

Market integration and economic policy uncertainty spillover in international soybean trade

Dewey J. Robertson

Department of Agricultural Economics, Kansas State University

April 13, 2026

Abstract: Recent rises in global tensions and deteriorating multilateral relationships threaten market integration and established trade flows. This study assesses market integration among large soybean market participants (Argentina, Brazil, China, United States) and seeks to capture the extent to which economic policy uncertainty affects integrated price relationships. Using a vector error correction model, we examine the relationship between weekly cash export and import prices among trading partners. Consistent with previous studies, we find that export and import prices have a long-run equilibrium relationship and price shocks are transmitted across regions. We further find that global economic policy uncertainty raises export and import prices in all regions. Domestic economic policy uncertainty influence follows price leadership; as price leader, U.S. domestic economic policy uncertainty spills over into global markets, putting downward pressure on prices. On average, import prices are affected more by economic policy uncertainty than export prices.

Key Words: Agricultural Trade, Commodity Markets, Market integration, Policy Incidence, Policy Uncertainty, Price Transmission, Vector Error Correction Model

JEL Codes: C22, F02, Q17

I. Introduction

International agricultural trade has increased global food security, expanded consumer choices, fostered international cooperation, and integrated markets, promoting economic efficiency (Anderson, 2010; Baldwin and Venables, 1995; Donaldson, 2015; Smith and Glauber, 2020). International market integration increases countries' gains from trade through comparative advantage and specialization. However, increasing economic policy uncertainty and deglobalization trends, such as the reoccurring trade war between the U.S. and China, threaten to dismantle integration in international agricultural markets. Such a reversal of international agricultural market integration would reduce efficiency, increase price volatility, and shift global trade patterns.

This paper considers how increased economic policy uncertainties may weaken market integration in international soybean trade. Of particular interest is considering how economic policy uncertainty may remove some countries from the integrated market place, altering trade flows and price transmission behaviors. Market integration is predicated on the tradability of goods among spatially separate markets (Barret and Li, 2002) and can be defined as market locations that have long-run equilibrium relationships (cointegration) (Harriss, 1979), spatial locations connected by trade (Ravallion, 1986), or locations that have a one-for-one price change—law of one price (Goodwin and Schroeder, 1991). McNew (1996), on the other hand, argues a necessary distinction of market integration from the law of one price, noting that the latter concerns whether absolute price levels across locations converge once transfer costs are considered, while market integration is better captured by examining the degree of price transmission—that is, whether and to what extent exogenous shocks in one market are fully and proportionally transmitted to another.

Following Harriss (1979) and McNew (1996)'s conceptions of market integration, this study considers international soybean price cointegration and transmission among the largest market participants—Argentina, Brazil, China, and the United States—and further considers how exogenous shocks captured by domestic and international economic policy uncertainty transmit across prices. Our analysis employs a vector error correction model (VECM) approach to address three central questions: (i) To what extent do domestic and global economic policy uncertainty influence international price relationships? (ii) Are export and import market prices affected differently by economic policy uncertainty? (iii) Do export and import prices adjust to economic policy uncertainty induced shocks through market mechanisms such as substitution among exporters?

This study contributes to our understanding of international agricultural commodity market dynamics and the role of policy uncertainty. First, consistent with prior studies, we find that soybean export and import prices are cointegrated and that price shocks transmit across exporters and importers. Second, we find that global economic policy uncertainty as measured by standard indices increases both export and import prices. Third, we find that U.S. economic policy uncertainty spills over into international markets depressing import and export prices, an influence consistent with the U.S. role as a price leader. Finally, we find that China's import prices are affected more by measures of economic policy uncertainty than U.S., Brazil, and Argentina's export prices are affected.

Market integration and price transmission are staple topics to agricultural price analysis and as such prior studies have laid the foundation for this study. Market integration is affected by both economic and political factors (Zorya et al., 2014). Agricultural commodity prices, though influenced by independent economic factors, regularly move together (Gilbert, 2010) – a

common indicator of market integration (Harriss, 1979). Soybean markets in particular have been found to be integrated, with price cointegration and transmission relatively resilient to structural changes such as the 2018 U.S.-China trade war (Barboza, Behrendt, and Paparas, 2022). It has been argued that the increased financialization of agricultural commodity markets has created more efficient markets and therefore stronger integration between crop prices (Irwin, Sanders, and Merrin, 2009).

This paper provides a novel contribution by directly testing how sources of domestic and global economic policy uncertainty affect international soybean price relationships. With rising economic uncertainty the world over, these findings help to inform policy makers, producers, and commodity traders of the effects of erratic policy changes on price relationships in integrated markets. While much of the existing literature has focused on futures market reactions to economic policy uncertainty (Du and Dong, 2023; Goyal, Mensah, and Steinbach, 2024), this study emphasizes the physical, trade-linked prices at port locations, which represent the first major price-setting point for international trade flows. Unlike futures prices, which are driven by expectations and are often detached from immediate trade realities, port prices capture the actual transactional value under which commodities are traded across borders. Port prices reflect all factors that shape international price transmission: transportation costs, quality adjustments, logistical frictions. Using a VECM approach, we model both global and bilateral contexts to examine price cointegration, transmission, and economic policy uncertainty spillover among export and import prices.

The remainder of this paper is organized as follows. Section II provides a review of relevant studies measuring economic policy uncertainty and its effects on agricultural commodity markets. Building on this review, we explain the selection of our economic policy

uncertainty variables and justify our focus on port prices rather than futures prices. Section III will lay out the data selection and empirical design of this study. Section IV presents the empirical results. Section V concludes the study and its implications to our understanding of international agricultural commodity market dynamics.

II. Economic Policy Uncertainty and Agricultural Markets

Economic policy uncertainty and its effects on agricultural markets have increased in the wake of geopolitical conflicts and disintegrating multilateral trade relationships. Measuring economic policy uncertainty, however, is difficult given the complexity of market-policy linkages. Most measures for economic policy uncertainty are based on indexes constructed from media coverage. One such measurement common in economic analysis is the Economic Policy Uncertainty Index developed by Baker, Bloom, and Davis (2016). Their approach includes the frequency of newspaper articles containing terms related to economy, policy, and uncertainty, the number of federal tax code provisions set to expire, reflecting uncertainty in fiscal policy, and the level of disagreement among economic forecasters about future government spending and inflation. Together, these components create an index that serve as a proxy for economic policy uncertainty.

Measures of economic policy uncertainty relevant to this study capture economic and trade policy uncertainty of large soybean market participants as well as tensions between these large market participants. These measures of economic policy uncertainty differ in scope. Specifying regional domestic economic policy uncertainty from global economic policy uncertainty allows us to consider how individual market participants' economic policy uncertainty affect market dynamics as well as how general global increases in economic policy uncertainty affect the markets. Further differentiations are made to isolate trade policy

uncertainty from economic policy uncertainty. Given the recent trade war and tensions between the U.S. and China, as well as the rising role of Brazil-China agricultural trade relations, it is expected that trade policy plays a more active role in international soybean trade than generalized economic policy uncertainty. Available trade policy uncertainty measures are limited to that of the U.S. and China.

Different indexes measuring economic policy uncertainty are generally uncorrelated with one another¹, though they are influenced by the same economic and political factors. One exception to that generality is that China economic policy uncertainty and China trade policy uncertainty are correlated. This reflects the role trade plays in Chinese economic planning. The non-stationarity of China economic and trade policy uncertainty captures this correlation but may also indicate an evolving policy environment, reflecting China's rising preeminence in the global order since entering the World Trade Organization in 2001.

Of course, many of these measures capture overlapping factors and some economic policy uncertainty measures may drive others. For example, in the U.S., economic policy uncertainty Granger causes agricultural policy uncertainty linearly in the short run, but the relationship is nonlinear and bidirectional in the long run (Du and Dong, 2023), whereas global economic policy uncertainty is an aggregation of the economic and trade policy uncertainties of prominent nations (Baker, Bloom, and Davis, 2016).

Diverse measures of economic policy uncertainty have been found to impact agricultural markets and trade flows. These measures of economic policy uncertainty may have different impacts on agricultural markets in the short, medium, and long run. Trade policy uncertainty, for

¹ See correlation matrix in appendix.

example, affects aggregate commodity markets in the medium to long run while geopolitical risk only has effects in the short term (Yang, Niu, and Gao, 2022; Goyal, Mensah, and Steinbach, 2024). Trade policy uncertainty is negatively associated with economic indicators in the agricultural sector such as lower employment, real value added, or loans to producers (Munisamy, 2021). Trade policy uncertainty's negative and positive effects on agricultural commodity prices indicate that trade policy uncertainty changes the supply and demand relationships of agricultural commodity prices (Sun et al 2021). On the other hand, geopolitical tensions impact markets in the short to medium run by significantly impacting futures prices and marketing behaviors, as is the case with corn and soybeans (Goyal, Mensah, and Steinbach, 2024). Likewise, agricultural policy uncertainty in the U.S. has short run effects reducing hedgers net short positions and speculators net long positions in the corn and soybean markets (Du and Dong, 2023).

