Friendshoring and agricultural trade in a geopolitically divided world

Aaron Staples[a]; K. Aleks Schaefer[b]; and Trey Malone[c]

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Abstract

Rising geopolitical tensions have prompted concerns about the resilience of global supply chains and the potential reorganization of international trade flows. This study investigates whether U.S. agricultural import patterns have shifted toward geopolitically aligned countries—a phenomenon commonly referred to as "friendshoring." Using monthly U.S. agricultural import data from 2010 to 2024 and a novel, time-varying index of geopolitical distance based on World Bank governance indicators, we estimate the extent to which trade flows have reoriented in the wake of heightened global conflict. Our baseline results show that U.S. agri-food imports have increasingly favored countries with closer geopolitical alignment since late 2022. We further examine whether this shift varies by industry characteristics, including cost differentials and baseline price volatility. Our findings consistently point to a measurable reconfiguration of agricultural trade consistent with friendshoring behavior.

Keywords: agribusiness strategy, friendshoring, geopolitical risk, international trade

JEL Codes: F14, Q17, L22

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1 Introduction

The globalization of supply chains has enabled agribusinesses to reduce production costs, expand into new markets, and improve operational efficiencies. Despite these numerous benefits, this trend has also introduced new risks and vulnerabilities threatening agri-food supply chain resiliency. Among the most prominent examples are geopolitical risks, including trade disputes (Grant et al., 2021; Steinbach, Yildirim and Zurita, 2024), political instability and war (Ahn, Kim and Steinbach, 2023; Lim and Oh, 2024), regulatory changes (Livingston, Schaefer and Malone, 2025), and border disruptions (Ker, 2020). Geopolitical risks challenge agri-food business decision-making, where companies must actively plan operations, logistics, and sourcing around this uncertainty (Du and Dong, 2023; Gopinath, 2021). Failure to adapt to these global events and market risks can significantly impact agri-food supply chain performance, pricing, and product availability.

One such decision includes strategic input sourcing, which forces firms to consider the tradeoffs between costs, risk, control, and market proximity. For example, outsourcing and offshoring emerged in high-income countries when firms realized they could sacrifice market proximity for lower wage rates and regulatory hurdles in some parts of the world (Hummels, Munch and Xiang, 2018; Li and Zhou, 2017; Schmeisser, 2013). However, growing geopolitical tension might make other input-sourcing strategies more appealing.

This study investigates whether agri-food supply chains have adopted friendshoring as a response to geopolitical risk. The World Economic Forum defines friendshoring as "rerouting of supply chains to countries perceived as politically and economically safe or low-risk, to avoid disruption to the flow of business" (Ellerbeck, 2023). In other words, friendshoring is the tendency of supply chain networks to align themselves with geopolitical allies (Ellerbeck, 2023). While the practice may come at the cost of reduced supplier options, higher expenses, and wider adverse economic outcomes (Javorcik et al., 2024), it can also allow firms to circumvent geopolitical risks and enhance supply chain resiliency. While it is generally accepted in the supply chain management literature that friendshoring is happening (Javorcik

et al., 2024; Klarin and Sosnovskikh, 2024), there is little empirical evidence supporting this claim in agri-food supply chains.

We argue that the agri-food sector is an ideal industry to explore friendshoring because of the rise of multinational enterprises (Scoppola, 2021), the growing concerns over tariffs and other geopolitical hurdles, and an intensifying focus on food security as national security. That said, agri-food supply chains face constraints that distinguish them from most industrial or consumer goods sectors. Perishability, biological production cycles, and sensitivity to weather and disease create volatility that firms must manage even without geopolitical shocks (Mitchell, Thompson and Malone, 2024; Sporleder and Boland, 2011). In addition, food systems operate under strict regulatory oversight and are shaped by sanitary and phytosanitary standards that vary across markets (Staples et al., 2022). These standards, coupled with growing consumer concern over traceability and safety, limit the substitutability of suppliers and raise the cost of switching trade partners (Chaudhary, Sharma and Vemireddy, 2024). As a result, agri-food supply chains are especially exposed to disruptions in international trade and require a higher degree of coordination across borders to maintain flow continuity (Loy, Britton and Malone, 2024). These characteristics make the sector an especially relevant context for examining whether firms have adjusted sourcing strategies based on geopolitical alignment.

Although the agri-food sector has features that make it uniquely vulnerable to disruption, the implications of this analysis extend beyond food and agriculture. Other critical supply chains also operate under high regulatory scrutiny, depend on global sourcing, and are subject to public trust concerns (Hutter and Jones, 2007). For example, pharmaceuticals, semiconductors, and medical equipment confront reliability and political alignment as core strategic considerations that rival cost in importance (Choi, Rogers and Vakil, 2020; Javorcik et al., 2024). Understanding how agri-food firms respond to geopolitical risk can offer insights into broader global supply chain governance shifts. In particular, if firms in a sector with limited sourcing flexibility are reorienting toward allied countries, this may signal

a broader move toward resilience strategies that prioritize alignment over efficiency.

This article examines whether agri-food supply chains have reoriented toward geopolitically aligned countries in response to rising global tensions. To test our hypotheses, we develop a quantitative measure of friendshoring, which enables us to examine sector-level relationships with U.S. agricultural import patterns over time. Specifically, we link monthly U.S. import trade data from 2010 to 2024, as reported by the U.S. International Trade Commission (USITC), to worldwide governance indicators from the World Bank to create a dynamic "friendship" index. This index enables us to econometrically assess how rising geopolitical tensions have influenced friendshoring behaviors in agricultural trade. Our empirical model quantifies the shift toward friendshoring using Poisson pseudo-maximum likelihood estimation procedures.

In conducting this analysis, we offer three key contributions. First is a dynamic and quantifiable measure of friendliness based on geopolitical distance. Using normalized annual data on worldwide governance indicators from the World Bank, we construct a measure of similarity or dissimilarity for more than 180 countries to the United States. In allowing this to adjust across time, we can capture how shifts in administrations and other geopolitical events (e.g., the Russian invasion of Ukraine) influence geopolitical distance. Second, we estimate the degree to which friendshoring has occurred by regressing the value of U.S. imports on the geopolitical distance measure across time. Finally, we estimate the country-level economic impacts of friendshoring, conveying which countries experienced an increase in trade and which countries experienced a loss and by how much. The results provide timely, policy-relevant insights on geopolitics, trade, and supply chain resiliency.

The remainder of this manuscript is structured as follows. Section 2 provides additional background on geopolitical risk and supply chain management in international trade, while Section 3 presents a conceptual model linking geopolitical risk with friendshoring. Section 4 describes the data used in the study, including the geopolitical distance measure using World Bank data, and Section 5 explains our modeling approach to analyze the extent

of friendshoring in agricultural trade. Section 6 presents our main results, and Section 7 presents a series of robustness checks to alternative specifications, estimation procedures, and control variables. Section 8 concludes with a discussion of the policy implications and areas for additional research.

