FRE

Paper presentation

The Impact of Twin Tariffs on China's Dairy Production System: Fixed Effects Model

Youmin Li

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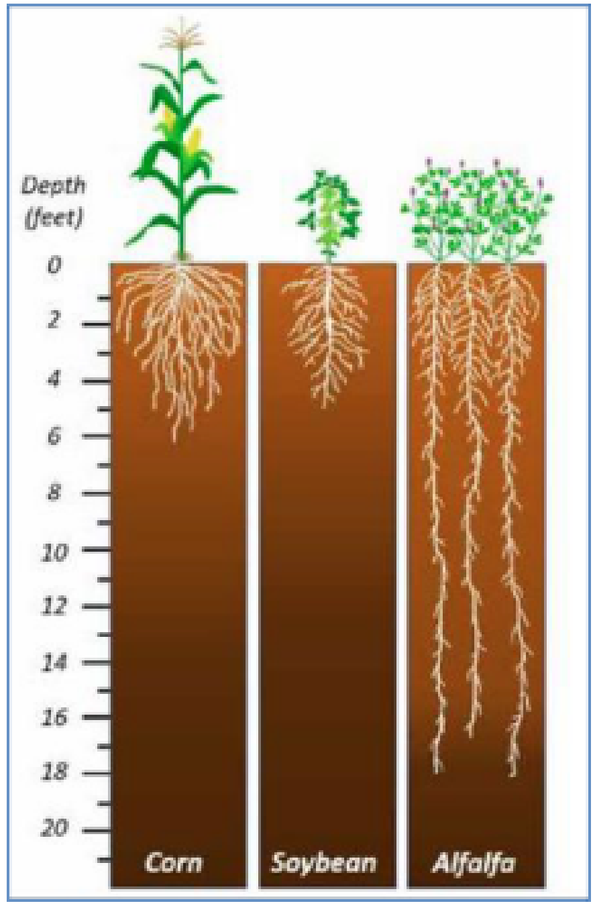
Background



- **China relies heavily on imported alfalfa** and dairy products. In 2015 imports supplied ~50% of alfalfa demand, rising to 89% of imports in 2023.
- Alfalfa is a key cash crop in the **western U.S.**, serving as the primary feed for dairy cattle. Alfalfa directly supports a multibillion-dollar dairy industry in states like California, Washington, Idaho, and Arizona.
- Alfalfa's robust root network not only supports its survival in arid conditions but also contributes to soil health by improving aeration and preventing erosion. Additionally, alfalfa's symbiotic relationship with nitrogen-fixing bacteria enhances its growth in low-nitrogen soils.

Retailory tariff on agricultural production

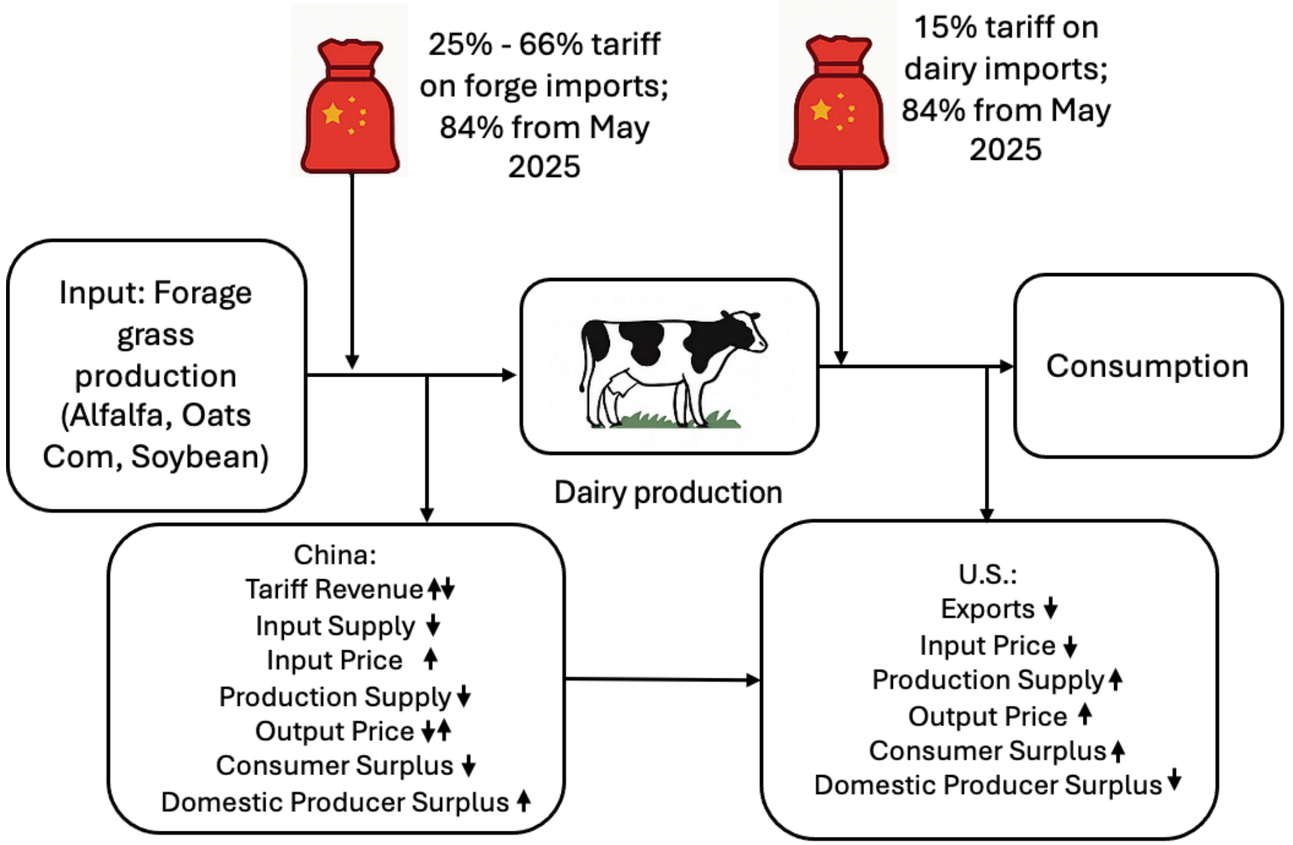
Main trigger: Richman et al, 2014 argued that the U.S. should impose high tariffs on Chinese imports to reduce the trade deficit and promote domestic production.