It is important to note the compounding effects of different measures of economic policy uncertainty. For example, heightened geopolitical risk during the Russia-Ukraine conflict increased oil prices and concerns for agricultural policy uncertainty by indirectly increasing commodity prices (Chepeliev, Maliszewska, and Pereira, 2023; Goyal, Mensah, and Steinbach, 2024). For this purpose, our study includes various measures of economic policy uncertainty to capture compounding effects. Of particular interest is separating the effects of domestic economic policy uncertainties from global economic policy uncertainties.

Economic theory suggests that when markets are integrated, exogenous shocks occurring in one market should be perfectly transmitted to others (Samuelson, 1954; Ardeni, 1989). Economic policy uncertainty manifests in futures markets (Du and Dong, 2023; Goyal, Mensah, and Steinbach, 2024); as futures markets are an important component to price discovery in

agricultural markets (Carter and Rosario, 1989) these effects should manifest in realized spatial (port) prices. For this purpose our study focuses on realized cash prices at major ports to capture how economic policy uncertainty affects commodity prices physically traded.

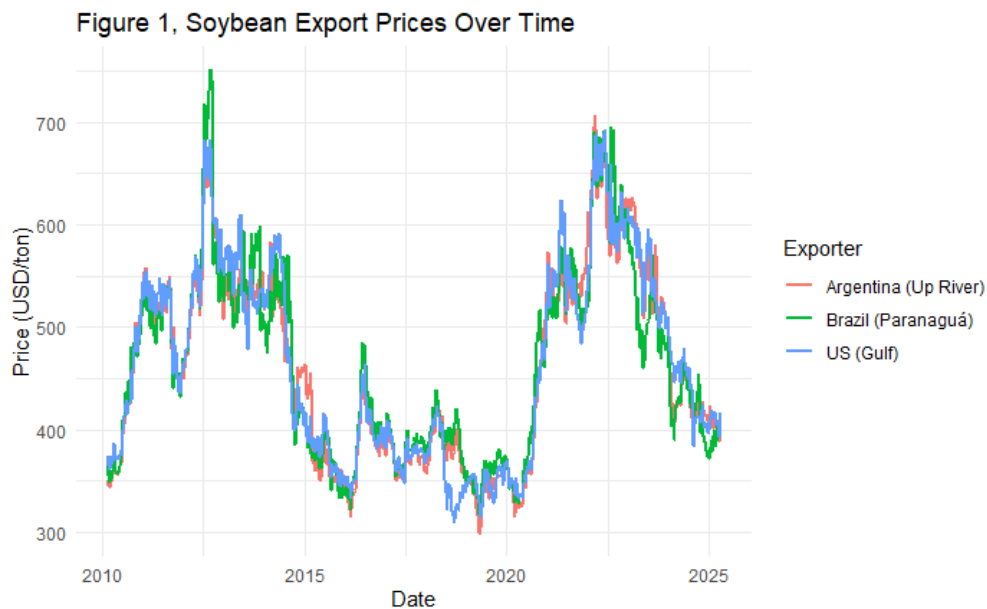
Agricultural commodities such as soybeans are homogenous and thus exporters act as substitutes for each other. Both simulation and econometric studies show that political barriers to trade affect agricultural trade relationships giving third party exporters increased market access (Adjemian, Smith, and He, 2021; Dhoubhadel, Ridley, and Devadoss, 2023; Robertson, Keeney, and Beckman, forthcoming). If economic policy uncertainty affects international spatial prices or price relationships, it could affect trade flows, changing price leadership and market structure. It is expedient in our study to examine the spillovers of domestic and global economic policy uncertainty on port prices for each large market participants in international soybean markets.

III. Data and Empirical Design

Data

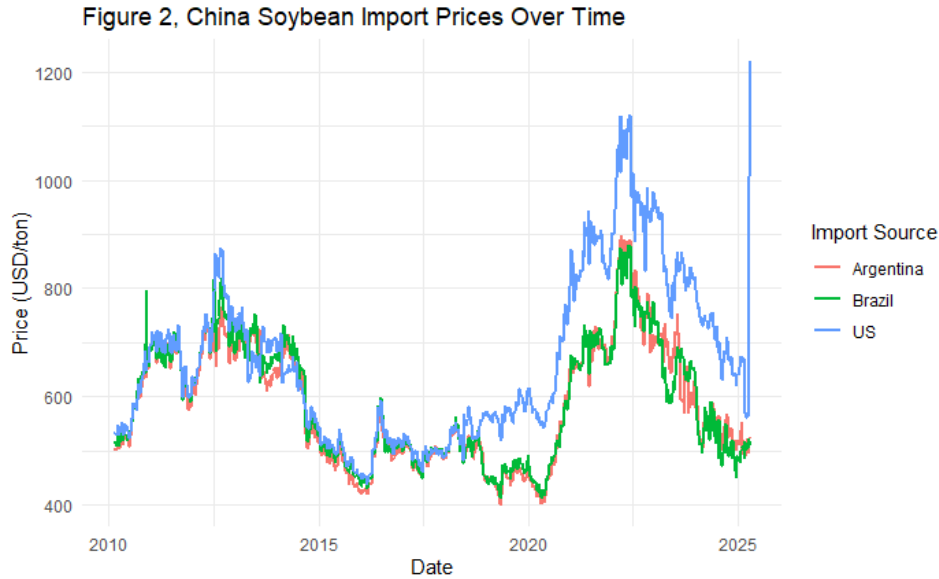
To test price cointegration, transmission, and the spillover effects of economic policy uncertainty in international soybean markets, we gather port prices from the largest soybean market participants and various measures of economic policy uncertainty. Weekly port prices are sourced from the London Stock Exchange Group and are measured in U.S. dollar per metric ton (\$/ton). Export prices are recorded at the major port of each country: Argentina (Up River), Brazil (Paranaguá), and U.S. (Gulf). Corresponding import prices sourced from each exporter are recorded at the China Shenzhen port. Our time series analysis is limited by the availability of China import price data and considers only 2/15/2010 – 4/14/2025.

Figures 1 and 2 show soybean export and import prices, respectively, over time. Soybean export prices move together in unison with only a slight deviation from U.S. prices in 2018 (due to the U.S.-China trade war which lowered U.S. export prices), but return to co-movement quickly. However, import prices sourced from the U.S. see a much larger deviation in co-movement in 2018 that does not converge again, indicating the trade war created a lasting structural change in import price relationships. Note also the large spike in U.S. import prices to China depicting the current trade war following President Trump's announcement of tariffs on April 2, 2025.



Notes: Weekly Nominal Soybean Export Prices, 5/15/2000 – 4/14/2025. U.S. dollar per metric ton.

Source: London Stock Exchange Group.



Notes: Weekly Nominal China Shenzhen Soybean Import Prices from Argentina, Brazil, and the United States, 2/15/2010 – 4/14/2025. U.S. dollar per metric ton.

Source: London Stock Exchange Group.

Economic policy uncertainty can significantly influence international soybean trade by altering production, marketing, and investment decisions. Given soybeans' deep integration into global supply chains, shifts in the policy environment that introduce uncertainty can reshape market expectations regarding future demand and price projection. These expectations, in turn, generate tangible effects on production, storage, and marketing strategies across the supply chain, affecting price relationships across regions.

As a proxy for economic policy uncertainty, we consider eight relevant and well documented measures of policy uncertainty: Global Economic Policy Uncertainty Index (Davis, Bloom, and Baker, 2025), Brazil Economic Policy Uncertainty Index (Castro, Ribeiro, and Kanimoto, 2025), China Economic Policy Uncertainty Index (Baker, Bloom, and Davis, 2025), China Trade Policy Uncertainty Index (Ahir, Bloom, and Furceri, 2025), U.S. Agricultural Policy Uncertainty Index (Du and Dong, 2023), U.S. Economic Policy Uncertainty Index (Baker, Bloom, and Davis, 2025), U.S. Trade Policy Uncertainty (Caldara et al., 2025), and U.S.-

China Tension Index (Caldara et al., 2025). Unlike broad macroeconomic indicators, these economic and trade policy uncertainty measures are purpose-built indices that capture not just the enacted policy changes but the anticipation and risk of policy changes—an essential component influencing soybean price discovery, inventory decisions and cross border arbitrage. Economic policy uncertainty indexes are reported monthly, to be consistent with weekly price data, indexes are linearly interpolated².