2 Background

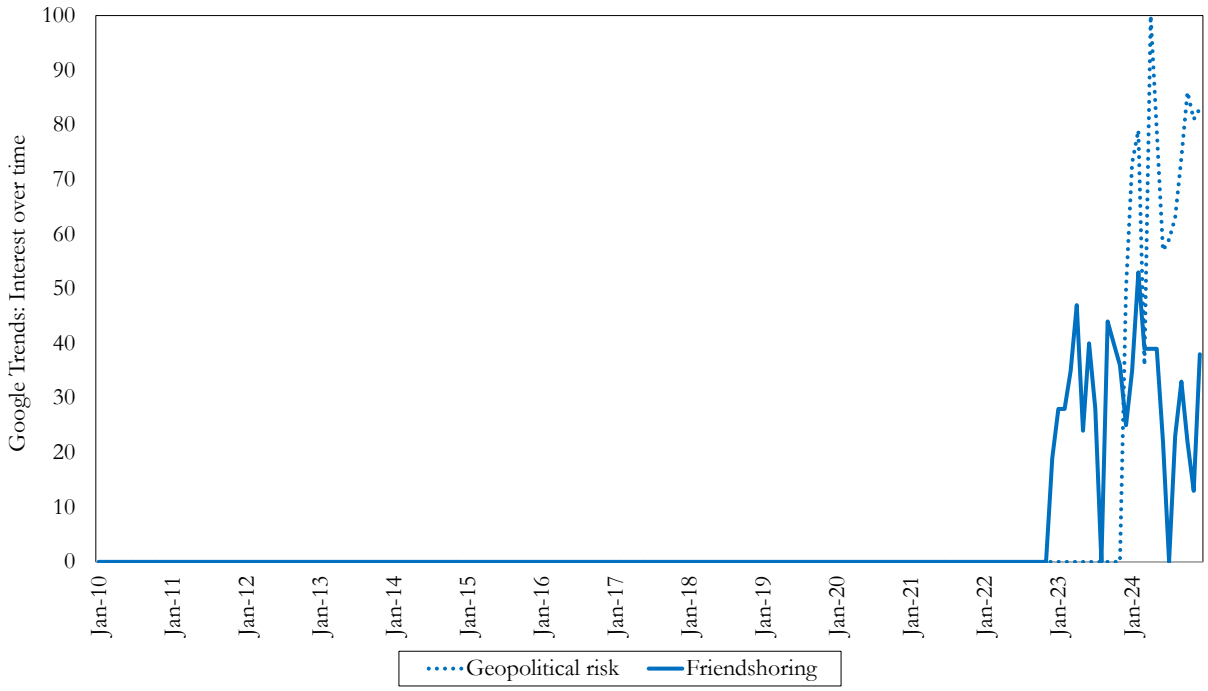
Globalized supply chains have greatly expanded global wealth by generating new market opportunities, amplifying innovations in the agri-food supply chain, and reducing input costs (Du et al., 2016; Livingston, Schaefer and Malone, 2025). The pandemic exposed global and hyper-specialized supply chain rigidities (Malone, Schaefer and Lusk, 2021; Norwood and Peel, 2021). For example, strategies to minimize exposure to labor constraints have emerged as a key approach to supply chain risk management during the COVID-19 pandemic (Wahdat and Lusk, 2023). Since then, resiliency has become a key focus for agri-food supply chains, even if it comes at an added cost for the firm (Hadachek, Ma and Sexton, 2024; Hobbs and Hadachek, 2024; Stevens and Teal, 2024).

Perhaps the most current prevalent risk at the top of mind for agri-food supply chains includes elevated levels of geopolitical risk, such as strategies to mitigate economic losses resulting from the Ukrainian invasion (Boyko, Nes and Schaefer, 2024; Poursina et al., 2024; Steinbach, 2023). Trade disputes, political instability, and regulatory changes can disrupt the functionality, efficiency, and resiliency of agri-food supply chains. Empirical studies have extensively documented the immediate and direct economic consequences of geopolitical shocks, particularly in trade and investment (Boyko, Nes and Schaefer, 2024; Caldara and Iacoviello, 2022; Steinbach, 2023). However, these analyses typically characterize responses as reactive, examining outcomes following the realization of geopolitical events. Far fewer studies examine proactive adjustments to sourcing strategies as anticipatory measures.

Strategic sourcing in the form of friendshoring has emerged as one of the most commonly

discussed risk management approaches in modern supply chains (Javorcik et al., 2024; Klarin and Sosnovskikh, 2024). Figure 1 presents U.S. Google Trends from 2010 to 2024 on "friendshoring" and "geopolitical risk." It shows that these became a prominent topic in the second half of 2022, with friendshoring first gaining traction as a trending topic in December 2022 This trend coincides with a plethora of geopolitical events, including the Russian-Ukraine war , escalating Israel-Palestine Tensions (Debre and Federman, 2022), and trade disputes between the United States and China over semiconductor export controls, among others. Thus, the concepts of friendshoring and geopolitical risks are inherently linked.

Figure 1: Google Trends Interest in "Friendshoring" and "Geopolitical Risk"



Notes: Figure shows Google Trends interest over time for the topics "friendshoring" and "geopolitical risk" in the United States from 2010–2024.

Despite growing recognition of geopolitical risks as critical determinants of international trade patterns, current scholarship offers limited empirical exploration of friendshoring as a strategic response, particularly within agri-food systems. Most existing frameworks for analyzing global supply chain strategies concentrate on standard economic trade-offs such as

cost, quality, and logistical efficiency (Hummels, Munch and Xiang, 2018; Schmeisser, 2013). For example, Caldara and Iacoviello (2022) analyze firm-level responses to geopolitical risks, measured through investment. They show that investments can decline because of the threat and realization of adverse geopolitical events, with the largest declines being in industries exposed to elevated risk (e.g., shipping and transportation).

While these dimensions remain important, geopolitical considerations increasingly influence supplier selection through channels that traditional economic models may undervalue. Friendshoring explicitly integrates geopolitical alignment into sourcing decisions, suggesting firms prioritize stability and risk mitigation alongside traditional metrics of economic performance (Ellerbeck, 2023; Klarin and Sosnovskikh, 2024). Such behavior deviates from traditional assumptions that emphasize cost minimization, indicating the need for an expanded conceptual framework that explicitly incorporates political risk into traditional economic supply chain models (Javorcik et al., 2024).

Conceptually, friendshoring can be viewed as a strategic hedging mechanism against disruptions that conventional economic indicators may fail to fully capture. Firms choosing suppliers based on geopolitical alignment are implicitly investing in a form of "political insurance" against future disruptions, thereby acknowledging an implicit cost-benefit calculation that transcends purely price-driven metrics. Unlike conventional risk mitigation strategies such as inventory buffering or geographic diversification, which focus primarily on managing economic volatility, friendshoring is uniquely targeted at mitigating risks tied to political stability and interstate relations.

Agriculture offers a particularly insightful context for examining friendshoring dynamics because agri-food supply chains are characterized by heightened sensitivity to disruptions due to biological constraints, perishability, and regulatory complexity (Malone, Schaefer and Lusk, 2021; Mitchell, Thompson and Malone, 2024; Sporleder and Boland, 2011). Moreover, food security has emerged as a critical component of national security policy, further amplifying the potential value of geopolitical alignment within this industry (Barel-Shaked

and Buda, 2024). Thus, the agri-food sector provides a rigorous testing ground for friendshoring theories and an opportunity to explicitly extend traditional supply chain frameworks to incorporate political risk.

3 Conceptual Framework

We conceptualize friendshoring as a strategic input sourcing decision under uncertainty. This framework allows us to interpret friendshoring as a form of implicit insurance purchasing: a costlier strategy in calm times that pays off in preserving continuity during global shocks. Specifically, we model an agribusiness firm choosing between two potential countries for sourcing a key input, weighing cost efficiency against geopolitical risk. This decision resembles a portfolio selection under an uncertainty framework, analogous to purchasing insurance against a "bad" state of the world.

Let the firm consider two sourcing options:

- Country A: a low-cost supplier in the "good" state of the world (no geopolitical disruption), but relatively high-cost in the "bad" state (e.g., trade embargo, political conflict, or sanctions).

- Country B: a higher-cost supplier in the "good" state, but one that is geopolitically aligned and therefore more resilient in the "bad" state.

