The Interplay of Geopolitics and Agricultural Commodity Prices

Raghav Goyal, Edouard Mensah, and Sandro Steinbach

Selected presentation for the International Agricultural Trade Research Consortium's (IATRC's) 2023 Annual Meeting: The Future of (Ag-) Trade and Trade Governance in Times of Economic Sanctions and Declining Multilateralism, December 10-12, 2023, Clearwater Beach, FL.

The Interplay of Geopolitics and Agricultural Commodity Prices

Raghav Goyal
Assistant Professor
Department of Agricultural Economics & Agribusiness
Louisiana State University
December 9, 2023

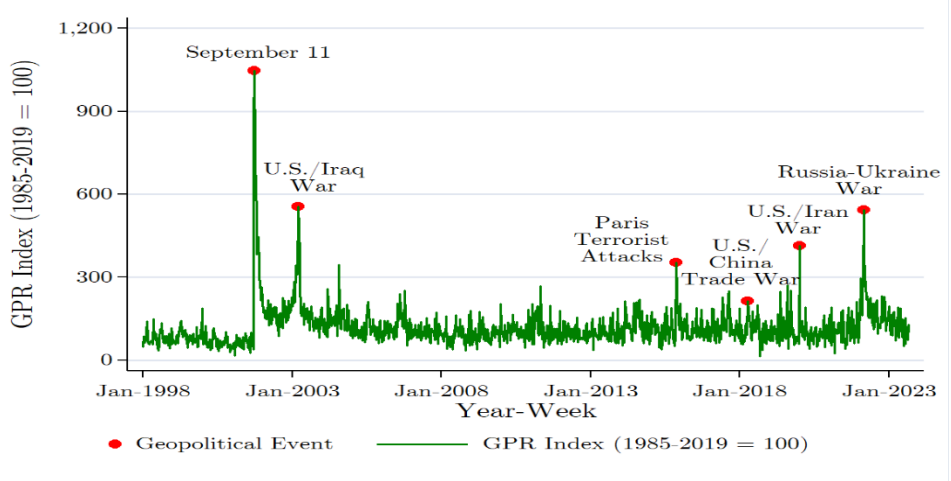
Executive Summary

- **Background:** The study of agricultural market reactions to geopolitical disturbances is crucial for timely and effective policy-making. However, unlike the impact of geopolitical risk on energy, oil and metals market that have been studied widely, the effects of geopolitical risks on agriculture market has got less attention.
- **Motivation:** We suggest that federal organizations, such as the USDA and the CFTC, can leverage the insights from the relationship between geopolitical risks and agricultural commodity market to formulate responses that stabilize agricultural commodity prices during geopolitical upheavals.
- **Findings:** Our results show that geopolitical risks significantly impact corn and soybean futures prices and market behaviors with context-specific implications in the short to medium term. The impact via exports and input prices is more pronounced as compared to other pathways.
- **Implication:** The thorough understanding of the interplay between geopolitical risks and agricultural commodity markets provided in this paper equips policymakers with the tools needed to ensure market resilience and the broader well-being of the farming economy.