Chinese Retaliatory Policy: As the largest importer of U.S. alfalfa, China responded by imposing retaliatory tariffs on both alfalfa and dairy products, significantly disrupting bilateral agricultural trade (Twin Tariff).

Key insight: Feed tariffs raise input costs and reduce imports; output tariffs have smaller short-run effects. Milk prices eventually rose by about 9% during the initial trade war period (2018–22).

Twin tariff framework

Twin tariff: tariffs imposed on both inputs (alfalfa) and outputs (dairy), tariffs imposed on alfalfa increased the dairy inputs cost, then the dairy supply curve shift to the left.



Timeline of Events

TRADE WAR

The U.S.–China trade war began in July 2018, escalating tensions between the two countries over tariffs.

TARIFF IMPOSITION

Tariffs on Alfalfa products were imposed in September 2018, significantly affecting trade dynamics and dairy production.

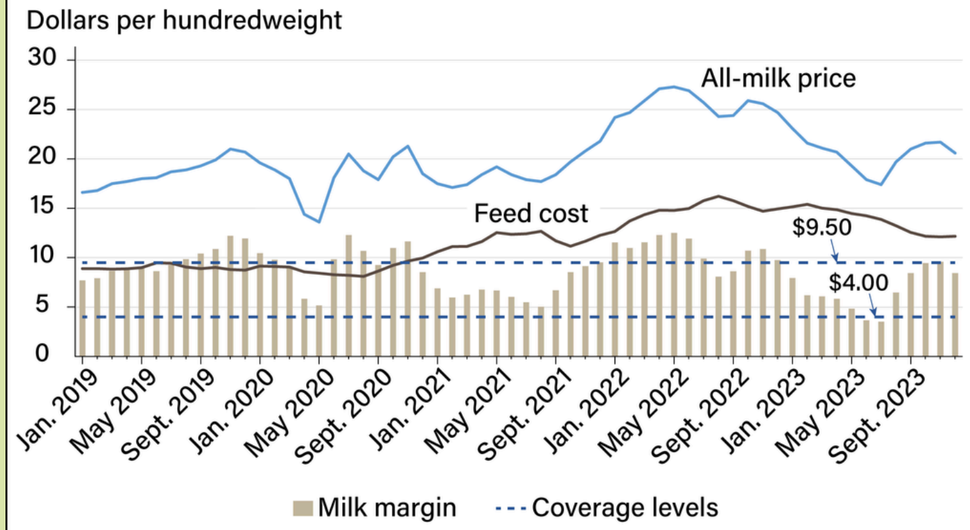
TRADE TENSIONS PERIOD

By 2020, twin tariffs on dairy feed and products, and COVID19 impacts resulted in considerable disruptions to China's dairy production system.

TARIFF ADJUST PERIOD

By 2023, China-U.S. set up many rounds of tariff trade negotiations, tariff rates changed frequantly and dynamic.

Federal Dairy Margin Coverage program compensates dairy producers when the difference between milk prices and feed costs drops below selected coverage level



Note: A **hundredweight** = 100 pounds. The lowest coverage level available is $4.00 per hundredweight, and the highest coverage available is $9.50 per hundredweight. Feed costs in 2021 and after are calculated for premium alfalfa hay. Feed costs in 2020 and earlier used the original formula of 50-percent premium hay and 50-percent regular hay.

Source: USDA, Economic Research Service calculations using data from USDA, Farm Service Agency.

Prices Received for Premium and Supreme Alfalfa Hay – States and 5-State Total: July 2023

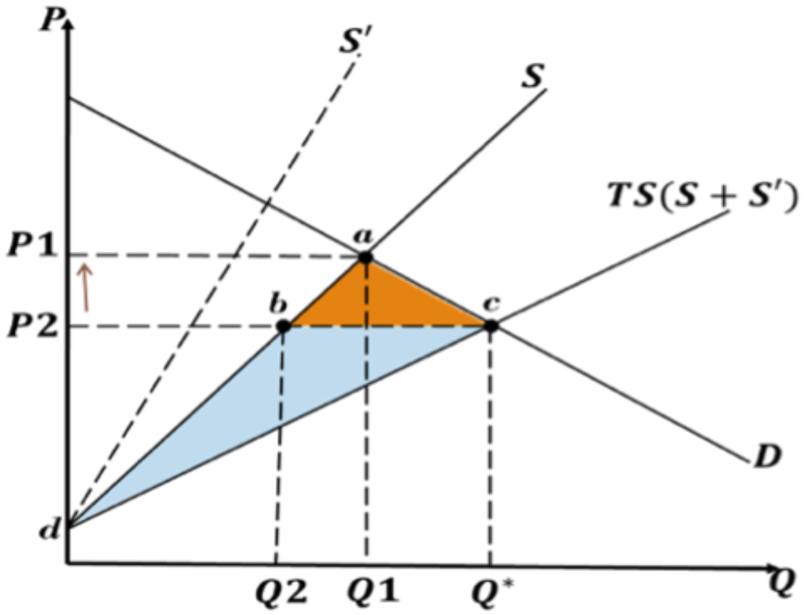
State	July 2022	June 2023	July 2023
	(dollars per ton)	(dollars per ton)	(dollars per ton)
California	370.00	340.00	300.00
Idaho	320.00	290.00	280.00
Michigan	205.00	225.00	220.00
Minnesota	195.00	221.00	222.00
New York	320.00	312.00	314.00
Pennsylvania	330.00	322.00	325.00
Texas	309.00	330.00	326.00
Wisconsin	168.00	188.00	185.00
5-State Total [1 2]	335.00	310.00	288.00