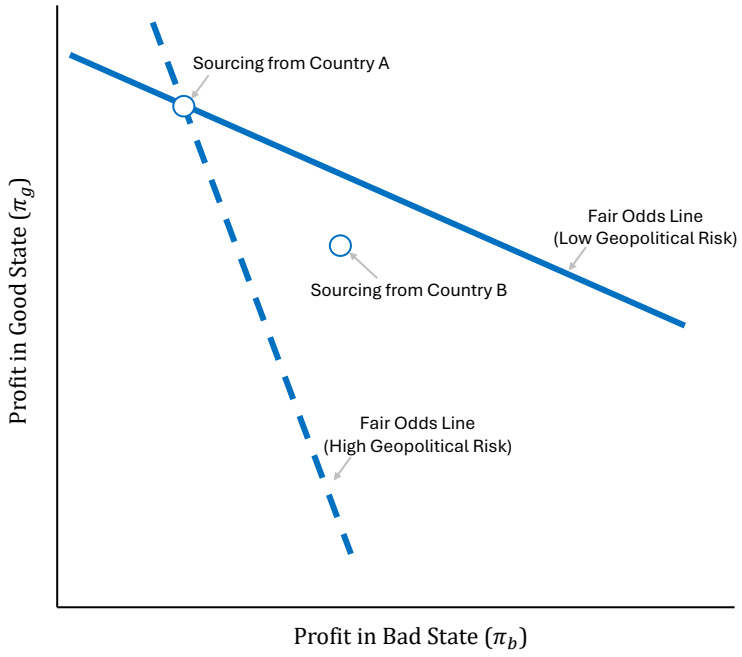
In the absence of geopolitical risk, expected profit maximization would lead the firm to choose Country A due to its lower average cost. However, as the probability of a bad state increases (driven by rising geopolitical tensions), the expected cost associated with Country A increases. Country B becomes relatively more attractive, not because its cost changes, but because it offers political insurance against disruption.

To formalize this, consider the following setup. Let π_g and π_b be the firm's profits in the good and bad state, respectively. Let ρ denote the probability of the good state occurring.

The firm maximizes expected profit: $\mathrm{E}[\pi] = \rho\pi_g + (1-\rho)\pi_b$. Each sourcing strategy produces a different profit vector (π_g^A, π_b^A) or (π_g^B, π_b^B). In a world with no geopolitical risk, ρ is close to 1, so the firm selects the strategy that maximizes π_g. But as geopolitical tensions rise, ρ decreases, and the weight placed on bad-state profit increases.

The decision framework can be visualized using the standard risk-return tradeoff shown in Figure 2, where the fair odds line represents combinations of π_g and π_b that yield equal expected profits. Rising geopolitical risk rotates the fair odds line inward, reducing the attractiveness of riskier sourcing strategies (Country A). In this context, friendshoring is a risk-mitigating shift from Country A to Country B as the fair odds line pivots—effectively paying an insurance premium (in the form of higher costs) for more secure access in the bad state.

Figure 2: Friendshoring as Political Insurance: Profit Trade-Off



We can deduce three empirically testable hypotheses from this framework:

Hypothesis 1: the observed sourcing behavior should shift toward geopolitically aligned countries in periods of elevated risk, even if it sacrifices short-run cost

efficiency.

Hypothesis 2: the magnitude of the shift will vary by industry, based on the size of the cost differential between suppliers.

Hypothesis 3: industries already accustomed to high volatility are less likely to adjust sourcing strategies in response to elevated geopolitical risk.

In the sections that follow, we empirically test whether this theoretical behavior is observed in U.S. agri-food trade patterns.

4 Data

The conceptual framework outlined above generates three testable hypotheses about how geopolitical alignment influences sourcing decisions in agricultural trade. To empirically evaluate these hypotheses, we construct a novel dataset combining measures of geopolitical "friendliness" with disaggregated U.S. import data across industries and time.

4.1 Measuring "Friendliness"

A central challenge in identifying friendshoring behavior is quantifying what it means for a country to be a geopolitical "friend" or "ally." We address this challenge by constructing a dynamic geopolitical distance index that captures alignment with the United States across six institutional dimensions. This index allows us to measure, for each year, how closely a country aligns with the U.S. in terms of governance performance, and it serves as our main explanatory variable for empirical analysis.

We base the index on the Worldwide Governance Indicators (WGIs) published annually by the World Bank for over 200 countries (World Bank, 2024). These indicators capture six core dimensions of governance: (i) control of corruption, (ii) government effectiveness, (iii) political stability and absence of violence, (iv) regulatory quality, (v) rule of law, and

(vi) voice and accountability (Kaufmann, Kraay and Mastruzzi, 2010). Each indicator is constructed using unobserved components modeling and incorporates over 30 data sources, including surveys, NGO reports, and commercial information providers.

We collect annual WGI scores from 2010 to 2023. Because 2024 data were not yet available at the time of writing, we use exponential smoothing to forecast 2024 scores for each country. We standardize each of the six indicators to have a mean of zero and a variance of one. To construct a single index of geopolitical distance from the United States, we calculate the Euclidean distance between the vector of standardized scores for each country and the corresponding U.S. scores for that year:

$$d_{oy} = \sqrt{\sum_{i=1}^{6} (z_{iy,o} - z_{iy,usa})^2} \tag{1}$$

Here, d_{oy} is the geopolitical distance between country o and the U.S. in year y, and z_{iy} represents the standardized score on dimension i. Countries with values closer to zero are more similar to the U.S. in governance structure and are interpreted as being more geopolitically "friendly."

This distance-based measure captures alignment across multiple institutional dimensions and can evolve over time due to changing domestic conditions or U.S. political shifts. For instance, from 2015 to 2020, the U.S. itself fell from the 69th to the 50th percentile in political stability, although it remained above the 70th percentile in other metrics as of 2023. This variation demonstrates the importance of a dynamic, relative index that tracks alignment year-by-year.

Panel (a) of Figure 3 shows U.S. performance across the six indicators. Panel (b) of Figure 3 shows how the geopolitical distance between the U.S. and several trading partners has changed over time. For example, Cote d'Ivoire, Fiji, and Palau became more aligned with the U.S. from 2010 to 2024, while South Sudan, Syria, and Mali grew more distant. These trends are consistent with geopolitical events over this period. The score for Russia worsened

sharply following its 2022 invasion of Ukraine, rising from the 75th to the 86th percentile in distance. Figure 3 maps global geopolitical distance to the U.S. for all countries in 2010, 2015, 2020, and 2024, segmented by standard deviation bands (with yellow indicating greater alignment and red indicating less).