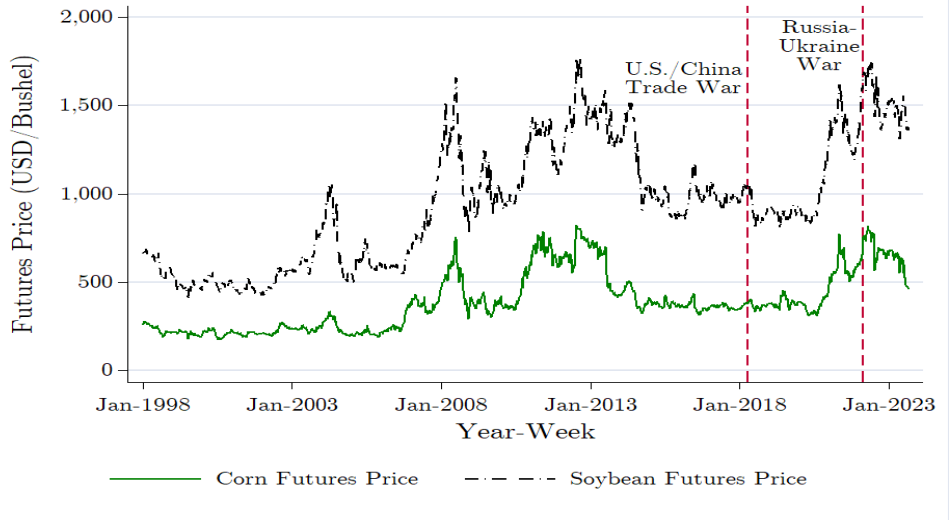
Introduction

- Several studies find the susceptibility of agricultural commodities to adverse geopolitical events.
- For instance, in response to the 25% retaliatory tariff imposed by China on U.S. soybean exports, there was a notable drop in soybean prices at the Gulf export points (Adjemian et al. 2021).
- Therefore, given the anticipated rise in geopolitical risks in frequency and severity, a profound comprehension of their impact on agricultural commodity markets is imperative.
- Understanding the geopolitical-agricultural impact is crucial for agricultural risk management, informing federal policies, and forecasting future price trends in an increasingly uncertain global market environment.

Risk Index and Crop Futures



(a) Geopolitical Risk Index



(b) Corn and Soybean Futures Prices

- The figure shows the geopolitical risk index for U.S. corn and soybean futures prices.
- Panel (a) data suggests a significant surge in geopolitical risk post-2000 marked by an elevated mean GPR index.
- A striking zenith of geopolitical unease was the 09/11 terror attacks, resulting in a GPR index surge by ten times.
- Panel (b)data highlight a parallel movement between the GPR index and agricultural commodity futures post the Second Gulf War and during the Russia-Ukraine conflict.

Conceptual Framework

- Most previous studies focus on the direct relationship between geopolitical risk and agricultural commodity prices.
- Also, there is limited discussion on breaking down the geopolitical-agricultural risk impact into its fundamental drivers.
- We suggest a theoretical framework that accounts for direct and indirect pathways that is indispensable to unpack the complex interplay between geopolitical risks and agricultural commodity prices.
- Instead of exploring uncertainty and macroeconomic transmission pathways that are studied in numerous literature, we introduce five working hypotheses centered on potential micro-economic mechanisms.