Measurement	Source	Description
Global Economic Policy Uncertainty Index	Davis, Bloom, and Baker, 2025	
Brazil Economic Policy Uncertainty Index	Castro, Ribeiro, and Kanimoto, 2025	
China Economic Policy Uncertainty Index	Baker, Bloom, and Davis, 2025	
China Trade Policy Uncertainty Index	Ahir, Bloom, and Furceri, 2025	
U.S. Agricultural Policy Uncertainty Index	Du and Dong, 2023	
U.S. Economic Policy Uncertainty Index	Baker, Bloom, and Davis, 2025	

² $Wk1_{montht} = Month_t$, $Wk2_{montht} = Month_t + .25 * (Month_{t+1} - Month_t)$, $Wk3_{montht} = Month_t + .5 * (Month_{t+1} - Month_t)$, $Wk4_{montht} = Month_t + .75 * (Month_{t+1} - Month_t)$

U.S. Trade Policy Uncertainty Index	Caldara et al., 2025	
U.S.-China Tension Index	Caldara et al., 2025	

Figure 3 shows weekly interpolated economic policy uncertainty indexes over time. Global economic policy uncertainty has an upward trend, reflecting the increase in geopolitical conflict and deterioration of multilateral economic relationships that motivate this study. Of particular interest to the study at hand is the economic and trade policy uncertainty from the U.S. and China, due to the high volume of bilateral soybean trade and increasing tension between the two countries. It is expected that economic policy uncertainty spillover should be most impactful from countries whose export price serves as the international benchmark price and large importing countries. U.S. economic and trade policy uncertainty is relatively stable when compared to other domestic or international measures with the exception of sharp spikes of economic policy uncertainty due to the COVID-19 pandemic in 2020 and of trade policy from 2018 – 2020 and 2025, reflecting trade wars from the first and second Trump administrations. U.S. agricultural policy uncertainty is also relevant for the current study; however, data is scarce (1/1/2000 – 9/27/2021). So as to not restrict the number of observations in all models, U.S. agricultural policy uncertainty will be considered only in a separate U.S.-China bilateral model.

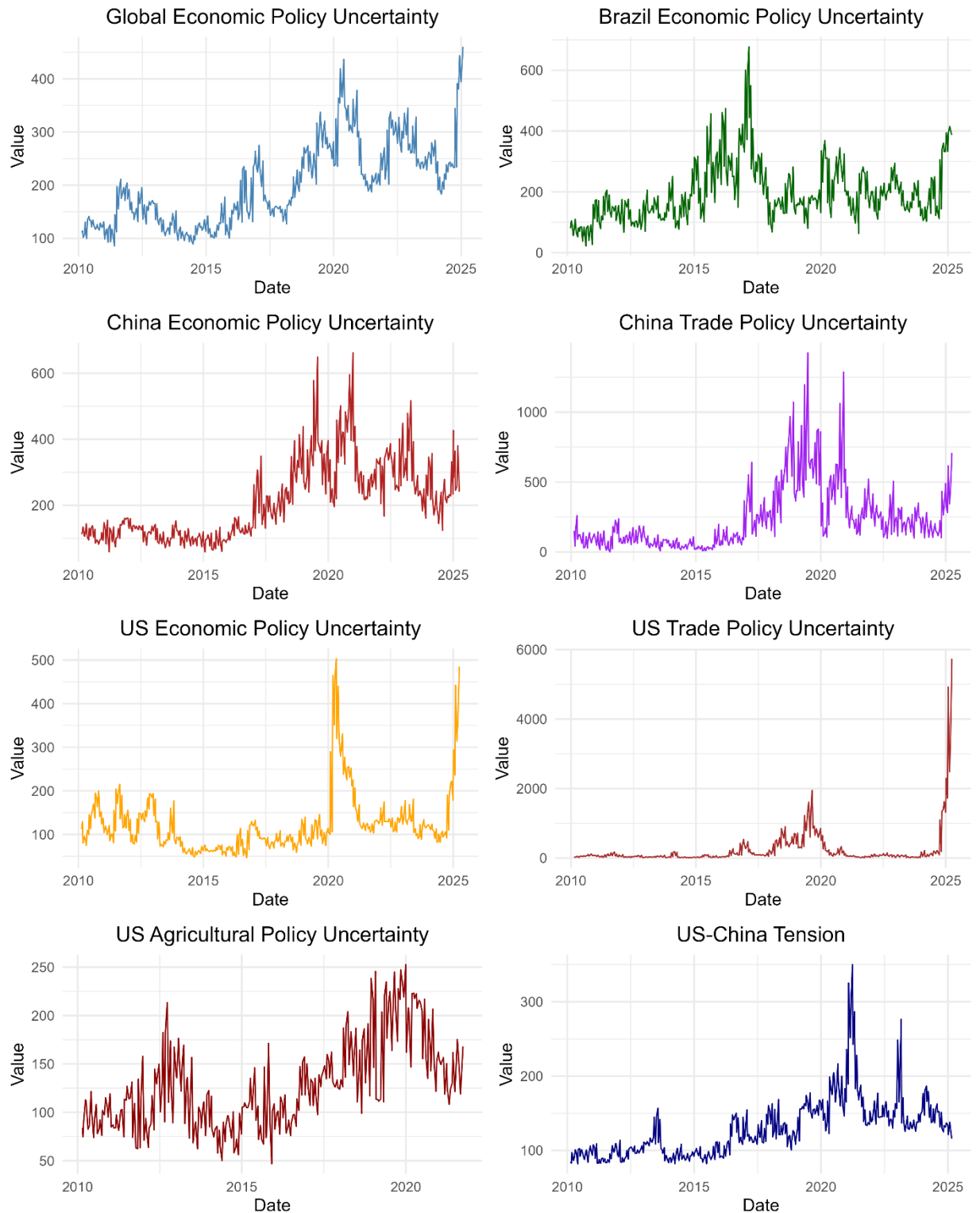


Figure 3, Economic Policy Uncertainty Measures. Monthly Index weekly interpolated.

Source: Davis, Bloom, and Baker, 2025; Castro, Ribeiro, and Kanimoto, 2025; Ahir, Bloom, and Furceri, 2025; Caldara et al., 2025; Du and Dong, 2023.

Table 1 shows the summary statistics for all series, including stationarity properties as captured by a standard unit root test, the Augmented Dickey-Fuller (ADF) test (Dickey and Fuller, 1981). All price series are found to be non-stationary and all economic policy uncertainty measures, with the exception of China economic and trade policy uncertainty, are stationary.

Table 1, Summary Statistics

	Mean	STDV	ADF Test	P-value	Properties
AR Export Price	460.18	93.45	-1.95	0.60	non-stationary
BR Export Price	462.88	92.38	-2.36	0.43	non-stationary
US Export Price	463.86	96.03	-2.08	0.55	non-stationary
CN_AR Import Price	586.36	110.35	-1.81	0.66	non-stationary
CN_BR Import Price	591.59	110.05	-2.01	0.57	non-stationary
CN_US Import Price	665.14	149.98	-1.96	0.60	non-stationary
Global Econ Policy Uncertainty	199.67	77.40	-4.17	0.01	stationary
BR Econ Policy Uncertainty	193.13	92.90	-4.43	0.01	stationary
CN Econ Policy Uncertainty	210.61	114.70	-3.35	0.06	non-stationary
CN Trade Policy Uncertainty	233.24	221.99	-3.21	0.09	non-stationary
US Econ Policy Uncertainty	120.22	62.56	-4.51	0.01	stationary
US Trade Policy Uncertainty	186.39	308.93	-5.16	0.01	stationary
US Ag Policy Uncertainty	127.56	44.12	-3.48	0.04	stationary
US-China Tension	128.74	38.74	-4.90	0.01	stationary

Note:

Make comments on Mean and STDV on variables and what that means. Higher STDV is more volatile

Model Selection and Description

Model selection in time series price analysis is determined in part by data stationarity. Time series methods such as vector autoregressions (VAR) and structural vector autoregressions (SVAR) require stationarity to yield reliable inferences. Non-stationarity undermines the validity of the analysis by inflating test statistics and distorting estimates and may be solved by taking the first difference. However, differencing non-stationary series may obscure long-term relationships. Given that price time series are non-stationary and cointegrated (see Johansen results, section IV), a vector error correction model (VECM) is most appropriate to estimate both short and long run price transmission elasticities and capture the effects of economic policy uncertainty measures.¹

A VECM with cointegrating relationships and exogenous policy consideration is specified as:

$$\Delta Y_t = \Pi Y_{t-1} + \sum_{i=1}^{p-1} \Gamma_i \Delta Y_{t-i} + \Psi d_t + \varepsilon_t \quad (1)$$

where ΔY is the first difference of the variables in vector Y , Π is a coefficient matrix of cointegrating relationships, Γ is a coefficient matrix of lagged differenced variables of vector Y (short-run dynamics), d is a vector of deterministic terms and Ψ its corresponding coefficient matrix. p is the lag order of the model in its VAR form and ε is an error term with zero mean and variance-covariance matrix Σ . Lags are selected following the Akaike information criterion (AIC) and can differ for each model. To best capture the effect of domestic and global economic policy uncertainty, iterative models are employed to put economic policy uncertainty effects in both global and bilateral contexts.

A global VECM captures market wide co-movements of soybean prices and detects multilateral influences. The global VECM is specified as in equation (1). We then let $Y_t =$

$[p_t^{AR}, p_t^{BR}, p_t^{US}, p_t^{CN_AR}, p_t^{CN_BR}, p_t^{CN_US}]$ be a 6x1 vector of (log) soybean export and import prices of major market participants (Argentina, Brazil, China, U.S.), representing global trade relationships. Exogenous variables in vector d include all relevant measures of economic policy uncertainty. We include all measures of economic policy uncertainty to isolate the effects of domestic versus global uncertainty and trade policy uncertainty from general economic policy uncertainty. Measures of economic policy uncertainty are uncorrelated with each other (see appendix figure A1.) with the exception of China economic policy uncertainty being correlated with China trade policy uncertainty and global economic policy uncertainty. We select a lag length of $k = 3$ to satisfy AIC.