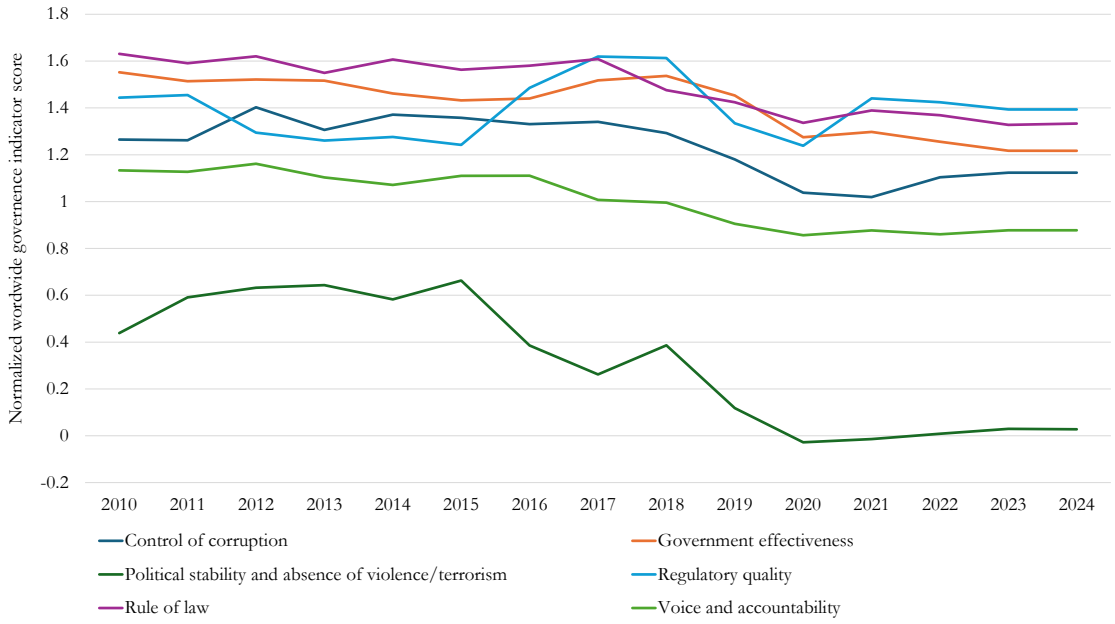
To assess the validity of our index, in Figure 5, we compare it to the similarity of voting patterns between a given country and the United States at the UN General Assembly. Countries with strong voting alignment—such as Israel (88% agreement) and the United Kingdom (72%)—rank in the lowest quintile of our distance measure. Conversely, countries with low agreement scores—like Syria (6%) and Nicaragua (10%)—rank among the most geopolitically distant. These comparisons suggest our index is a meaningful measure of geopolitical alignment. In our empirical analysis, we test the sensitivity of our findings using the UN voting measure as an alternative measure of "friendliness."

4.2 Agricultural Trade Flows

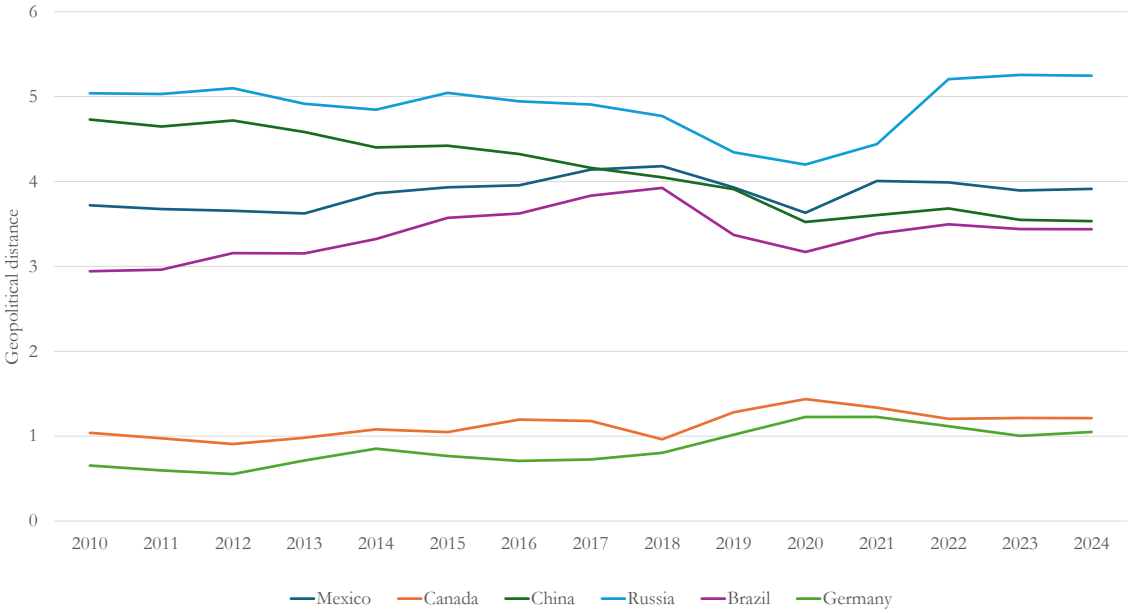
We link the friend index of geopolitical distance d_{oy} described above with monthly data on the value and quantity of U.S. imports from January 2010 to August 2024. Our outcome variable V_{opt} is value of U.S. imports from origin country o in industry p at time t. We include all industry-country combinations containing non-zero trade flow value during our sampling period across the four-digit NAICS codes specified in Table 1. This includes select NAICS code data for 27 sectors across 11** (Agriculture, Forestry, Fishing, and Hunting) and 31** - 33** (Manufacturing) of relevance to agricultural and food supply chains.

For the purposes of preliminary analysis, in Figure 6, we plot the percent change in U.S. agricultural import value from 2018 to 2023 against each trade partner's mean Euclidean geopolitical distance from the United States over the sample period. Each point represents a trade partner country. The figure includes a LOWESS-smoothed trend line and a simple linear regression line. Both are estimated using data restricted to countries between the 5th and 95th percentiles of the Euclidean distance distribution to reduce the influence of outliers.