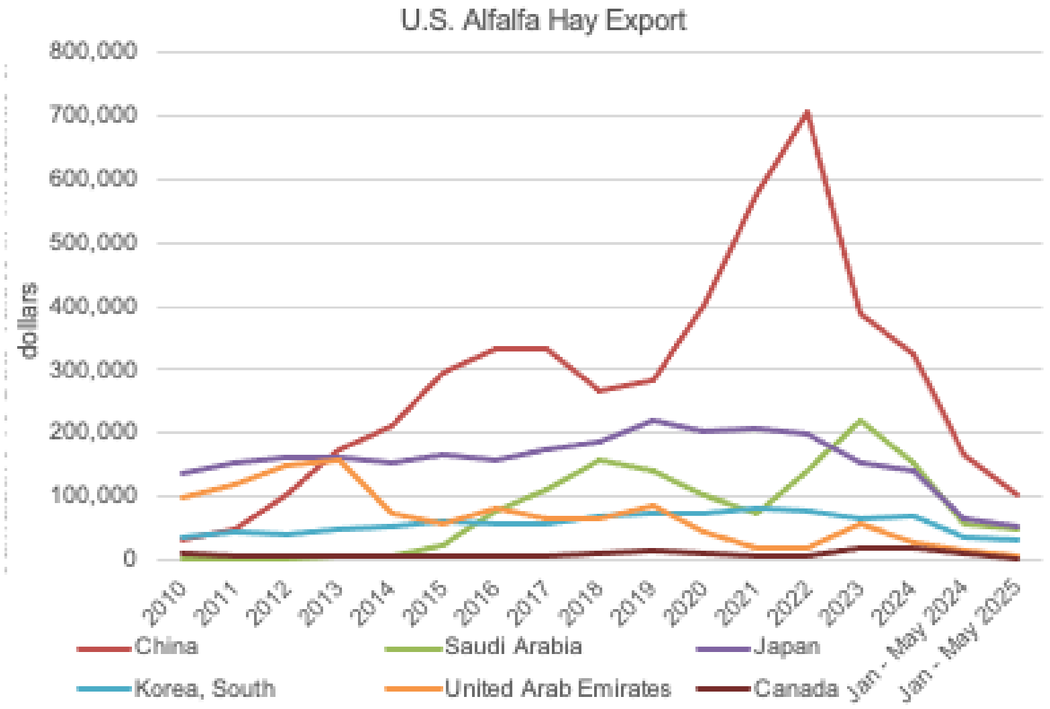
Significance for China's Dairy Sector

DAIRY CONSUMPTION

As per capita dairy consumption is projected to increase by 0.8% annually, alfalfa's contribution to feeding a growing population becomes even more vital.

Research question: How have twin tariffs on feed inputs and dairy outputs affected import volumes and farm-gate milk prices in China?





Data Sources

• USDA FAS – Global Agricultural Trade System (GATS) and U.S. Census Bureau trade data provide import volumes and values for alfalfa (HS 1214) and dairy products (HS 04).

• China Customs Statistics (GACC) supply domestic farm-gate milk prices and tariff rates.

• FAO's world dairy price index tracks global input–output price transmission.

• Tariff revenues are constructed as tariffs × import values.

Variable	Source	Period
Alfalfa import qty/value	USDA GATS & Census	2005–2025
Dairy import qty/value	USDA GATS & Census	2005–2025
Farm-gate milk price	GACC	2005–2025
World dairy price index	FAO	2005–2025
Tariff rates	GACC (announced rates)	2010–2025