Bilateral VECMs track direct pairwise adjustments providing a simpler interpretation of specific bilateral relationships. We model four bilateral VECMs (U.S.-China, U.S.-China with U.S. agricultural policy considerations, Brazil-China, Argentina-China) each specified as in equation (1). Vector Y_t is then defined as bilateral relationships, for example, to model a U.S.-China bilateral VECM we let $Y_t = [p_t^{US}, p_t^{CN_US}]$ be a 2x1 vector of (log) soybean export prices from the U.S. and China import prices of U.S. soybeans. All bilateral models contain U.S. domestic economic policy uncertainty as an exogenous variable to capture U.S. policy incidence as a price leader in the market. Lags are set to satisfy AIC: U.S.-China bilateral model $k = 4$, U.S.-China bilateral model with agricultural policy uncertainty $k = 2$, Brazil-China bilateral model $k = 3$, Argentina-China bilateral model $k = 2$.

IV. Results and Discussion

Table 2 contains results of the Johansen cointegration test (Johansen, 1991), which show the number of long-term (cointegrated) relationships of endogenous variables. The trace test

evaluates the null hypothesis that there are at most r cointegrating vectors ($\text{rank} \leq r$) against the alternative that there are more than r against the critical values for the 10, 5, and 1% confidence levels. Cointegration results indicate long-term equilibrium relationships exist between export and import prices in both a global and bilateral context. Four long-term price relationships exist in a global context. Bilateral Johansen cointegration results shed light as to which prices make up these relationships. Bilateral price cointegration is present for Argentina-China and Brazil-China while it is absent for U.S.-China. These findings indicate that the U.S. may have been removed from international soybean market integration, likely by economic policy uncertainty through trade wars with China.

Table 2, Johansen cointegration tests

		Trace test	10% c.v.	5% c.v.	1% c.v.
Global VECM	$r \leq 0$	190.20	97.18	102.14	111.01
	$r \leq 1$	117.96	71.86	76.07	84.45
	$r \leq 2$	66.92	49.65	53.12	60.16
	$r \leq 3$	38.28	32	34.91	41.07
	$r \leq 4$	16.12	17.85	19.96	24.6
	$r \leq 5$	3.30	7.52	9.24	12.97
Bilateral Argentina-China	$r \leq 0$	41.91	17.85	19.96	24.6
	$r \leq 1$	3.16	7.52	9.24	12.97
Bilateral Brazil-China	$r \leq 0$	38.4	17.85	19.96	24.6
	$r \leq 1$	4.32	7.52	9.24	12.97
Bilateral US-China	$r \leq 0$	10.28	17.85	19.96	24.6
	$r \leq 1$	2.39	7.52	9.24	12.97
Bilateral US-China w/ APU	$r \leq 0$	18.38	17.85	19.96	24.6
	$r \leq 1$	3.47	7.52	9.24	12.97

Notes: We run Johansen cointegration tests to find the number of cointegrated relationships among our stationary price time series.

Global and bilateral VECM results are reported in tables 3 and 4, respectively. VECM results show how prices adjust to disequilibrium as captured by the error correction terms (ect) as

well as short-term dynamics captured by the estimates of lagged differences of endogenous variables.

Global VECM

Table 3 reports results of the global VECM. The global VECM captures multilateral price transmission elasticities and allows for a comprehensive picture of international soybean trade. Short run price transmission elasticities show how export and import prices are affected by lagged prices of own and other prices, the magnitudes of which are likely explained in part by global price leadership structure. For example, Argentina export prices increase by 0.13% for a 1% increase in one-month lagged Brazil export prices ($p < 0.05$) and 0.1% for a 1% increase in two-month lagged Brazil export price ($p < 0.10$) Brazil export prices increase by 0.1% for a 1% increase in one-month lagged China import price from the U.S. ($p < 0.10$). U.S. export prices, in contrast, are only affected by own prices increasing by 0.08% for both one- and two-month lags ($p < 0.10$). These results suggest that U.S. prices serve as an anchor in international soybean markets. Elasticities reflect the asymmetric transmission of price signals, reinforcing the idea that global soybean trade is structured around a price leader (the U.S.) who is removed from integrated influences.

Chinese import prices from Argentina increase by 0.12% for a 1% increase in one-month lagged Brazil export prices ($p < 0.10$) and decrease by 0.15% for every 1% increase in one-month lagged own price ($p < 0.10$). Import prices from Brazil likewise increase by 0.18% for a 1% increase in one-month lagged Brazil export price ($p < 0.05$) and decrease by 0.42% for a 1% increase in one-month lagged own price ($p < 0.01$). Import prices from the U.S. are more complicated, increasing by 0.24% for every 1% increase in one-month lagged Brazil export prices ($p < 0.01$) and increasing 0.16% for a 1% increase in two-month lagged Brazil export

price ($p < 0.05$), while decreasing by 0.2% for 1% increase in one-month lagged own price ($p < 0.01$) and 0.13% for every 1% increase in two-month lagged import price from Argentina. Price transmission is found to be more elastic among import prices than export prices.

Increases in global economic policy uncertainty increase soybean export and import prices across all markets but is only statistically significant for China import prices from Argentina ($p < 0.10$) and the U.S. ($p < 0.05$). This is intuitive and consistent with prior findings: as economic policy is increasingly uncertain, it drives up prices (Baker, Bloom, and Davis, 2016). Notably increases to import prices are larger than increases to export prices. China import prices from the U.S. see the largest effects, reflecting the recent tensions and trade wars between the two.

Domestic measures of economic policy uncertainty vary in ways consistent with a particular market participants' presence in the international market. Brazil and China economic policy uncertainty, for example, do not spillover into international soybean export and import prices. U.S. economic policy uncertainty, on the other hand, does spillover into international prices putting downward pressure on all export and import prices. U.S. economic policy uncertainty decreases Argentina and U.S. export prices ($p < 0.10$) and China import prices from Argentina ($p < 0.05$) and the U.S. ($p < 0.01$). The widespread effects of U.S. economic policy uncertainty across markets implies that economic policy uncertainty in the U.S. affects international soybean markets more than increased global economic policy uncertainty. Import markets are more susceptible to a certain country's domestic economic policy uncertainty spillovers than export prices of other countries.

While China economic policy uncertainty has no effects on soybean export or import price, China trade policy uncertainty has negative effects on export prices—however, only

statistically significant for U.S. export prices ($p < 0.10$). U.S. trade policy uncertainty positively affects export prices and negatively affects import prices, though not statistically significant. In theory, trade policy uncertainty should have more of an effect on internationally traded agricultural commodities than generalized economic policy uncertainty. This discrepancy may be attributable to the nature of constructed indexes where economic policy uncertainty captures more key words than trade policy uncertainty.

Table 3 also shows the error correction terms (ect) in the global model. Error correction terms show how prices adjust back toward long-run equilibrium after a shock, with the magnitude and sign of the coefficients indicating which markets respond to disequilibrium and how quickly they correct. In a global context, Argentina and Brazil soybean prices adjust to disequilibrium quickly, both as export prices (ect1 and ect2) and as import prices (ect4 and ect5). This may reflect their role as substitutes to U.S. soybeans and further confirms previous findings that the U.S. is the price leader in the international soybean market (Margarido, 2012; Barboza, Behrendt, and Paparas, 2022). Market price takers such as Argentina and Brazil fill an important role in returning the market to equilibrium in the midst of economic and trade policy uncertainty.

[TABLE 3 ABOUT HERE, SEE TABLES IN BACK]

Bilateral VECMs

Table 4 reports the results for the four bilateral VECMs. Bilateral VECMs provide a robustness check to the global VECM by capturing country specific transmissions. Across all markets, import prices are positively impacted by lagged export prices (price transmission that conforms to the law of one price) and is negatively impacted by lagged import prices, indicating a downward trend on import prices. There is stronger price transmission in China import prices

from Brazil than from the U.S. or Argentina, indicating that Brazil is more integrated with China in soybean trade than the other countries. Bilateral models confirm the results of the global model in that global economic policy uncertainty only manifests in China import prices from the U.S. and Argentina. Bilateral models also confirm that U.S. economic policy uncertainty spills over into bilateral prices of other market participants. U.S. economic policy uncertainty puts downward pressure on international soybean prices, as captured by the import and export prices of major soybean market participants.

U.S. agricultural policy, while not statistically significant, has a larger nominal impact on export and import prices than any other measure of economic policy uncertainty. Instead of implying a causal inference, this may allude to a more direct price effect of U.S. agricultural policy on U.S. soybean producer prices. Consistent with the global VECM results, Argentina and Brazil export and import prices adjust quickly to disequilibrium acting as substitutes for the U.S. under economic policy uncertainty.