Figure 3: U.S. Governance and Geopolitical Distance of Major Trade Partners



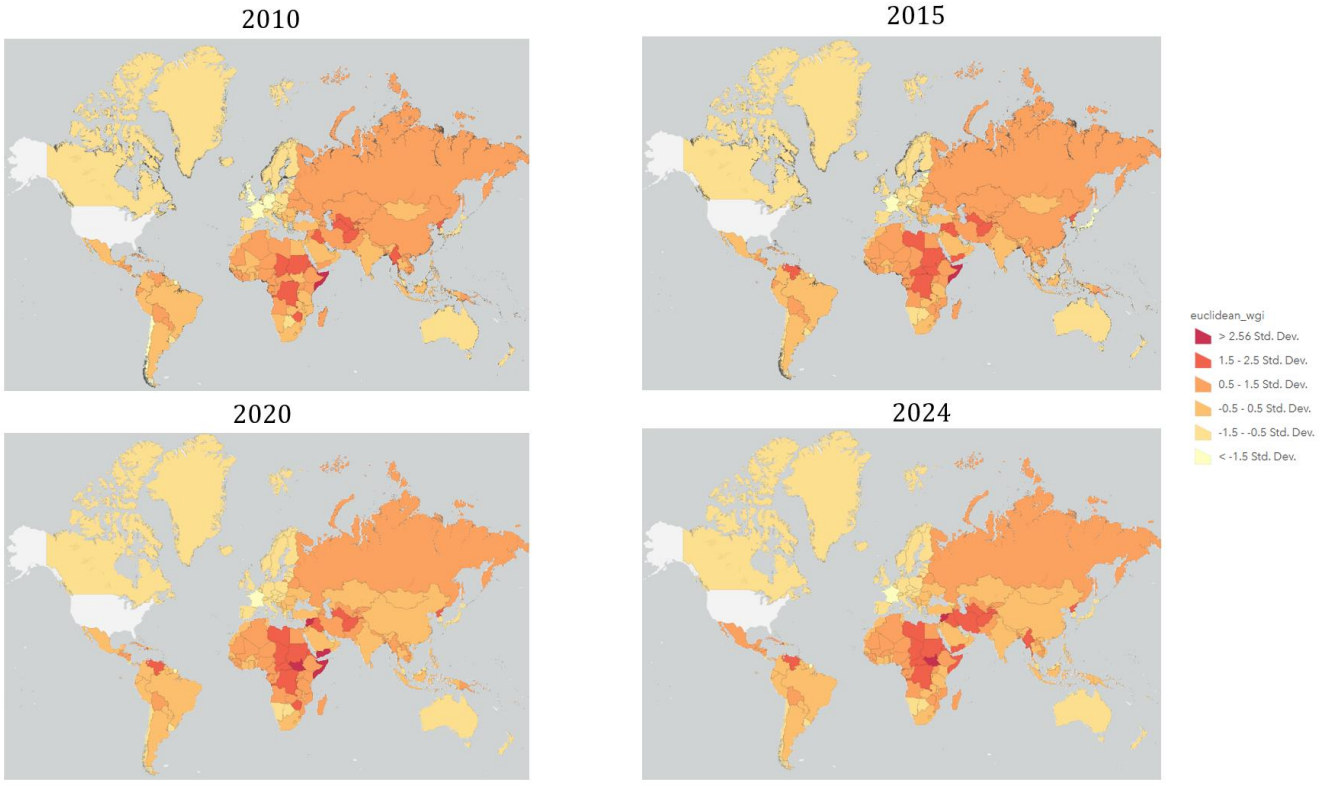
(a) U.S. WGI Performance



(b) Geopolitical Proximity of Selected Countries

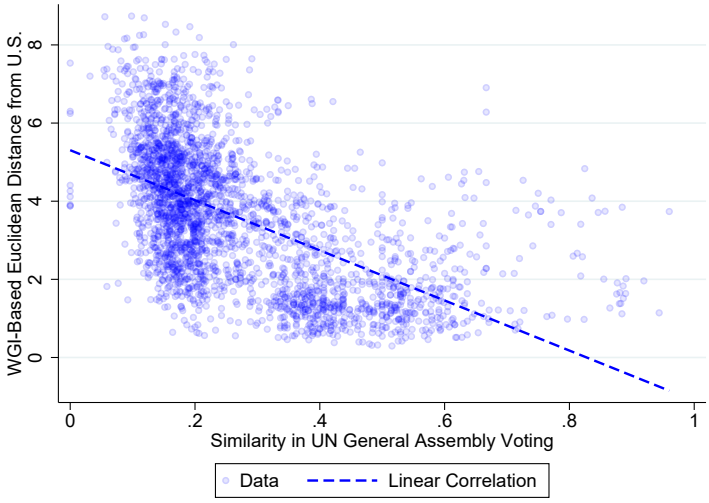
Notes: Panel (a) shows the standardized scores of the United States from 2010 to 2023 across six governance dimensions: control of corruption, government effectiveness, political stability, regulatory quality, rule of law, and voice and accountability. Panel (b) plots the Euclidean geopolitical distance of selected major U.S. agricultural trade partners relative to the United States over the same period. Underlying data obtained from World Bank (2024).

Figure 4: Governance-Based Geopolitical Alignment with the U.S.



Notes: This figure maps the geopolitical distance to the United States for all countries in 2010, 2015, 2020, and 2024, based on Euclidean distance across six standardized Worldwide Governance Indicators. Countries closer to the United States in governance quality appear in yellow (lower distance), while those more dissimilar appear in red (higher distance). This dynamic measure captures institutional alignment across multiple governance dimensions and allows for changes over time due to domestic reforms, political instability, or shifting international relations. The 2024 values are based on exponential smoothing forecasts due to limited data availability at the time of writing. Underlying data obtained from World Bank (2024).

Figure 5: Correlation Between Governance-Based Friendliness Index and UN Voting Similarity



Notes: Each point represents a country-year observation. The x-axis shows the similarity in United Nations General Assembly voting with the United States, and the y-axis shows the Euclidean geopolitical distance to the United States based on normalized Worldwide Governance Indicators (WGI). Lower distance values indicate greater institutional similarity (i.e., geopolitical friendliness). The simple correlation is -0.62.

Both trends indicate that agricultural imports increased more between 2018 and 2023 from countries that are geopolitically aligned ("friends") relative to less aligned countries. This pattern is suggestive of friendshoring behavior. However, a more rigorous empirical model is required to verify whether geopolitical alignment systematically influences trade flows after accounting for confounding factors.

5 Empirical Methods

To test the three hypotheses developed in Section 3 regarding whether and how U.S. agri-food import patterns have shifted towards friend countries, we estimate a series of panel data models linking trade value to our time-varying geopolitical distance index. Our empirical strategy centers on identifying whether the relationship between import value and geopolitical distance changes following a discrete increase in global geopolitical risk in late

Table 1: Sampled Industries

NAICS code	Industry
1111	Oilseed and Grain Farming
1112	Vegetable and Melon Farming
1113	Fruit and Tree Nut Farming
1114	Greenhouse, Nursery, and Floriculture Production
1119	Other Crop Farming
1121	Cattle Ranching and Farming
1122	Hog and Pig Farming
1123	Poultry and Egg Production
1124	Sheep and Goat Farming
1125	Aquaculture
1129	Other Animal Production
1132	Forest Nurseries and Gathering of Forest Products
1133	Logging
1141	Fishing
3111	Animal Food Manufacturing
3112	Grain and Oilseed Milling
3113	Sugar and Confectionery Product Manufacturing
3114	Fruit and Vegetable Preserving and Specialty Food Manufacturing
3115	Dairy Product Manufacturing
3116	Meat Product Manufacturing
3117	Seafood Product Preparation and Packaging
3118	Bakeries and Tortilla Manufacturing
3119	Other Food Manufacturing
3121	Beverage Manufacturing
3122	Tobacco Manufacturing
3253	Pesticide, Fertilizer, and Other Agricultural Chemical Manufacturing
3331	Agriculture, Construction, and Mining Machinery Manufacturing

2022.

Testing Hypothesis #1:

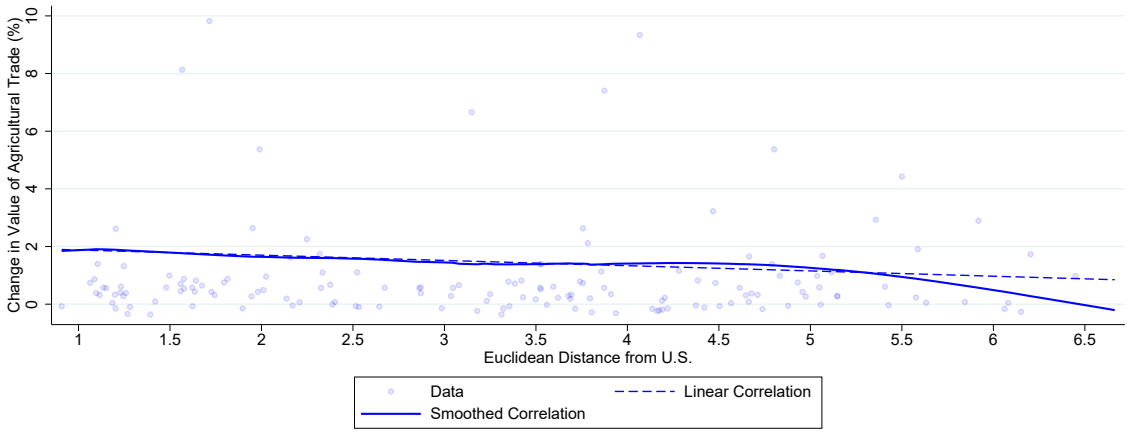
> *Hypothesis 1: the observed sourcing behavior should shift toward geopolitically aligned countries in periods of elevated risk, even if it sacrifices short-run cost efficiency.*

To test whether sourcing behavior shifts toward geopolitically aligned countries in periods of elevated risk, we estimate the following baseline model:

$$V_{opt} = \beta_0 + \beta_1 d_{oy} + \beta_2 \text{Treat}_t \times d_{oy} + \gamma_{op} + \delta_t + \varepsilon_{opt} \tag{2}$$

where V_{opt} denotes the monthly value of U.S. imports from origin country o in industry p

Figure 6: Change in Agricultural Import Value (2018–2023), by Geopolitical Distance to the U.S.