Geopolitical Impact Pathways

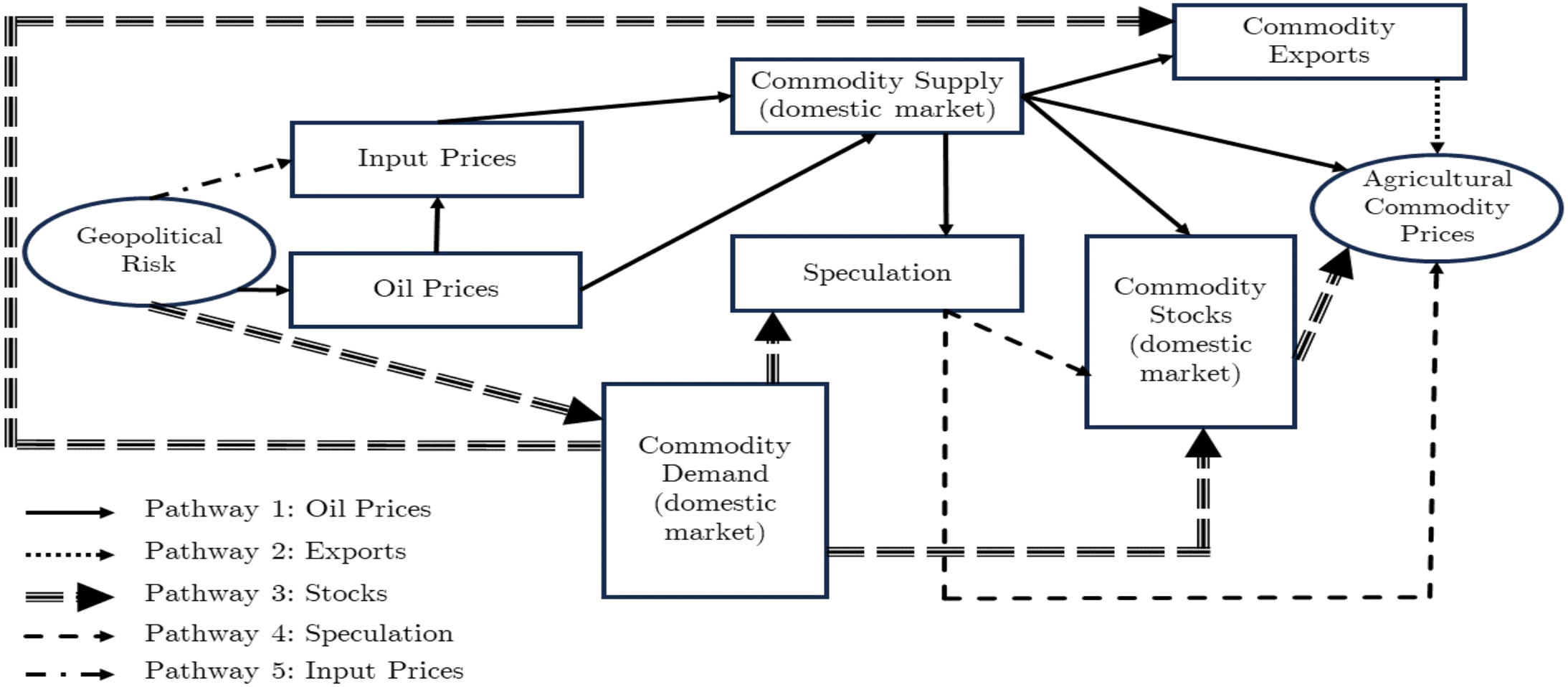


Figure 2: Conceptual Framework linking Geopolitical Risk and Agricultural Commodity Prices

Data

- We use the GPR index from Caldara and Iacoviello (2022), covering the period from 1985 to the present.
- The Working's T-index comes from the weekly Commitments of Traders reports provided by the Chicago Mercantile Exchange (CME).
- For exports, stocks, as well as weekly crude oil, corn, and soybean futures prices, we rely on Bloomberg data.
- Producer price index of inputs (pesticide, fertilizer, and other agricultural chemical manufacturing; farm machinery and equipment manufacturing) are extracted from the Federal Reserve Bank database (FRED).

Summary Statistics

Table A.1: Descriptive Statistics.

Variables (in logs)	Summary Statistics					ADF Test	
	Obs	Mean	SD	Min	Max	Test-stat	p
(a) Log of Commodity Prices							
Corn Futures Price (USD/Bu)	1,331	5.879	0.414	5.163	6.715	-1.963**	0.025
Soybean Futures Price (USD/Bu)	1,331	6.782	0.391	6.025	7.476	-1.665**	0.048
(b) Log of Working T Index							
T Index for Corn	1,331	0.136	0.072	0.027	0.377	-5.593***	0.000
T Index for Soybean	1,331	0.119	0.057	0.023	0.321	-5.408***	0.000
(c) Log of Exports							
Value of Corn Exports (1,000 MT)	1,288	6.406	0.825	-0.916	8.914	-8.254***	0.000
Value of Soybeans Exports (1,000 MT)	1,244	5.883	1.139	-0.223	8.763	-4.918***	0.000
(d) Log of stocks							
Value of Corn Stocks (1,000 Bu)	808	8.547	0.876	5.591	10.330	-5.277***	0.000
Value of soybean Stocks (1,000 Bu)	809	8.513	0.903	4.745	9.920	-5.343***	0.000
(e) Log of Crude Oil Price							
WTI Crude Oil Price (USD/Bbl)	1,331	3.951	0.551	2.379	4.979	-2.387***	0.009
(f) Log of Producer Price Index for Inputs							
Pesticide, Fertilizer, and Other Ag. Chemical Manuf. (Dec 1984=100)	1,331	5.262	0.300	4.799	5.946	-1.294*	0.098
Farm Machinery and Equipment Manufacturing (Dec 1982=100)	1,331	5.207	0.204	4.900	5.661	0.866	0.807
(g) Log of Geopolitical Characteristics							
Geopolitical Risk (GPR) Index (1985-2019 = 100)	1,331	4.658	0.456	2.665	6.952	-7.888***	0.000

