.030)

$^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$
Observations: 6,240 (Balanced), 947 (Positive)
Canada is the reference partner.
$\text{AME}_i = {}_i + \gamma_i$
All models include Partner, Year, and Month fixed effects.
Standard errors clustered by Partner and Year.