Notes: This figure plots the percent change in U.S. agricultural import value from 2018 to 2023 against each trade partner's mean Euclidean geopolitical distance from the United States, based on normalized Worldwide Governance Indicators. Each point represents a trade partner country. The figure includes a LOWESS-smoothed trend line and a simple linear regression line. Both are estimated using data restricted to countries between the 5th and 95th percentiles of the Euclidean distance distribution to reduce the influence of outliers. A positive relationship between proximity and import growth is suggestive of friendshoring, though it is not causal.

at time t. The key explanatory variable, d_{oy}, is our index of geopolitical distance between the origin country and the United States in year y. Variable Treat_t is an indicator equal to one beginning in November 2022, marking the onset of heightened global geopolitical risk (as evidenced in Section 2). The interaction term $\text{Treat}_t \times d_{oy}$ captures whether geopolitical distance became a stronger predictor of trade following the rise in geopolitical tensions.

We include two-way fixed effects: γ_{op} captures country-by-industry pair effects to absorb time-invariant unobservables such as geography, historical relationships, and industry-specific comparative advantage; and δ_t is a month-year fixed effect capturing global trends such as inflation, macroeconomic shocks, or supply chain constraints that affect all trade flows contemporaneously.

Testing Hypotheses #2:

Hypothesis 2: the magnitude of the shift will vary by industry, based on the size of the cost differential between suppliers.

To test Hypothesis 2, we estimate a triple interaction model that incorporates industry-level cost differentials. We define an industry as "high cost differential" if its average unit value for imports from highly aligned countries (top decile of the WGI-based friend index) exceeds that from the least aligned countries (bottom decile) by more than the sample median differential during the baseline period. Specifically, for each four-digit NAICS industry, we calculate the cost differential as:

$$\text{Cost Differential}_p = \frac{\overline{UV}_{p,friends} - \overline{UV}_{p,non-friends}}{\overline{UV}_{p,non-friends}} \tag{3}$$

where $\overline{UV}_{p,friends}$ and $\overline{UV}_{p,non-friends}$ denote the average unit values of imports in industry p from countries in the top and bottom 10th percentiles of the friend index, respectively, among all trade partners with non-zero observed trade flows. Industries above the median value of this relative cost measure are coded as "high cost differential" for the purposes of testing this hypothesis. The distribution of these industry-level cost differentials is shown in Panel (a) of Figure 7.

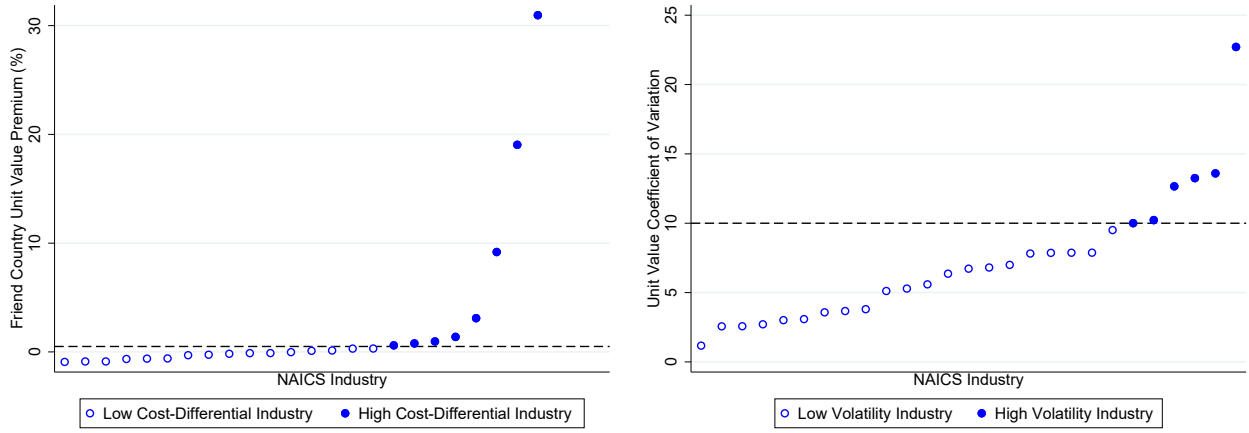
We augment the model outlined in equation (2), including the additional interaction term $\text{HighCost}_p \times \text{Treat}_t \times d_{oy}$. The coefficient on this additional interaction term captures whether the extent of friendshoring is greater in industries with larger sourcing cost penalties from friendly countries.

Testing Hypotheses #3:

> *Hypothesis 3: industries already accustomed to high volatility are less likely to adjust sourcing strategies in response to elevated geopolitical risk.*

To test Hypothesis 3, we estimate a triple interaction model that captures heterogeneity in friendshoring behavior based on industry-level volatility. Specifically, we calculate the coefficient of variation in unit values (i.e., the standard deviation divided by the mean) for each four-digit NAICS industry during the baseline period. This provides a measure of price volatility that reflects how inherently variable unit values are within each industry,

Figure 7: Characterizing Industry Heterogeneity



(a) Cost Differentials (b) Baseline Volatility

Notes: This figure illustrates how industries are classified to test for heterogeneity in friendshoring behavior. Panel (a) reports cost differentials across industries, calculated as the relative difference in mean unit values between imports from countries in the top and bottom deciles of the WGI-based friend index. Specifically, for each industry, we compute $\frac{\text{uv}_{friend} - \text{uv}_{non-friend}}{\text{uv}_{non-friend}}$, where "friend" and "non-friend" refer to countries with observed positive trade flows in the top and bottom 10th percentiles, respectively. Industries above the sample median of this metric are classified as "High Cost-Differential" for Hypothesis 2. Panel (b) reports baseline volatility across industries, measured as the coefficient of variation in monthly import unit values during the pre-treatment period. Industries above the median are classified as "High Baseline Volatility" for Hypothesis 3.

independent of geopolitical disruptions.

Industries with a baseline coefficient of variation above the sample median are classified as "high volatility" industries. This classification allows us to assess whether sourcing patterns in these industries are less responsive to geopolitical alignment, consistent with the notion that firms in highly volatile sectors may already operate under uncertainty and have limited flexibility to adjust their sourcing in response to new risks. Panel (b) of Figure 7 shows the distribution of baseline volatility across industries.

We then re-estimate the model outlined in equation (2), including the interaction term $\text{HighVol}_p \times \text{Treat}_t \times d_{oy}$. The coefficient on this additional interaction term tests whether the degree of friendshoring is attenuated in more volatile industries during the post-treatment period.

Joint Hypothesis: Finally, to assess the combined effects of hypotheses #1–3 jointly, we

estimate a fully interacted specification that includes both heterogeneity terms.

Estimation Procedure: All models are estimated using White-heteroskedasticity robust standard errors to correct for potential heteroskedasticity in the residuals. All models are estimated via ordinary least squares (OLS) using the reghdfe command in Stata.

6 Results

Table 2 reports the baseline estimates for testing Hypotheses 1–3. Column (1) presents the simplest specification (eq. 2); columns (2)–(3) add the triple interactions that test the heterogeneity predictions; column (4) includes both sources of heterogeneity simultaneously. All regressions include country-industry and month-year fixed effects and are estimated with White-heteroskedasticity-robust standard errors.