[TABLE 4 ABOUT HERE, SEE TABLES IN BACK]

V. Policy Implications and Conclusion

This paper examines price cointegration, transmission and economic policy uncertainty spillover in international soybean markets. Consistent with other studies, soybean export and import prices are found to be cointegrated and transmit price changes among each other. Bilateral VECM results show that the U.S. exports and China imports do not share an integrated relationship, likely caused, at least in part, by increased economic policy uncertainty and tension between the two countries. Argentina and Brazil adjust quickly to disequilibrium acting as substitutes for U.S. soybeans in times of economic policy uncertainty. Further, global economic

policy uncertainty is found to positively influences prices and U.S. domestic policy uncertainty has greater spillover than other domestic policies or global economic policy uncertainty, negatively impacting export and import prices. On average, China import prices are more affected by economic policy uncertainty than export prices in source countries.

These findings have implications for agricultural producers, commodity traders, and regulatory agencies. Economic and trade policy uncertainty is costly, negatively affecting production, consumption, and investment decisions (Hillberry, 2025; Baker, Bloom, and Davis, 2016). Increased global economic uncertainty raises prices, benefiting producers while U.S. economic policy uncertainty spillover depresses prices benefiting soybean importers. Of course, economic policy uncertainty spillover into international soybean trade increases price volatility, complicating welfare assessments. The relationship between economic policy uncertainty and international soybean prices implies policy agendas and multilateral trade cooperation are partial determinants of soybean trade flows and ultimately food security.

Producers and traders should utilize the futures market to smooth out shocks from economic policy uncertainty before spatially realized at ports. Governments should look for actionable ways to decrease economic policy uncertainty and create an environment of trust and predictability for markets to flourish. Whereas old trade agreements focused on traditional trade measures such as tariffs and quotas, new trade agreements should seek to promote international cooperation by creating more certainty in economic and trade policy (Grossman, McCalman, and Staiger, 2022).

References

- Adjemian, Michael K., Aaron Smith, and Wendi He. "Estimating the market effect of a trade war: The case of soybean tariffs." *Food Policy* 105 (2021): 102152.
- Ahir, Hites, Nicholas Bloom, and Davide Furceri. *China Trade Policy Uncertainty Index*. PolicyUncertainty.com. Accessed April 29, 2025. <https://www.policyuncertainty.com/tpu.html>.
- Anderson. K. 2010. "Globalization's effects on world agricultural trade, 1960-2050." *Philosophical Transactions of the Royal Society* 365: 3007-3021.
- Ardeni, P. G. (1989). Does the law of one price really hold for commodity prices? *American Journal of Agricultural Economics*, 71(3), 661–669.
- Baker, Scott R., Nicholas Bloom, and Steven J. Davis. "Measuring economic policy uncertainty." *The quarterly journal of economics* 131, no. 4 (2016): 1593-1636.
- Baker, Scott R., Nicholas Bloom, and Steven J. Davis. *China Economic Policy Uncertainty Index*. PolicyUncertainty.com. Accessed April 29, 2025. https://www.policyuncertainty.com/china_epu.html.
- Baker, Scott R., Nicholas Bloom, and Steven J. Davis. *U.S. Economic Policy Uncertainty Index*. PolicyUncertainty.com. Accessed April 29, 2025. <https://www.policyuncertainty.com>.
- Baldwin, Richard E., and Anthony J. Venables. "Regional economic integration." *Handbook of international economics* 3 (1995): 1597-1644.
- Barboza Martignone, Gustavo, Karl Behrendt, and Dimitrios Pappas. "Price transmission analysis of the international soybean market in a trade war context." *Economies* 10, no. 8 (2022): 203.
- Barrett, Christopher B., and Jau Rong Li. "Distinguishing between equilibrium and integration in spatial price analysis." *American Journal of Agricultural Economics* 84, no. 2 (2002): 292-307.
- Caldara, Dario, Matteo Iacoviello, Patrick Molligo, Andrea Prestipino, and Andrea Raffo. *U.S. Trade Policy Uncertainty Index*. PolicyUncertainty.com. Accessed April 29, 2025. <https://www.policyuncertainty.com/tpu.html>.
- Caldara, Dario, Matteo Iacoviello, Patrick Molligo, Andrea Prestipino, and Andrea Raffo. *U.S.–China Trade Tension Index*. PolicyUncertainty.com. Accessed April 29, 2025. https://www.policyuncertainty.com/US_China_tension.html.
- Carter, C. A., & Rosario, M. (1989). Joint estimation of cash and futures markets' spatial price relationships. *American Journal of Agricultural Economics*, 71(1), 97–108.
- Castro, Filipe Lage de, João Barata Ribeiro, and Sérgio Kanimoto. *Brazil Economic Policy Uncertainty Index*. PolicyUncertainty.com. Accessed April 29, 2025. https://www.policyuncertainty.com/brazil_epu.html.
- Chepeliev, Maksym, Maryla Maliszewska, and Maria Filipa Seara E. Pereira. "The war in Ukraine, food security and the role for Europe." *EuroChoices* 22, no. 1 (2023): 4-13.

- Davis, Steven J., Nicholas Bloom, and Scott R. Baker. *Global Economic Policy Uncertainty Index*. PolicyUncertainty.com. Accessed April 29, 2025.
https://www.policyuncertainty.com/global_epu.html.
- Dhoubhadel, Sunil P., William Ridley, and Stephen Devadoss. "Brazilian soybean expansion, US–China trade war, and US soybean exports." *Journal of the Agricultural and Applied Economics Association* 2, no. 3 (2023): 446-460.
- Dickey, David A., and Wayne A. Fuller. "Likelihood ratio statistics for autoregressive time series with a unit root." *Econometrica: journal of the Econometric Society* (1981): 1057-1072.
- Donaldson, Dave. "The gains from market integration." *Annual Review of Economics* 7, no. 1 (2015): 619-647.
- Du, Xiaodong, and Fengxia Dong. "Agricultural policy uncertainty and its impact on commodity markets." *Journal of the Agricultural and Applied Economics Association* 2, no. 2 (2023): 263-277.
- Gilbert, Christopher L. "How to understand high food prices." *Journal of agricultural economics* 61, no. 2 (2010): 398-425.
- Goodwin, Barry K., and Ted C. Schroeder. "Cointegration tests and spatial price linkages in regional cattle markets." *American Journal of Agricultural Economics* 73, no. 2 (1991): 452-464.
- Goyal, Raghav, Edouard Mensah, and Sandro Steinbach. "The interplay of geopolitics and agricultural commodity prices." *Applied Economic Perspectives and Policy* 46, no. 4 (2024): 1533-1562.
- Grossman, Gene M., Phillip McCalman, and Robert W. Staiger. "The “new” economics of trade agreements: From trade liberalization to regulatory convergence?." *Econometrica* 89, no. 1 (2021): 215-249.
- Harriss, Barbara. "There is method in my madness: Or is it vice versa? Measuring agricultural market performance." *Food Research Institute Studies* 17, no. 2 (1979): 197-218.
- Hillberry, Russell. 2025. "Interesting Times for U.S. Trade Policy." *Purdue Agricultural Economics Report PAER-2025-02*, January 31. Purdue University Center for Commercial Agriculture.
- Irwin, Scott H., Dwight R. Sanders, and Robert P. Merrin. "Devil or angel? The role of speculation in the recent commodity price boom (and bust)." *Journal of agricultural and applied economics* 41, no. 2 (2009): 377-391.
- Johansen, Søren. "Estimation and hypothesis testing of cointegration vectors in Gaussian vector autoregressive models." *Econometrica: journal of the Econometric Society* (1991): 1551-1580.
- Margarido, M. A., and F. A. Turolla. "Análise da transmissão espacial de preços no mercado internacional de trigo." In *CONFERÊNCIA EM GESTÃO DE RISCO E COMERCIALIZAÇÃO DE COMMODITIES*, vol. 2. 2012.