Theoratical framework

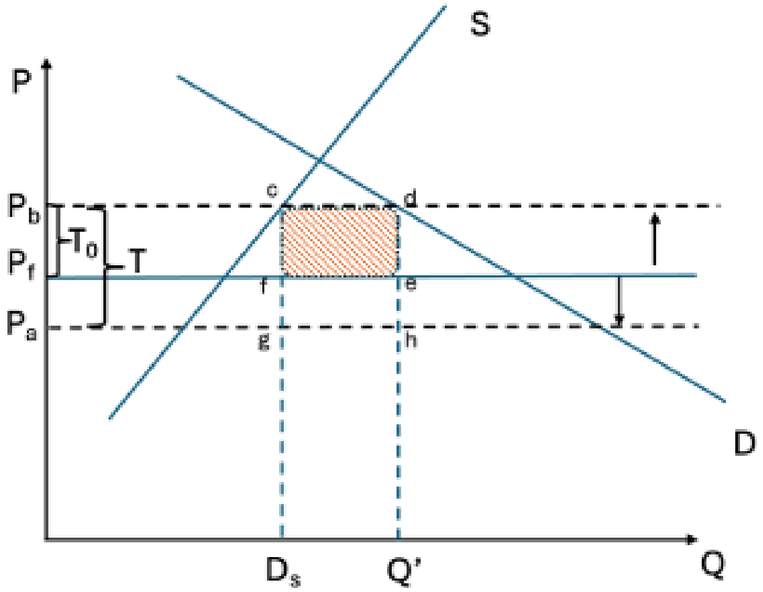


Figure 4: Effects of tariffs on terms of trade effects in small country

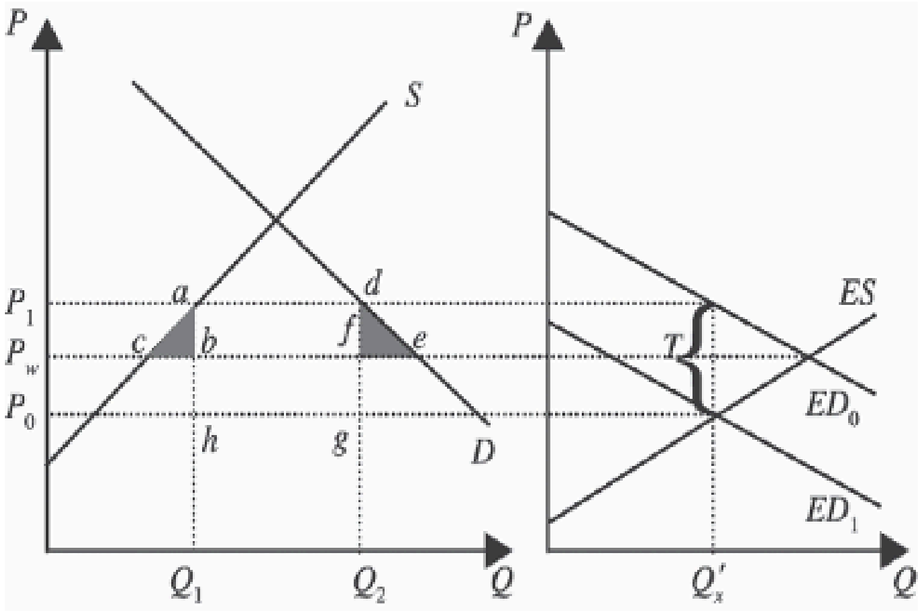


Figure 5: Effects of tariffs on terms of trade effects in large country

Theoratical framework

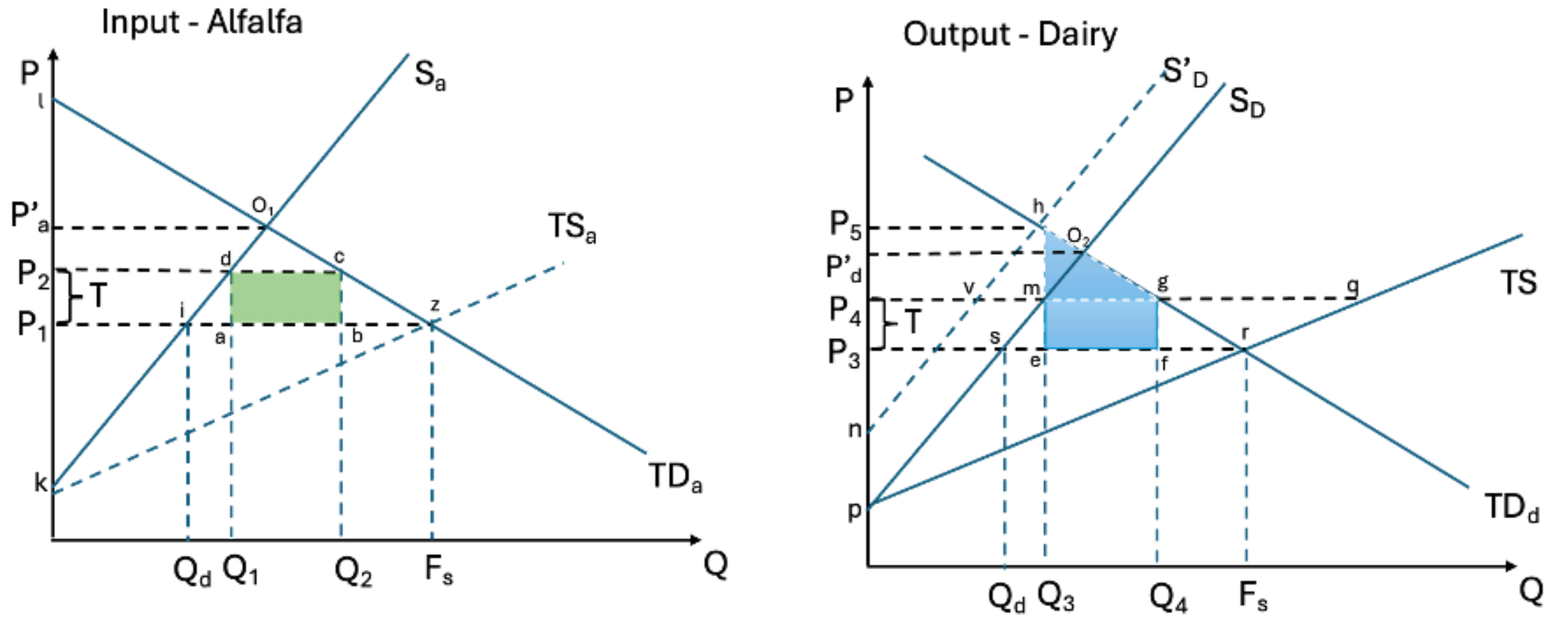
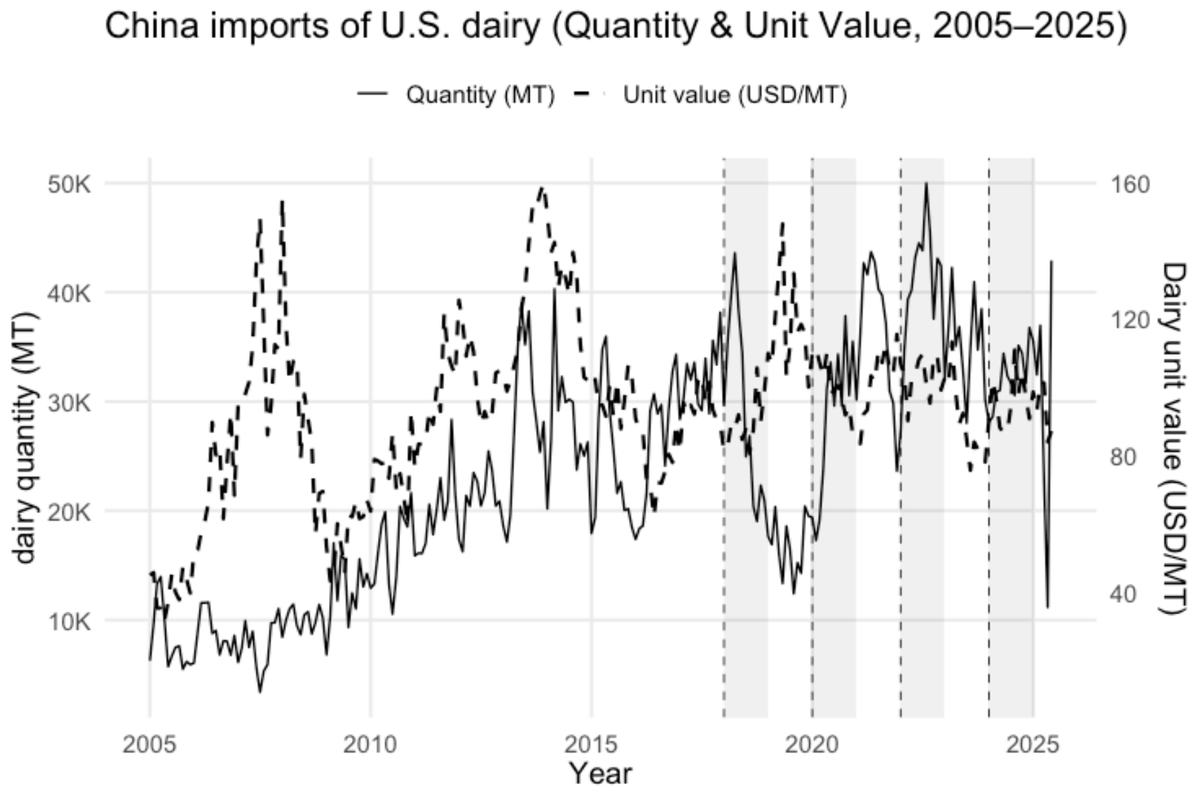
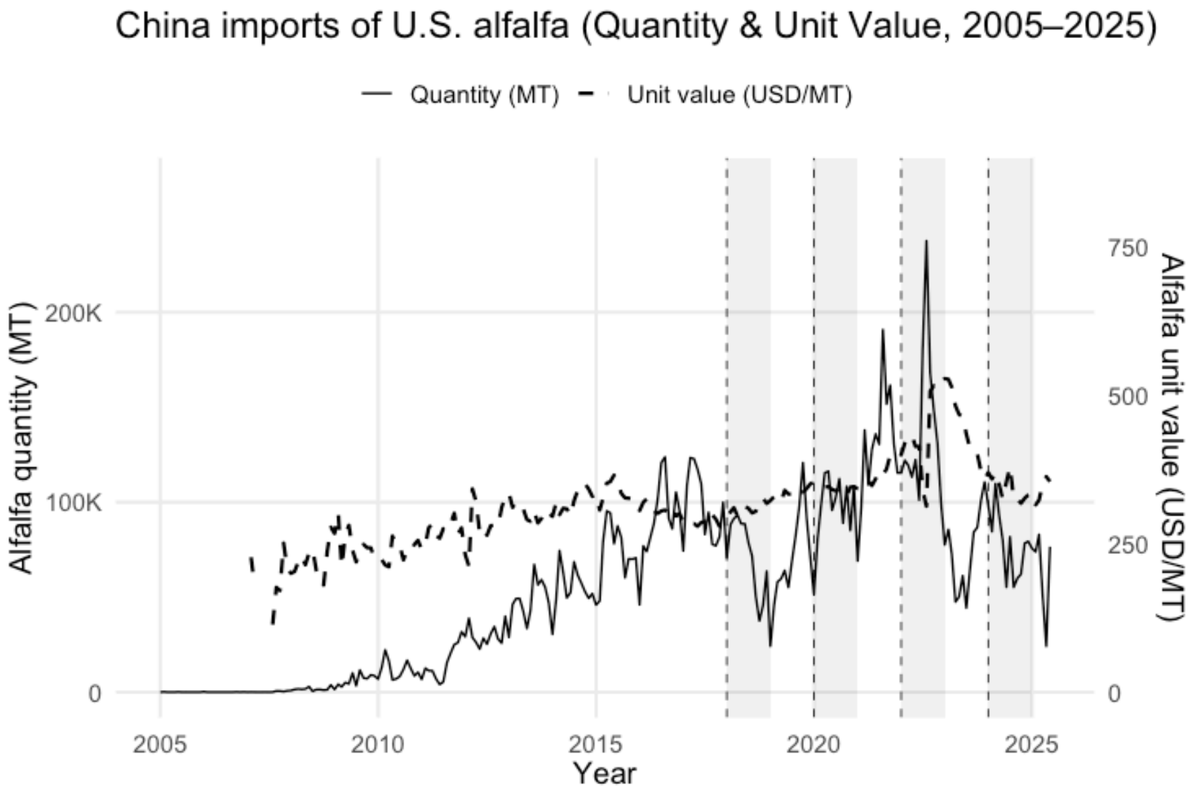