Table 2: Friendshoring Behavior in U.S. Agricultural Trade—Baseline Results

VARIABLES	(1) Hypothesis #1	(2) Hypothesis #2	(3) Hypothesis #3	(4) Joint Hypotheses
Friend Index	1253759.660***	1253841.957***	1252803.543***	1253087.886***
	(48,222.433)	(48,216.672)	(48,189.684)	(48,182.856)
Treat x Friend Index	-590,695.558***	-534,334.280***	-638,725.388***	-580,441.797***
	(38,265.048)	(38,096.899)	(38,702.265)	(37,141.623)
High Cost x Treat x Friend Index		-180,277.323***		-151,878.389***
		(40,476.337)		(39,395.753)
High Vol x Treat x Friend Index			164,615.425***	127,597.021***
			(46,570.750)	(45,793.213)
Constant	851,795.611***	852,056.130***	856,383.917***	855,571.587***
	(155,453.439)	(155,434.817)	(155,296.137)	(155,270.678)
Panel Fixed Effects	Yes	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes	Yes
Observations	621,104	621,104	621,104	621,104
R-squared	0.839	0.839	0.839	0.839

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Baseline Effect of Geopolitical Distance (H1): In every specification the coefficient on the Treat×Friend Index interaction is negative and highly significant ($p < 0.01$). Because the friend index is measured as Euclidean distance from the United States, a larger value denotes a less-aligned partner. The negative interaction therefore implies that, after November 2022,

import values from geopolitically distant countries contracted relative to those from more closely aligned partners. In the baseline model (col. 1), a one-standard-deviation increase in distance ($\approx$ 2.1 index points) is associated with a post-treatment reduction of roughly \$1.24 million per country-industry-month (-590,696$\times$2.1), holding all else constant. This supports Hypothesis 1: U.S. agri-food sourcing shifted measurably toward "friend" countries once geopolitical risk intensified.

Cost-Differential Heterogeneity (H2): Column (2) adds the triple interaction High Cost$\times$Treat$\times$Friend Index. The coefficient is -180,277 ($p < 0.01$), indicating that the post-2022 distance penalty is more pronounced in industries where sourcing from aligned partners is relatively expensive. Evaluated at the sample mean distance, the combined post-treatment effect in high-cost-differential sectors is roughly 34 percent larger in absolute value than in low-cost sectors. Thus, even when friendshoring entails a sizable unit-value premium, firms appear willing to incur that premium, consistent with the political-insurance interpretation. This finding is contrary to a purely cost-minimizing view and supports Hypothesis 2.

Volatility Heterogeneity (H3): Column (3) introduces High Volatility$\times$Treat$\times$Friend Index. The positive coefficient (164,615; $p < 0.01$) reverses part of the baseline distance penalty: in high-volatility industries, the post-treatment decline in imports from distant partners is about 28 percent smaller than in low-volatility sectors. Firms operating in inherently volatile markets appear less willing—or less able—to re-optimize their supplier portfolio in response to geopolitical risk. This finding aligns with Hypothesis 3.

Joint Specification: The joint model in column (4) confirms that the two forms of heterogeneity operate simultaneously. The distance penalty remains negative and significant (-580,442), the cost-differential interaction stays negative (-151,878), and the volatility interaction stays positive (127,597). Magnitudes fall slightly relative to columns (2)–(3), perhaps because both channels compete for explanatory power, but the qualitative patterns are unchanged.

7 Potential Limitations and Model Robustness

The specifications described above offer initial evidence that geopolitical alignment influences U.S. agricultural import patterns. For the purposes of evaluating the robustness of our empirical approach, we focus on the core relationship tested in Hypothesis 1—namely, whether geopolitical distance became a stronger predictor of trade flows following the sharp increase in global geopolitical risk in late 2022—because this baseline result forms the foundation of our analysis.

Focusing on this relationship, Table 3 reports the results of several robustness checks to address empirical concerns that warrant further scrutiny. Across all robustness checks, the sign and significance of the effects of interest are stable. This supports the proposition that U.S. agri-food imports reoriented toward geopolitically aligned partners after late 2022, regardless of how alignment, outcomes, or fixed effects are defined.

Alternative Friendship Index: First, our main measure of geopolitical alignment—based on Euclidean distance across six Worldwide Governance Indicators (WGIs)—aggregates complex governance characteristics into a single index. While conceptually grounded, this measure may not fully capture the strategic or political alignment between countries in practice. As a robustness check, we re-estimate the baseline model using an alternative "friend" variable: the share of UN General Assembly votes in which a country aligns with the United States. This allows us to assess whether similar empirical patterns emerge using a more behaviorally grounded indicator of diplomatic affinity.

Column (1) of Table 3 reports the results of replacing the WGI-based distance with the share of UN-GA votes aligning with the United States produces an even larger effect in absolute terms. The interaction Treat×Alt Friend Index is positive and highly significant (β = 8.74 million; p $<$ 0.01), while the main-effect coefficient is negative (β = -5.46 million; p $<$ 0.01). Thus, imports from countries that vote more frequently with the United States rise relative to imports from less-aligned partners after November 2022. This is consistent with the baseline pattern.

Table 3: Friendshoring Behavior in U.S. Agricultural Trade—Model Robustness

VARIABLES	(1) Alt Friend Index	(2) Alt Outcome	(3) Alt Outcome+Alt Friend Index	(4) Alt FEs	(5) Alt FEs+Alt Friend Index	(6) Drop COVID	(7) Drop COVID+Alt Friend Index
Alt Friend Index	-5461949.877***		-615,125.551**		-5072267.036***		-5547415.751***
	(472,757.649)		(292,317.534)		(475,973.137)		(507,958.060)
Treat x Alt Friend Index	8738742.794***		823,235.343***		9316017.554***		9063517.936***
	(524,387.889)		(226,120.673)		(539,019.228)		(546,744.457)
Friend Index		221,422.829***		1316554.476***		1303644.014***	
		(21,576.032)		(49,107.224)		(54,304.980)	
Treat x Friend Index		-25,492.646*		-647,346.407***		-598,828.195***	
		(13,129.705)		(39,447.756)		(38,976.674)	
Constant	6188904.547***	1318870.286***	2293142.089***	666,790.300***	6053484.311***	604,383.554***	6061398.412***
	(122,747.672)	(71,739.655)	(77,006.580)	(157,749.391)	(123,298.464)	(174,949.077)	(130,305.437)
Panel Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes	No	No	Yes	Yes
Industry-Time Fixed Effects	No	No	No	Yes	Yes	No	No
Observations	584,892	621,104	584,892	621,104	584,892	543,466	511,872
R-squared	0.839	0.907	0.907	0.841	0.841	0.833	0.832

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Alternative Outcome Variable: Second, our outcome variable—trade value—may conflate changes in quantity and price. For example, if friendshoring leads firms to pay higher prices for goods sourced from more geopolitically aligned suppliers, trade value may increase even without a shift in physical volumes. To disentangle these channels, we replicate our main results using trade quantity as the dependent variable, applying both the WGI-based and UN-voting-based alignment measures. This helps clarify whether our findings reflect changes in supplier relationships or simply shifts in the price per unit.

When trade quantity replaces trade value (col. 2), the post-treatment interaction Treat× Friend Index remains negative and significant (β = -25,493; p $<$ 0.10). This indicates that the baseline result is not driven solely by price movements. Combining quantity with the UN voting measure (col. 3) yields a positive and significant interaction (β = 823,235; p $<$ 0.01) alongside a negative main effect. This mirrors the value-based results and reinforces the intensive-margin interpretation.

Alternative Fixed Effects: Third, the inclusion of time fixed effects common across all industries may mask heterogeneity in industry-specific seasonal or trend dynamics. If different industries follow different temporal trajectories or respond differently to macroeconomic shocks, the estimated treatment effect may be biased. We address this concern by estimating a model with industry-specific time fixed effects, allowing more flexible temporal dynamics within each sector.

Allowing each NAICS sector to have its own month-year fixed effect tightens identification by absorbing industry-specific shocks. The friend-distance interaction remains strongly negative (β = -647,346; p $<$ 0.01). Using the UN voting metric with these richer fixed effects (col. 5) again produces a large positive interaction (β = 9.32 million; p $<$ 0.01). Hence, the result is not an artefact of differential seasonality or sector-specific macro shocks.

Excluding COVID Period: Fourth, the COVID-19 pandemic introduced major disruptions to global supply chains, particularly during 2020 and 2021. These shocks may be unrelated to geopolitical alignment but could still affect our estimates if they overlap with

the post-treatment period. To mitigate this concern, we exclude all observations from March 2020 through December 2021 and test whether our baseline results are robust to omitting this anomalous window.