Methods

- To assess the impact of geopolitical risk on agricultural commodity markets and test the five hypotheses, the following empirical approach allows us to measure the direct and indirect time varying response to geopolitical risk:

$$Ay_t = F_1 y_{t-1} + \cdots + F_s y_{t-s} + u_t, \qquad t = s+1, \ldots, n \qquad (1)$$

- y_t is a $k \times 1$ vector of dependent variables. F *denotes* $k \times k$ matrix of coefficients. u_t *represents* structural shocks which is distributed normally with mean 0 and standard deviation σ. A is assumed to be a $k \times k$ lower-triangular matrix identifying structural shocks.
- We define A and Σ matrices as:

$$A = \begin{bmatrix} 1 & 0 & \cdots & 0 \\ a_{21} & \ddots & \ddots & \vdots \\ \vdots & \ddots & \ddots & 0 \\ a_{k1} & \cdots & a_{k,k-1} & 1 \end{bmatrix}, \quad \Sigma = \begin{bmatrix} \sigma_1 & 0 & \cdots & 0 \\ 0 & \ddots & \ddots & \vdots \\ \vdots & \ddots & \ddots & 0 \\ 0 & \cdots & 0 & \sigma_k \end{bmatrix} \qquad (2)$$

Methods (Continued…)

- We can rewrite Equation 1 such that we obtain the modified error following a standard normal distribution:

$$y_t = B_1 y_{t-1} + \cdots + B_s y_{t-s} + A^{-1}\Sigma\epsilon_t, \qquad \epsilon_t \sim N(0, I_k) \qquad (3)$$

- Here, $B_i = A^{-1}F_i$.

  X_t: Vector of lagged dependent variables.

  a_t: Stacked vector of elements in matrix A.

  $h_t = (h_{1t}, h_{2t}, \ldots, h_{kt}), h_{jt} = \log \sigma_{jt}^2$

- Introduce time variation in parameters by introducing a t subscript in the β and A coefficients:

$$y_t = X_1\beta_t + A^{-1}\Sigma\epsilon_t \qquad (4)$$

Methods (Continued…)

- Following Nakajima (2011), we assume that all the parameters β_t, a_t , h_t follow a random walk process. The innovations are assumed to follow normal distribution:

$$\begin{pmatrix} \epsilon_t \\ u_{\beta t} \\ u_{at} \\ u_{ht} \end{pmatrix} \sim N\left(0, \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & \Sigma_\beta & 0 & 0 \\ 0 & 0 & \Sigma_a & 0 \\ 0 & 0 & 0 & \Sigma_h \end{bmatrix}\right) \quad (5)$$

Results (Corn)