Figure 6: Twin tariff effects on alfalfa and dairy

Data overview





Empirical Approach

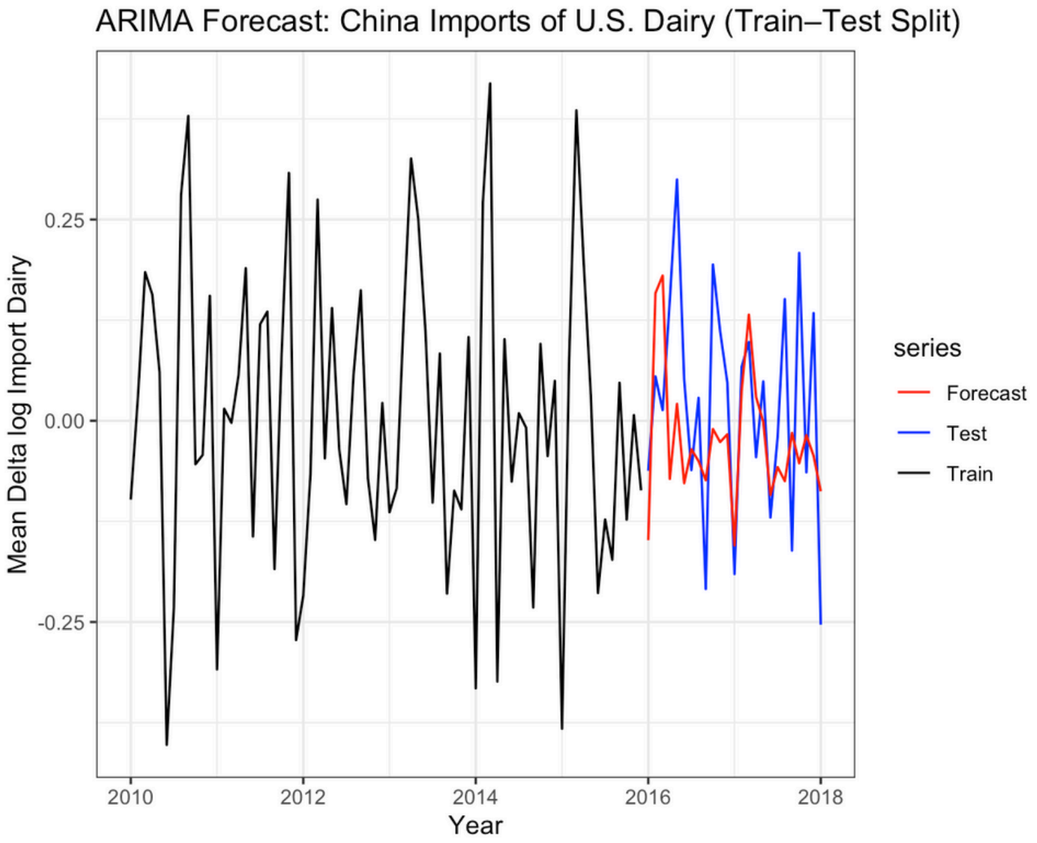
Large-country trade framework:
China is treated as a large importer of alfalfa and dairy; tariff changes influence world prices. Small competitors are price-takers; alfalfa is assumed to have limited substitutes.