- McNew, Kevin. "Spatial market integration: Definition, theory, and evidence." *Agricultural and Resource Economics Review* 25, no. 1 (1996): 1-11.
- Munisamy, Gopinath. "Does trade policy uncertainty affect agriculture?." *Applied Economic Perspectives and Policy* 43, no. 2 (2021): 604-618
- Office of the United States Trade Representative (USTR). (2018). *Request for comments concerning proposed modification of action pursuant to Section 301: China's acts, policies, and practices related to technology transfer, intellectual property, and innovation*. Federal Register Notice, July 10, 2018. Retrieved from https://ustr.gov/sites/default/files/301/2018-0026%20China%20FRN%207-10-2018_0.pdf
- Ravallion, Martin. "Testing market integration." *American Journal of Agricultural Economics* 68, no. 1 (1986): 102-109.
- Robertson, Dewey J., Roman Keeney, and Jayson Beckman. "Reversing regional integration – the potential costs for agriculture in the USMCA". Manuscript under review at *Applied Economics Perspectives and Policy*. Submitted April 15, 2025
- Samuelson, P. A. (1954). The transfer problem and transport costs, II: Analysis of effects of trade impediments. *Economic Journal*, 64(254), 264–289.
- Smith, Vincent H., and Joseph W. Glauber. "Trade, policy, and food security." *Agricultural Economics* 51, no. 1 (2020): 159-171.
- Sun, Ting-Ting, Chi-Wei Su, Nawazish Mirza, and Muhammad Umar. "How does trade policy uncertainty affect agriculture commodity prices?." *Pacific-Basin Finance Journal* 66 (2021): 101514.
- Yang, Cai, Zibo Niu, and Wang Gao. "The time-varying effects of trade policy uncertainty and geopolitical risks shocks on the commodity market prices: Evidence from the TVP-VAR-SV approach." *Resources Policy* 76 (2022): 102600.
- Zorya, Sergiy, S. von Cramon-Taubadel, F. Greb, N. Jamora, C. Mengel, and N. Würriehausen. "Price transmission from world to local grain markets in developing countries. Why it matters, how it works, and how it should be enhanced." *Trade policy and food security: Improving access to food in developing countries in the wake of high world prices*. Washington DC: World Bank (2014)

Appendix

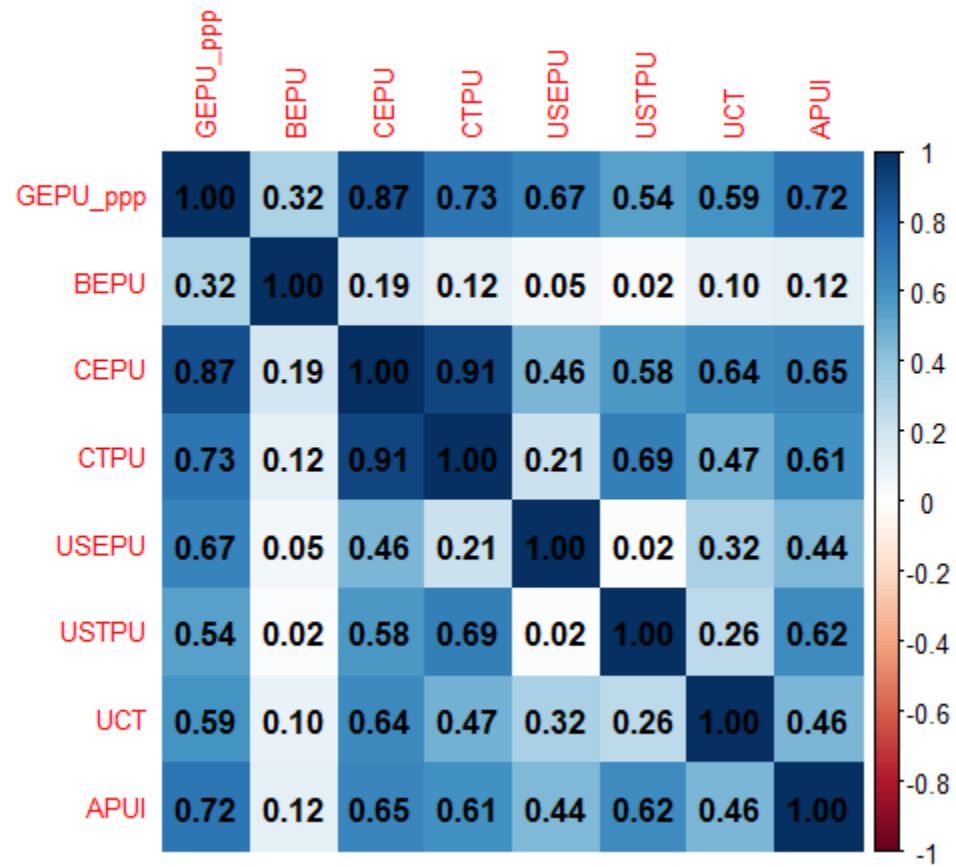
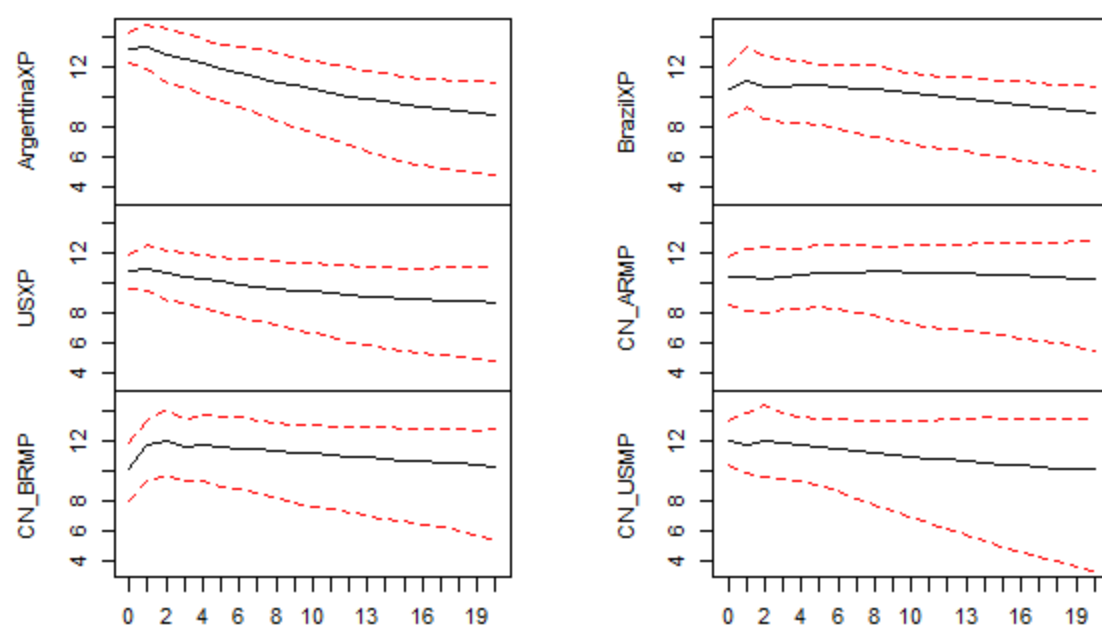


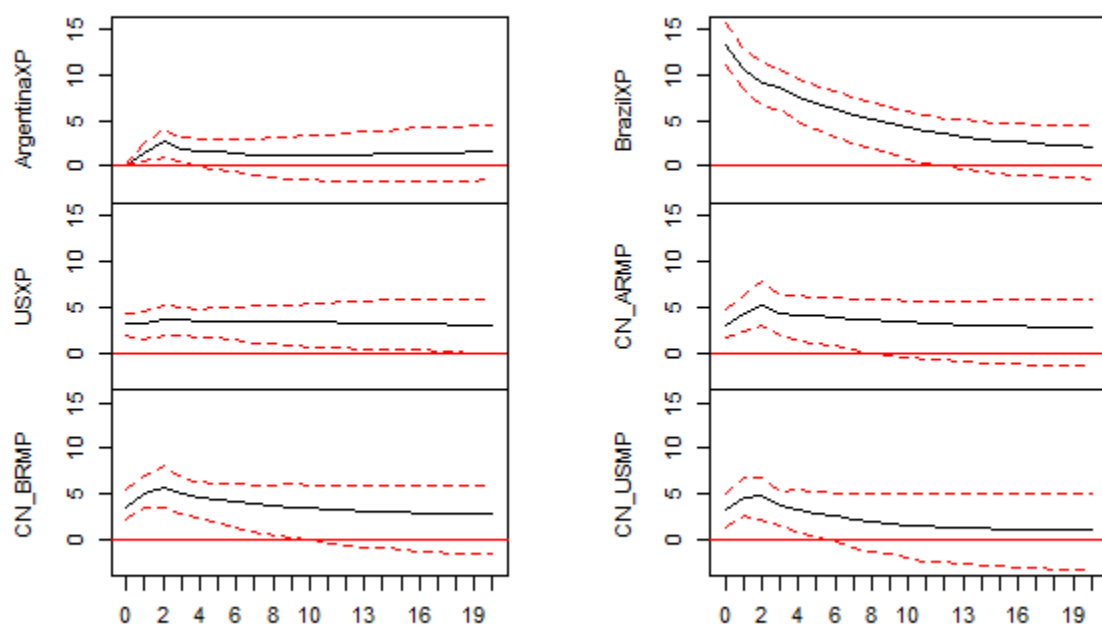
Figure A1. Correlation matrix of exogenous variables.