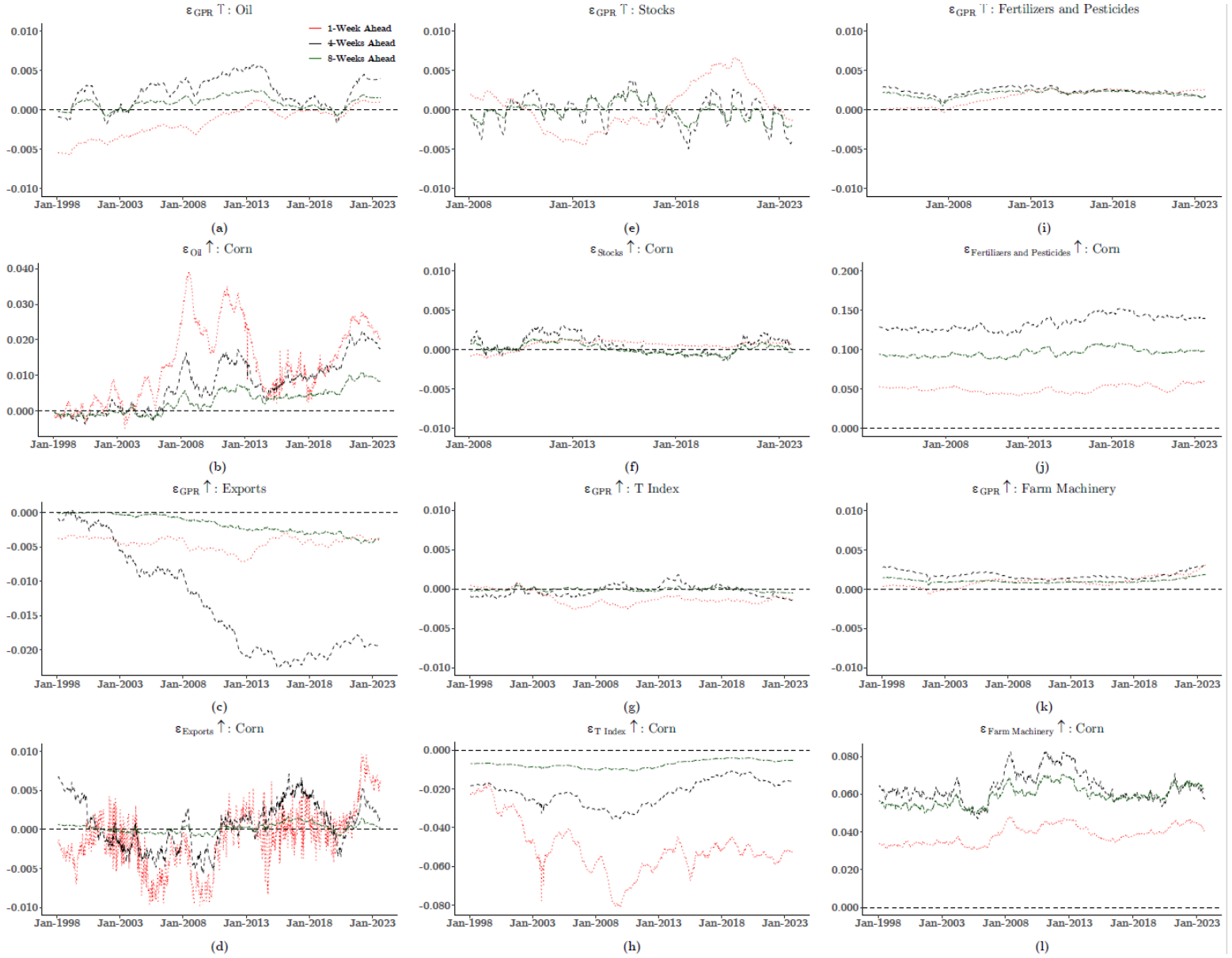
This figure shows the time-varying impulse responses for the different transmission pathways for corn.

The short-term response of oil prices to GPR is negative from 1998 through 2020 and becomes positive from 2020 to 2023.

However, the impact of corn exports on corn futures prices fluctuates up and down, with the impact mostly being positive during the latter half of the sample period.

The overall short-term effect of GPR on stocks is negative before 2018 and becomes positive after that.

Our results show that corn markets react negatively to a positive shock in speculation.