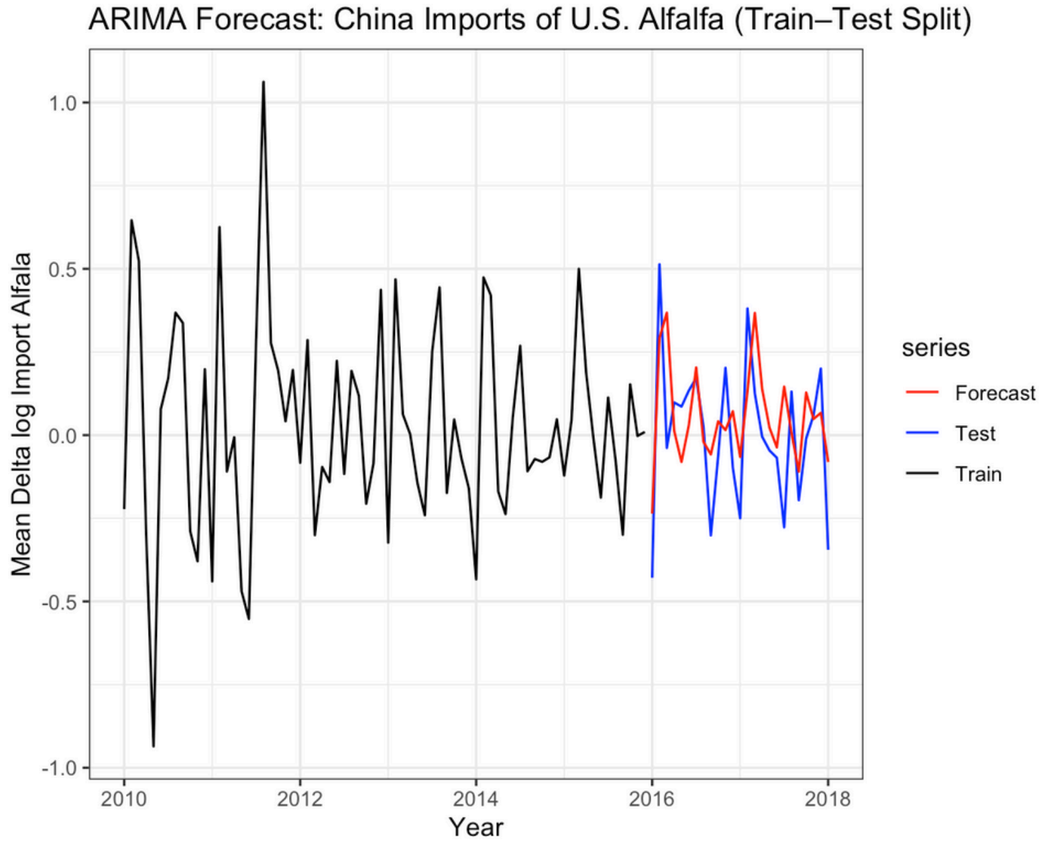
Econometric model:
Monthly and yearly fixed effects which absorb seasonal and macroeconomic fluctuations (e.g. Chinese new year, melamine incident in 2008).

Imports quantities are instrumented to isolate the causal pathway from tariff changes to farm-gate prices. Log-differences of quantities, prices and tariff rates are regressed over current and lagged values.

$$\Delta P_t^{milk} = \theta_0 + \sum_{k=0}^{2} \left(\theta_k^A \, \Delta \ln(\mathrm{tr}_{t-k}^A + 1) + \theta_k^D \, \Delta \ln(\mathrm{tr}_{t-k}^D + 1) \right) + \mu_m + \lambda_y + \nu_t.$$

Stationarity assumptioncheck





Parellel trend: Alfalfa is seasonal agricultural product, this study assumes price trends are the same across different years, so all impacts come from exogenous variables. With this assumption, we used one-way fixed effect model to estimate each key period policy treatment impacts.