Orthogonal Impulse Response from ArgentinaXP



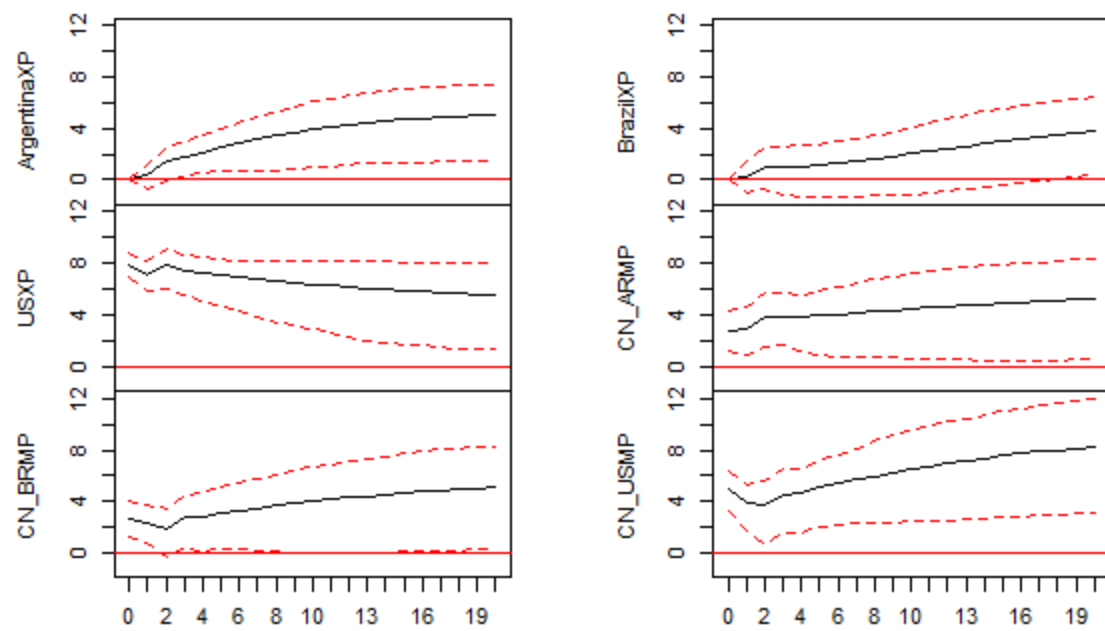
95 % Bootstrap CI, 100 runs

Orthogonal Impulse Response from BrazilXP



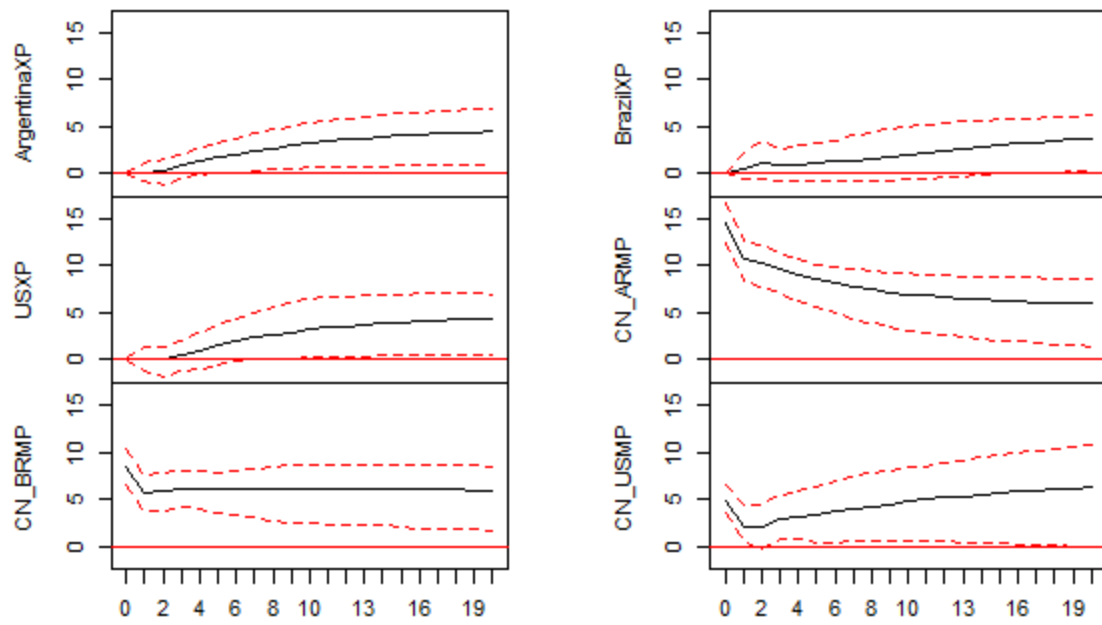
95 % Bootstrap CI, 100 runs

Orthogonal Impulse Response from USXP



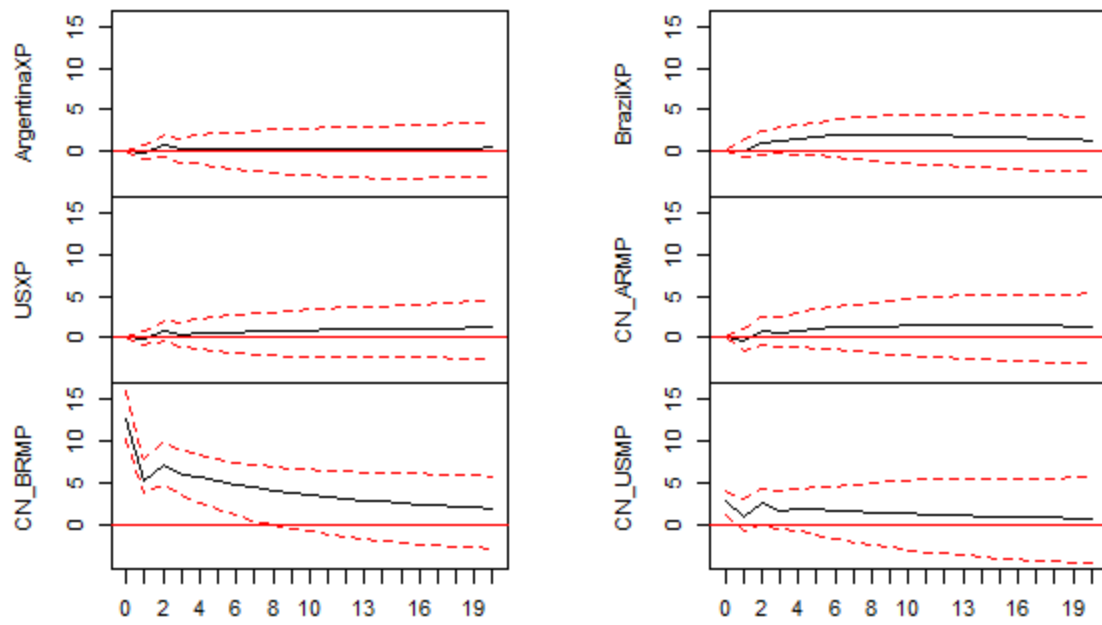
95 % Bootstrap CI, 100 runs

Orthogonal Impulse Response from CN_ARMP



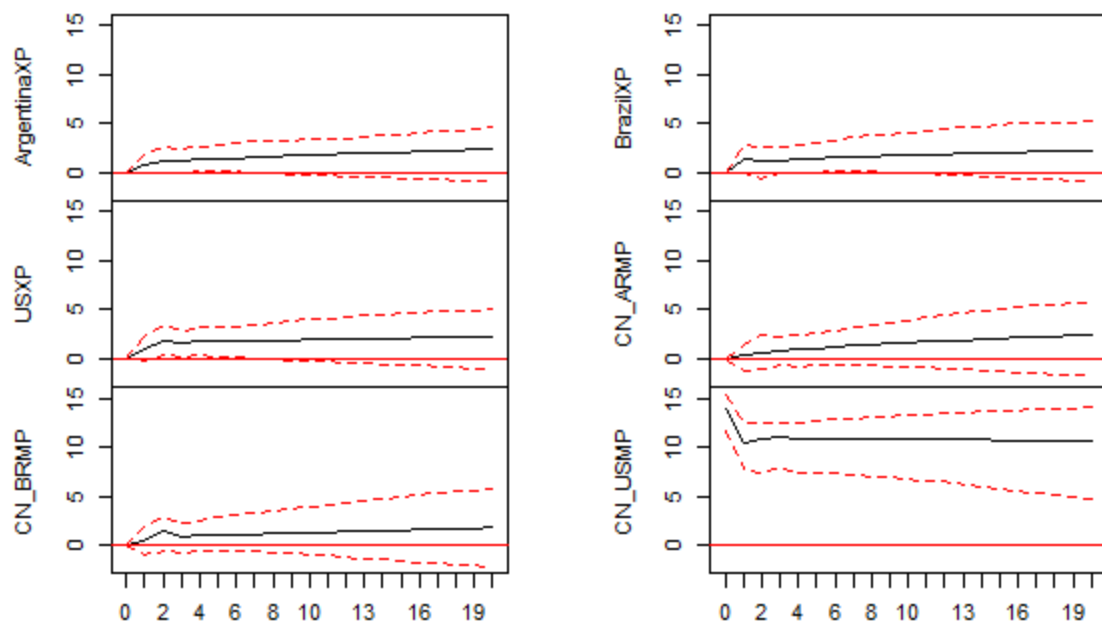
95 % Bootstrap CI, 100 runs

Orthogonal Impulse Response from CN_BRMP



95 % Bootstrap CI, 100 runs

Orthogonal Impulse Response from CN_USMP



95 % Bootstrap CI, 100 runs

Table 3, Global VECM Results

	Dependent variable (equation)					
	ArgentinaXP	BrazilXP	USXP	CN_ARMP	CN_BRMP	CN_USMP
Intercept	-3.7519(2.6898)	-4.0545(3.4513)	-3.9891(2.7737)	3.4116(3.7169)	6.3547(3.8148).	2.3751(4.0353)
-1 ArgentinaXP	-0.0280(0.0653)	0.0657(0.0838)	0.0786(0.0673)	0.0007(0.0902)	0.1494(0.0926)	0.1243(0.0979)
-1 BrazilXP	0.1279(0.0415)**	-0.0690(0.0533)	0.0198(0.0428)	0.1230(0.0574)*	0.1783(0.0589)**	0.2384(0.0623)***
-1 USXP	-0.0438(0.0677)	-0.0262(0.0868)	-0.0794(0.0698)	0.0540(0.0935)	0.0646(0.0960)	-0.0026(0.1015)
-1 CN_ARMP	-0.0512(0.0443)	0.0466(0.0568)	-0.0318(0.0456)	-0.1537(0.0612)*	0.0439(0.0628)	-0.0843(0.0664)
-1 CN_BRMP	-0.0319(0.0444)	-0.1040(0.0570).	-0.0729(0.0458)	-0.0793(0.0614)	-0.4232(0.0630)***	-0.1194(0.0666).
-1 CN_USMP	0.0577(0.0366)	0.0955(0.0470)*	0.0806(0.0377)*	0.0245(0.0506)	0.0415(0.0519)	-0.2000(0.0549)***
-2 ArgentinaXP	-0.1499(0.0640)*	-0.0641(0.0821)	-0.0924(0.0660)	-0.1699(0.0884).	0.0490(0.0908)	0.0604(0.0960)
-2 BrazilXP	0.1039(0.0409)*	-0.0658(0.0524)	0.0002(0.0421)	0.1018(0.0565).	0.1359(0.0580)*	0.1622(0.0613)**
-2 USXP	0.0620(0.0669)	0.0616(0.0859)	0.0890(0.0690)	0.0768(0.0925)	-0.0932(0.0949)	-0.0593(0.1004)
-2 CN_ARMP	-0.0767(0.0423).	0.0546(0.0542)	-0.0881(0.0436)*	-0.0571(0.0584)	-0.0646(0.0599)	-0.1340(0.0634)*
-2 CN_BRMP	0.0442(0.0404)	-0.0217(0.0519)	0.0142(0.0417)	0.0249(0.0559)	-0.0389(0.0574)	0.0315(0.0607)
-2 CN_USMP	0.0352(0.0356)	0.0123(0.0456)	0.0791(0.0367)*	0.0160(0.0491)	0.0585(0.0504)	-0.0430(0.0534)
GEPU_ppp	0.0298(0.0227)	0.0325(0.0291)	0.0288(0.0234)	0.0689(0.0313)*	0.0404(0.0322)	0.1103(0.0340)**
BEPU	0.0022(0.0070)	0.0025(0.0090)	-0.0008(0.0072)	-0.0056(0.0097)	0.0011(0.0099)	-0.0198(0.0105).
CEPU	0.0040(0.0166)	0.0034(0.0213)	0.0154(0.0171)	-0.0163(0.0230)	-0.0287(0.0236)	0.0270(0.0249)
CTPU	-0.0067(0.0064)	-0.0064(0.0082)	-0.0148(0.0066)*	0.0023(0.0088)	0.0070(0.0090)	-0.0181(0.0095).
USEPU	-0.0305(0.0124)*	-0.0269(0.0160).	-0.0302(0.0128)*	-0.0511(0.0172)**	-0.0261(0.0176)	-0.0708(0.0186)***
USTPU	0.0002(0.0027)	0.0020(0.0035)	0.0006(0.0028)	-0.0039(0.0038)	-0.0030(0.0039)	-0.0076(0.0041).
UCT	0.0072(0.0191)	-0.0020(0.0245)	0.0157(0.0197)	-0.0159(0.0264)	-0.0159(0.0271)	-0.0174(0.0287)
ect1	-0.0921(0.0324)**	0.0944(0.0416)*	-0.0127(0.0334)	0.0152(0.0448)	0.0315(0.0460)	0.0092(0.0486)