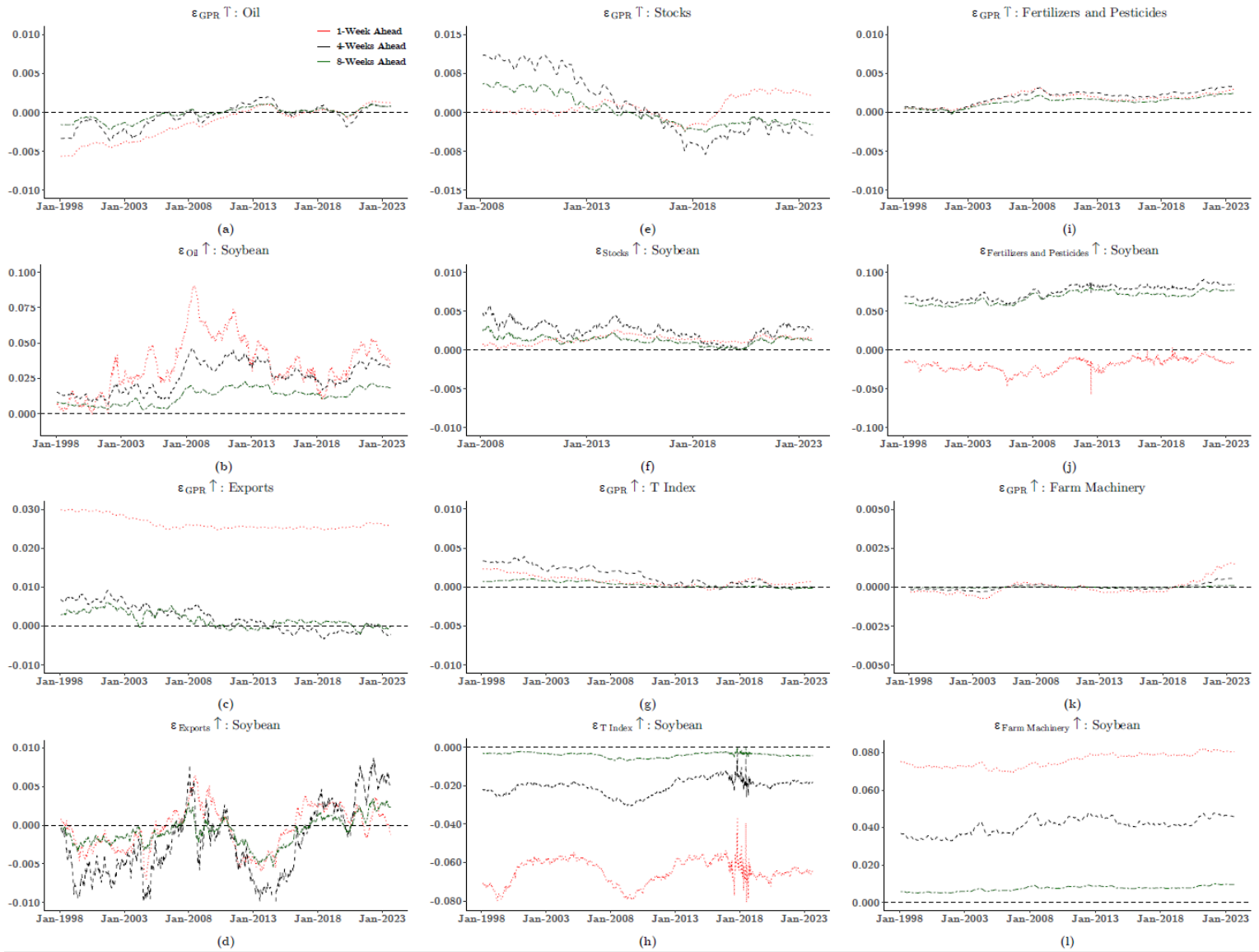
Results (Soybeans)

The figure presents the impulse responses for inputs and soybean prices.

High GPR results in lower oil prices in the short to medium term.

The impact of soybean exports on soybean futures prices fluctuates, displaying both positive and negative effects, with a consistent positive trend observed post-2017.

We witness some transmission of a positive GPR shock to soybean prices via stocks.