Instrumental Variable Approach

The import quantity was constructed as an instrument variable (IV) to reveal the mechanism pathway of the twin tariff impacts on domestic milk price. Log-linear regressions were estimated to test the sensitivity of import quantities and unit values to tariff rates, with fixed effects capturing the tariff shock. We treat the tariff changes as exogenous and assume that they are uncorrelated with unobserved shocks to import value (Amiti et al., 2019).

$$\text{First stage:} \quad \Delta \ln Q_{D,t} = \alpha_0 + \sum_{k=0}^{2} \left(\gamma_k^D \Delta \ln(\mathrm{tr}_{t-k}^D + 1) + \gamma_k^A \Delta(\mathrm{tr}_{t-k}^A + 1) \right) + \mu_m + \lambda_y + u_t,$$

$$\text{2SLS:} \quad \Delta \ln P_t^{mi} = \beta_0 + \sum_{k=0}^{2} \left(\beta_{1,k} \Delta \ln \widehat{Q_{D,t-k}} + \beta_{2,k} \Delta \ln(\mathrm{P}_{t-k}^D) + \beta_{3,k} \Delta \ln(\mathrm{P}_{t-k}^A) \right) + \mu_m + \lambda_y + \varepsilon_t,$$

Tariff Impacts - price effects

- From 2018–22, alfalfa prices increased 15% and per-capita milk output in Inner Mongolia declined 9.2%.
- Tariff changes significantly reduce import quantities but have little impact on CIF prices; importers and producers absorb most costs.
- 1% increase in the alfalfa tariff reduces farm-gate milk prices by ~2.2% one month later; dairy tariffs have negligible direct effects.
- Overall, twin tariffs squeeze margins: feed costs rise while output prices lag, pressuring small farms.

Table 1: Twin Tariff Impacts on China's Dairy Production System (One-way Fixed Effects)

		(1) $\Delta\log(\textit{dairy import qty})$ *(First stage)*	(2) $\Delta\log(\textit{milk price})$ *(2SLS)*	(3) $\Delta\log(\textit{milk price})$ *(Direct)*
Tariff on dairy $\Delta\log(\cdot)$	$t=0$	0.086	0.011	0.010
	$t-1$	0.046	0.009	−0.008
	$t-2$	0.25***	0.03***	−0.009
Tariff on alfalfa $\Delta\log(\cdot)$	$t=0$	−0.155**	−0.022**	−0.013
	$t-1$	0.008	0.002	0.003
	$t-2$	−0.124**	−0.017***	0.006
Alfalfa price $\Delta\log(\cdot)$	$t=0$	−0.035·		
	$t-1$	−0.036*		
	$t-2$	−0.035**		
Dairy price $\Delta\log(\cdot)$	$t=0$	−0.324***		
	$t-1$	0.101		
	$t-2$	0.170·		
Observations		243	243	243
Adj. R^2		0.414	0.998	0.998

Notes: One-way fixed effects (month and year) included. Heteroskedasticity-robust standard errors. Dependent variables as labeled in column headings. Significance levels: $^{***}p<0.01$, $^{**}p<0.05$, $^{*}p<0.10$, $^{\cdot}p<0.15$.

15.5%

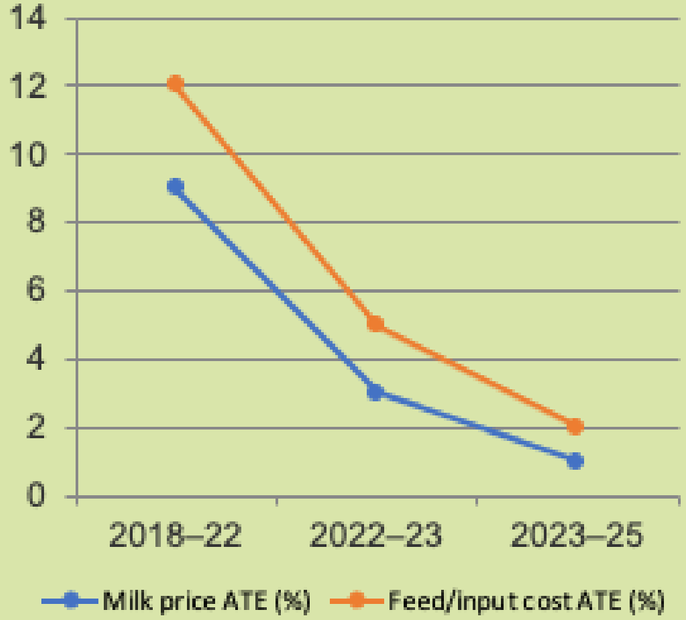
Reduction in dairy imports

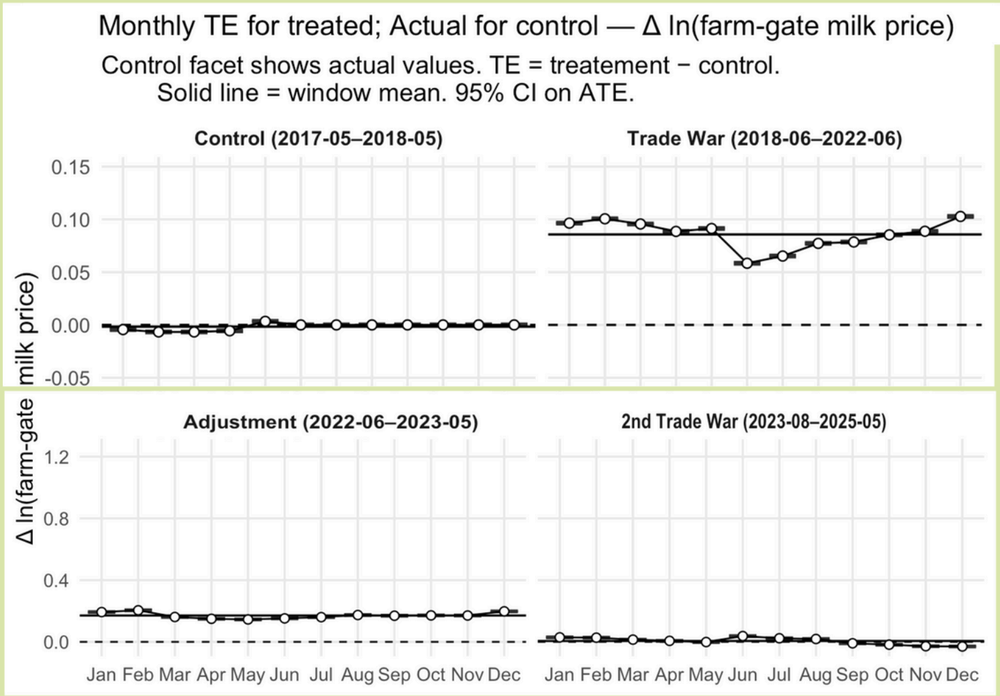
Average treatment effects (ATE) compare tariff windows relative to the pre-tariff baseline.