ect2	-0.0230(0.0249)	-0.1530(0.0320)***	0.0090(0.0257)	0.0025(0.0344)	0.0287(0.0353)	-0.0593(0.0374)
ect3	0.0517(0.0296).	-0.0064(0.0380)	-0.0717(0.0305)*	0.0699(0.0409).	0.0333(0.0420)	0.0525(0.0444)
ect4	0.0422(0.0282)	-0.0424(0.0361)	0.0242(0.0290)	-0.1027(0.0389)**	0.0991(0.0399)*	-0.0002(0.0422)
ect5	0.0169(0.0333)	0.1020(0.0427)*	0.0482(0.0343)	0.0433(0.0460)	-0.1680(0.0472)***	0.0558(0.0499)

Notes: Global VECM includes all exogenous policy measures. Data tested from 2/15/2010 – 1/27/2025.

Significance indicated at the 10% (*), 5% (**), and 1% (***) levels.

Table 4, Bilateral VECMs

	Dependent variable (equation)							
	US-China Bilateral VECM		US-China Bilateral VECM w/ APU		Brazil-China Bilateral VECM		Argentina-China Bilateral VECM	
	USXP	CN_USMP	USXP	CN_USMP	BrazilXP	CN_BRMP	ArgentinaXP	CN_ARMP
Intercept	3.9999(2.8611)	-1.6966(4.2109)	3.8707(3.0311)	-1.5471(3.9246)	-3.0817(2.1636)	-0.5018(2.4289)	-0.8941(1.5371)	0.4602(2.1201)
-1 USXP	-0.0658(0.0499)	0.1523(0.0734)*	-0.0084(0.0575)	0.1104(0.0744)	-	-	-	-
-1 CN_USMP	0.0462(0.0341)	-0.2318(0.0502)***	0.0368(0.0446)	-0.1284(0.0578)*	-	-	-	-
-2 USXP	-0.0346(0.0497)	0.0015(0.0732)	-	-	-	-	-	-
-2 CN_USMP	0.0611(0.0349)	-0.0240(0.0514)	-	-	-	-	-	-
-3 USXP	-0.0522(0.0483)	-0.1636(0.0711)*	-	-	-	-	-	-
-3 CN_USMP	0.0568(0.0333)	0.0649(0.0490)	-	-	-	-	-	-
-1 BrazilXP	-	-	-	-	-0.0211(0.0447)	0.3012(0.0502)***	-	-
-1 CN_BRMP	-	-	-	-	-0.0258(0.0399)	-0.3802(0.0448)***	-	-
-2 BrazilXP	-	-	-	-	-0.0387(0.0439)	0.1310(0.0493)**	-	-
-2 CN_BRMP	-	-	-	-	0.0120(0.0378)	-0.0650(0.0424)	-	-
-1 ArgentinaXP	-	-	-	-	-	-	0.0503(0.0457)	0.1122(0.0631).
-1 CN_ARMP	-	-	-	-	-	-	-0.0269(0.0332)	-0.1690(0.0459)***
GEPU_ppp	-0.0026(0.0195)	0.0569(0.0287)*	0.0008(0.0238)	0.0491(0.0308)	0.0348(0.0238)	0.0307(0.0268)	0.0257(0.0175)	0.0489(0.0241)*
BEPU	-	-	-	-	0.0026(0.0076)	0.0061(0.0085)		
CEPU	0.0075(0.0160)	0.0203(0.0235)	-0.0123(0.0220)	-0.0236(0.0284)	0.0048(0.0188)	-0.0089(0.0211)	0.0059(0.0145)	-0.0292(0.0200)
CTPU	-0.0085(0.0059)	-0.0122(0.0086)	-0.0024(0.0081)	0.0056(0.0105)	-0.0089(0.0071)	-0.0035(0.0080)	-0.0091(0.0055).	0.0061(0.0076)
USEPU	-0.0178(0.0119)	-0.0512(0.0175)**	-0.0157(0.0152)	-0.0340(0.0197).	-0.0296(0.0143)*	-0.0333(0.0161)*	-0.0290(0.0110)**	-0.0404(0.0151)**
USTPU	0.0024(0.0028)	-0.0021(0.0041)	0.0004(0.0036)	-0.0064(0.0047)	0.0010(0.0033)	-3.7e-05(0.0037)	0.0001(0.0025)	-0.0034(0.0035)
USAPU	-	-	25.2909(44.9638)	68.6352(58.2167)	-	-	-	-
UCT	-0.0098(0.0187)	-0.0384(0.0275)	-0.0087(0.0206)	-0.0303(0.0267)	-	-	-	-
ect1	-0.0279(0.0169).	0.0446(0.0248).	-0.0425(0.0191)*	0.0259(0.0247)	-0.1238(0.0272)***	0.0403(0.0306)	-0.0695(0.0201)***	0.0599(0.0278)*

Notes: We run four bilateral VECMs that include all relevant exogenous policy measures. US-China, Brazil-China, and Argentina-China models tested from 2/15/2010 –

1/27/2025. Due to data limitations, US-China w/ APU model tested from 2/15/2010 – 9/27/2021.

Significance indicated at the 10% (*), 5% (**), and 1% (***) levels.

DRAFT