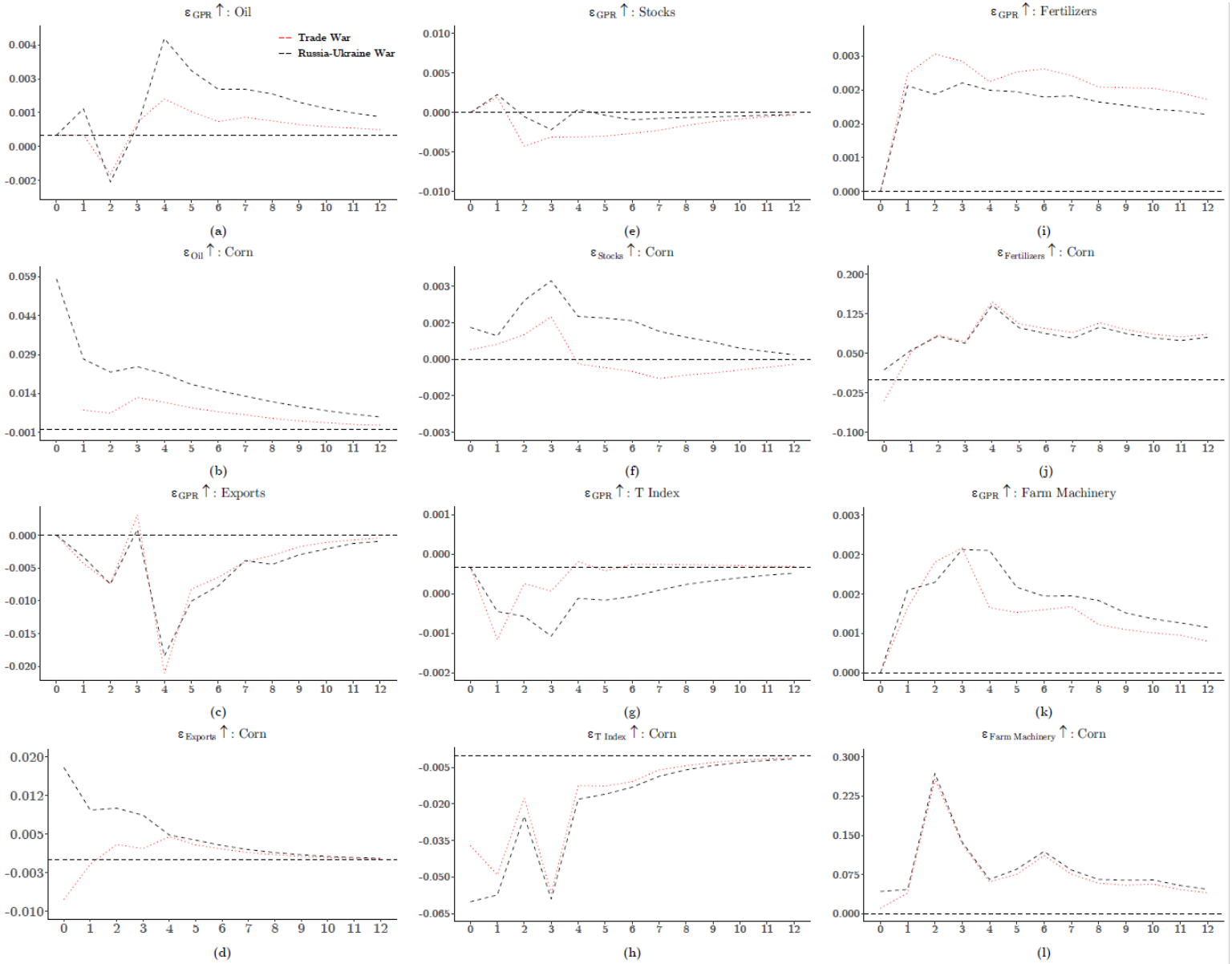
Results (Corn)

The figure show the corn impulse responses for the U.S.- China trade conflict and the Russia-Ukraine war.

We find that elevated oil prices led to higher corn and soybean prices, with the effect dissipating after approximately 12 weeks for corn.

For exports, our findings indicate that the impact of an increase in GPR due to both events is similar for corn.

both events contributed to decreased speculative activity and lower prices in the corn market.