• Initial trade war (2018–22): Milk prices rose about 9%, feed costs surged and logistics bottlenecks exacerbated pressures.

• Adjustment period (2022–23): Temporary tariff reductions, subsidies and import-tax refunds moderated impacts.

• Second trade war (2023–25): Adaptation via diversification and domestic forage production reduced ATEs.



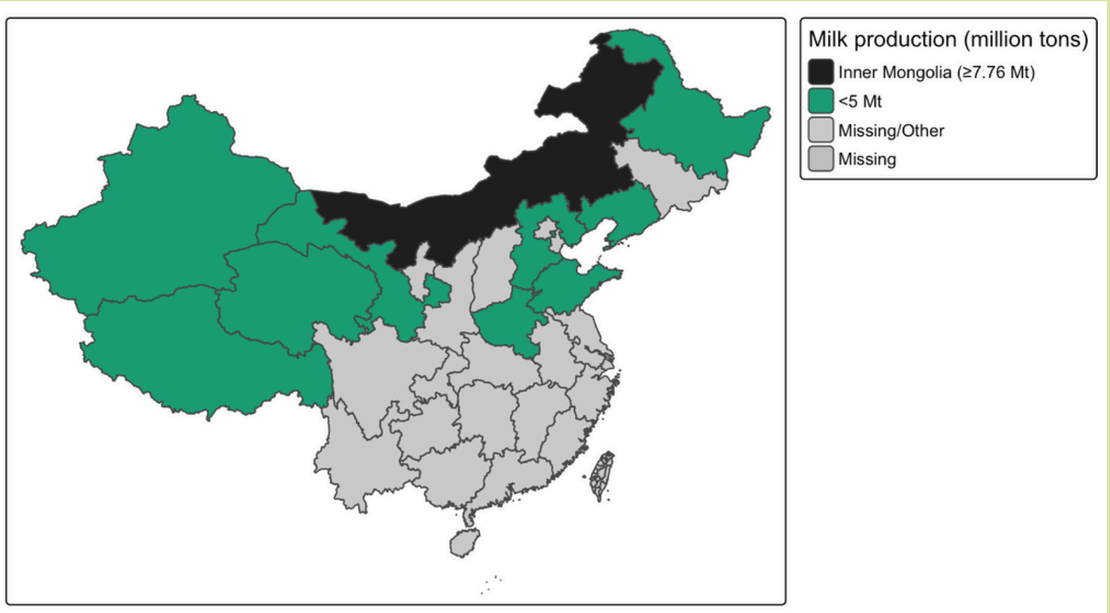


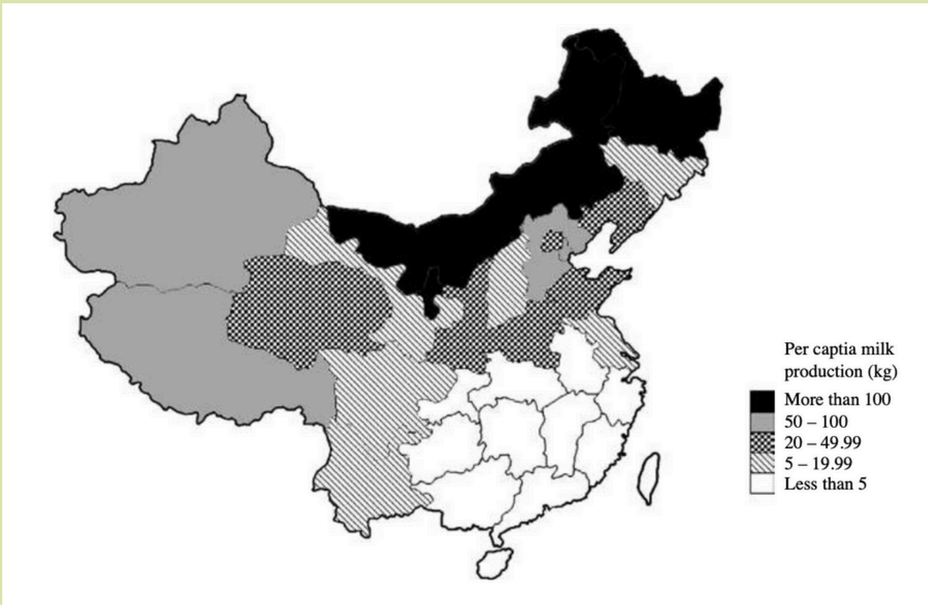
Economic Interpretation

•Alfalfa prices increased by 35.6% (2021–2022): China does not have a comparative advantage in land-intensive feed grains and proteins such as alfalfa and soybean.

•Per capita milk output declined by 9.2% (2018–2022): Per capital consumption demand increased 20% (2018-2024).

•Dairy input costs rose significantly but farm-gate milk price declined 9% due to dairy import alternatives to Australia, the EU and New Zealand. Small dairy farms facing the challenge of squeeze out of the market.





Policy Recommendations

- **Twin tariffs amplify cost pressures—input tariffs raise production costs while output tariffs depress world prices.**
- **Diversification of feed sources and domestic forage development can buffer shocks.**
- **Producer subsidies for critical inputs like alfalfa can offset short-run welfare losses.**

Conclusion

- **Tariffs directly shift the landed cost of U.S. alfalfa → reduces imports**
- **Reduced imports tighten domestic feed availability → raises feed costs**
- **Higher feed costs pass through to raw-milk prices**

The economic burden of tariffs was mainly borne by importers and producers, not exporters.

In short, the twin tariff regime increased production costs, squeezed small farmers, and amplified welfare losses beyond a single-tariff scenario.

Future research should integrate other feed costs—like soy and corn—and model heterogeneity across Chinese provinces.”

Thank you!

Any questions or comments?

YOUMIN LI

liyoumin@ufl.edu

DATA AND CODING SHARE:

github: https://github.com/liyoumin/Trade-tarrifs-impacts-on_Chinnese_dairy/blob/main/estimates.R