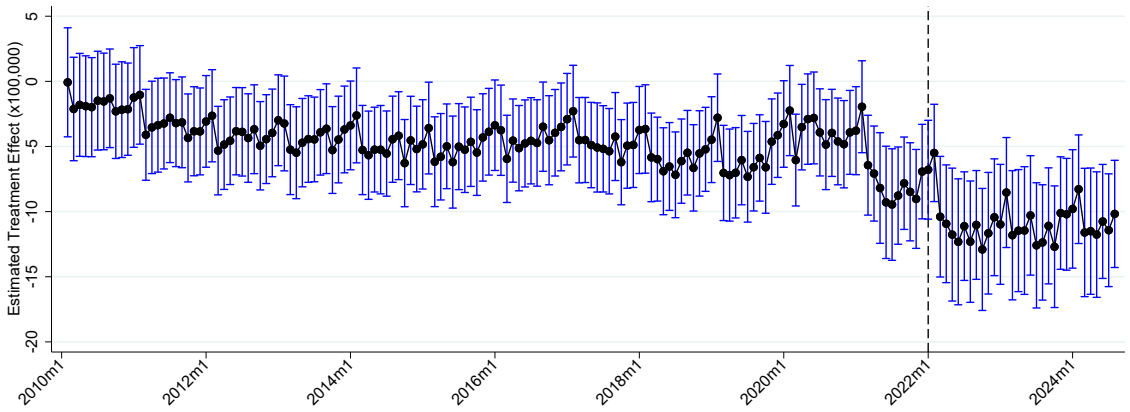
Dropping observations from March 2020 through December 2021 slightly reduces sample size but leaves the post-treatment effect virtually unchanged. The distance interaction remains negative and significant (β = -598,828; $p < 0.01$), and the UN-based specification (col. 7) continues to show a positive, highly significant interaction (β = 9.06 million; $p < 0.01$). Thus, pandemic-related disruptions are unlikely to be driving the friendshoring pattern.

Investigating Treatment Dynamics: Finally, our model assumes that treatment effects emerged discretely beginning in November 2022 and that no differential trends existed prior to this point. To test the validity of this assumption, we estimate a distributed leads-and-lags specification, interacting the geopolitical distance variable with month-year indicators. This allows us to assess the timing of the treatment effect and verify that no anticipatory shifts or diverging pre-trends were present prior to the observed shock.

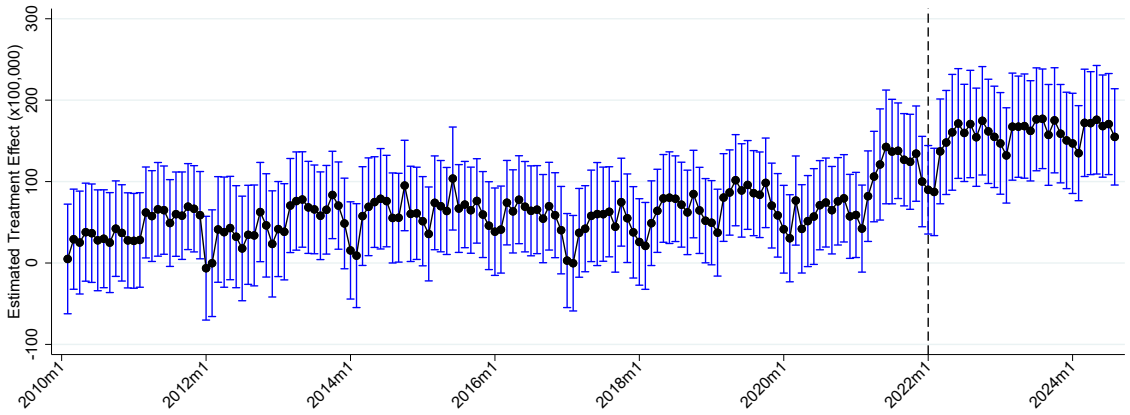
Figure 8 plots the month-by-month coefficients interacted with the friend index with separate indicators for every month in the sample. The pre-treatment profile is essentially flat: from January 2018 through June 2022 the estimated effects hover near zero and their 95 percent confidence intervals routinely cross the baseline, indicating no systematic correlation between geopolitical distance and import values before the shock. Beginning around July 2022—just after the escalation of sanctions related to the Russia-Ukraine war—the coefficients turn sharply negative, and by November 2022 they reach a magnitude comparable to the baseline DiD estimate. The effect remains persistently negative through the end of the sample, with no evidence of reversion toward zero.

The absence of a pre-trend coupled with the abrupt, durable shift after mid-2022 is consistent with a structural break: the relative cost of sourcing from geopolitically distant partners rose abruptly and has stayed elevated. In short, the treatment-dynamics exercise corroborates the main Difference-in-Differences result, reinforcing the interpretation that

Figure 8: Investigating Treatment Dynamics



(a) Governance-Based Friendship Index



(b) Alternative Friendship Index

Notes: This Figure plots the month-by-month coefficients interacted with the friend index with separate indicators for every month in the sample. Beginning around July 2022—just after the escalation of sanctions related to the Russia-Ukraine war—the coefficients turn sharply negative, and by November 2022 they reach a magnitude comparable to the baseline DiD estimate. The effect remains persistently negative through the end of the sample, with no evidence of reversion toward zero.

agri-food importers re-optimized their supplier portfolios once geopolitical risk became salient in the second half of 2022.

8 Conclusion

Failure to adapt to the global and dynamic nature of agri-food systems and events worldwide can affect U.S. supply chain performance, pricing, and product availability. Geopolitical risk is among the leading stressors for global supply chains, including political instability and war (Ahn, Kim and Steinbach, 2023), trade disputes (Grant et al., 2021), regulatory disruptions (Malone, Schaefer and Lusk, 2021), and border disruptions (Ker, 2020). To combat this, firms are thinking strategically about input sourcing. This has prompted the phrase friendshoring to be used in the supply chain management literature. However, empirical evidence of friendshoring remains limited. This study aims to fill this gap.

Using detailed monthly import data and a novel time-varying index of geopolitical alignment, we show that U.S. sourcing behavior has shifted measurably toward more geopolitically aligned partners in the wake of rising global risk in late 2022. This friendshoring dynamic is economically meaningful and robust across a range of model specifications, alternative measures of alignment, and outcome variables.

Importantly, our results reveal that friendshoring is not uniform across sectors. The shift is strongest in industries where the cost of switching to aligned suppliers is highest—suggesting that firms are increasingly willing to absorb cost premiums to mitigate geopolitical risk. At the same time, we find that the response is muted in industries characterized by high baseline price volatility, consistent with the idea that firms in more turbulent markets may already be accustomed to operating under uncertainty and face greater frictions in adjusting sourcing strategies.

Taken together, these findings point to a structural change in the determinants of global trade patterns. While traditional economic fundamentals—such as comparative advantage

and cost efficiency—remain important, geopolitical considerations are now exerting an independent and growing influence on firm-level sourcing decisions. This shift has potentially far-reaching implications for global supply chain resilience, trade policy design, and the distributional impacts of international trade across sectors and countries.

Future work should investigate the persistence of these patterns, explore how firm characteristics mediate friendshoring behavior, and assess how these dynamics affect downstream prices, availability, and food security. As geopolitical risk becomes a more permanent feature of the global economic landscape, understanding its role in shaping trade flows will remain a key challenge for both researchers and policymakers.

Conflicts of Interest: The authors report no conflicting interests relevant to this work.

Data Availability Statement: All data and programs necessary to replicate the analyses and results in this manuscript are available from the authors upon request.

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Ethics Committee Approval: This project did not involve human subjects research.

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