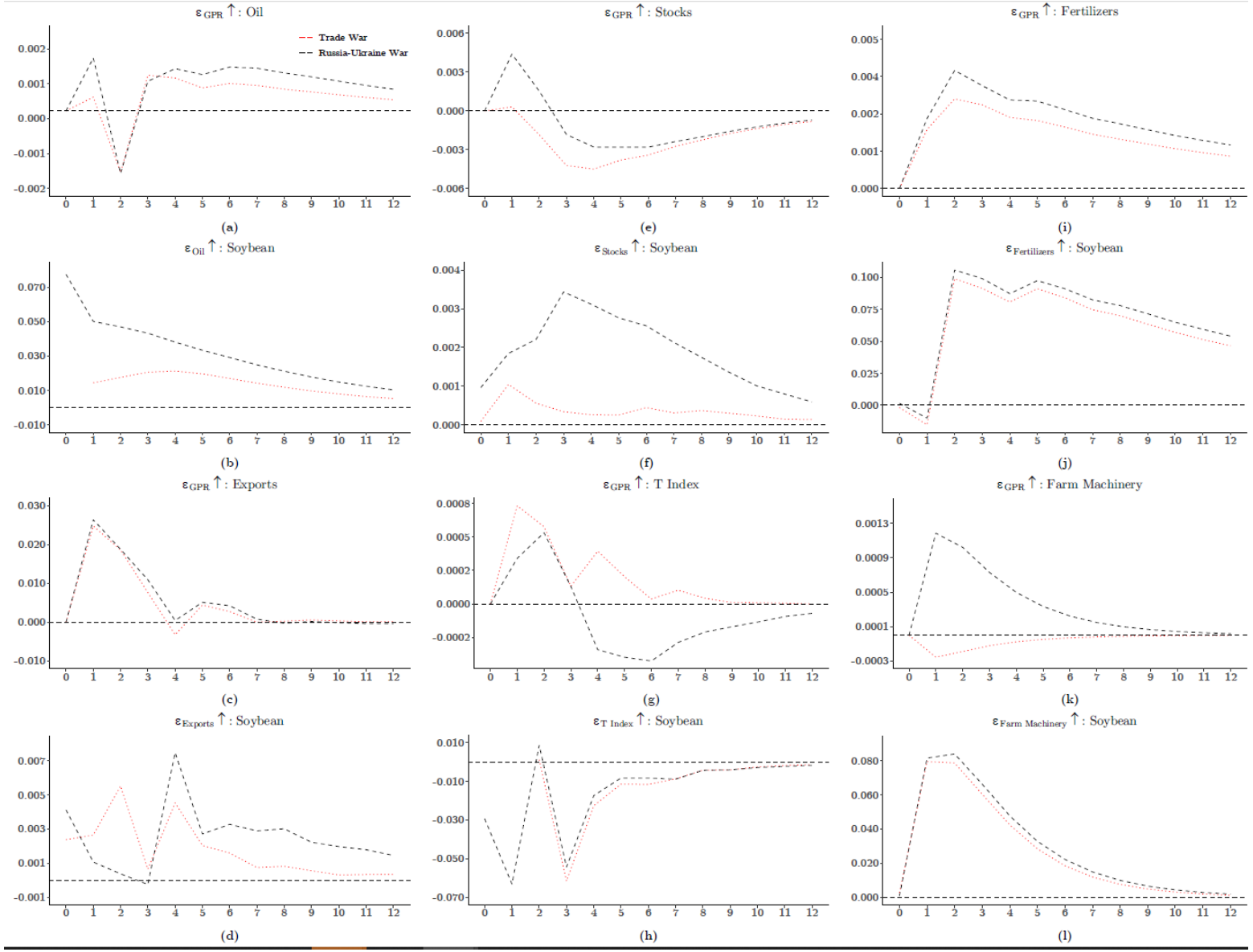
Results (Soybeans)

The figure show the soybean impulse responses for the U.S.- China trade conflict and the Russia-Ukraine war.

We observe similar fluctuations in corn and soybean stocks during the period of Russia-Ukraine tensions.

For soybean, however, during the trade war, stocks responded negatively to a positive geopolitical risk shock.

Given similar fluctuations in the input prices amidst the Russia-Ukraine tensions in 2022 (Jenkins 2022), corn and soybean prices respond similarly



Significance of our Study

- Our analysis offers an in-depth analysis of the critical but under-researched subject of how geopolitical risks influence agricultural commodity markets, specifically corn and soybean futures prices.
- We find that geopolitical risks have a direct and pronounced influence on agricultural commodity prices, not only through immediate shifts in supply and demand but also by modifying market expectations and altering hedging and speculation behaviors.
- Understanding how geopolitical disturbances reverberate through agricultural markets is pivotal for crafting timely and effective policy interventions.
- Our findings underscore the critical need for agricultural stakeholders and policymakers to comprehend how geopolitical events shift market dynamics.
- A nuanced comprehension of agricultural commodity price dynamics is instrumental in anticipating market shifts, crafting informed policy responses, and ensuring the stability and resilience of the agricultural sector amidst geopolitical uncertainties.