Agricultural Commodity Market Response to Russia's Withdrawal from the Grain Deal

Sandro Steinbach and Yasin Yildirim

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IATRC Annual Meeting

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Background

Russian Invasion of Ukraine (24 Feb, 2022 - Ongoing)

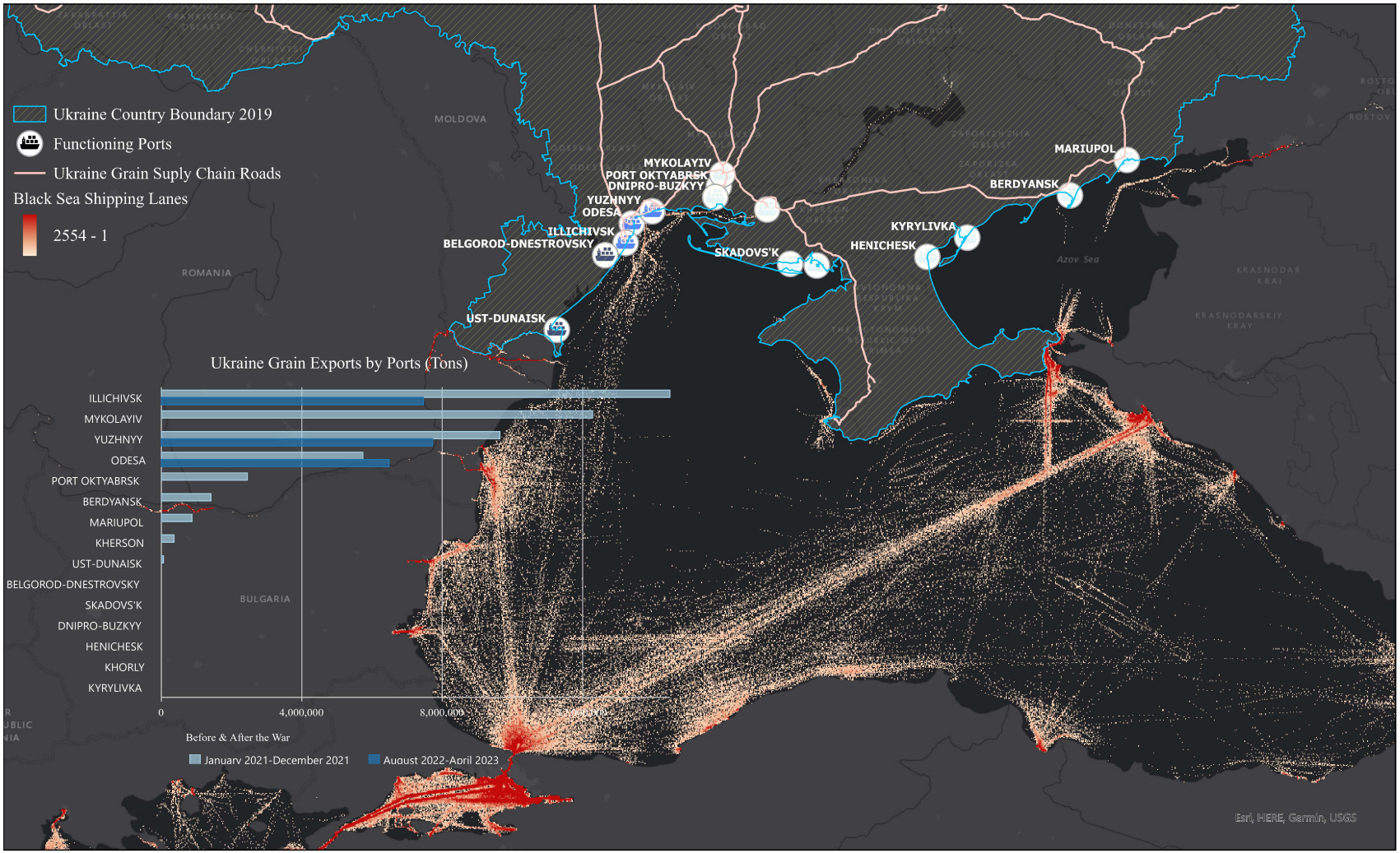
- Leading global financial markets were sharply down yesterday (*Financial Times*, Feb 25, 2022).
- Immediate price impact on energy & commodity markets.
- Russia blockaded Ukraine's Black Sea ports through which 90% of Ukrainan grain shipped
- Ukraine is major player in export of rapeseed (20%), barley (17%), corn (12%), wheat (9%) ..., (USDA, 2023).
- Russia is the world's largest exporter of wheat (20%).

Background

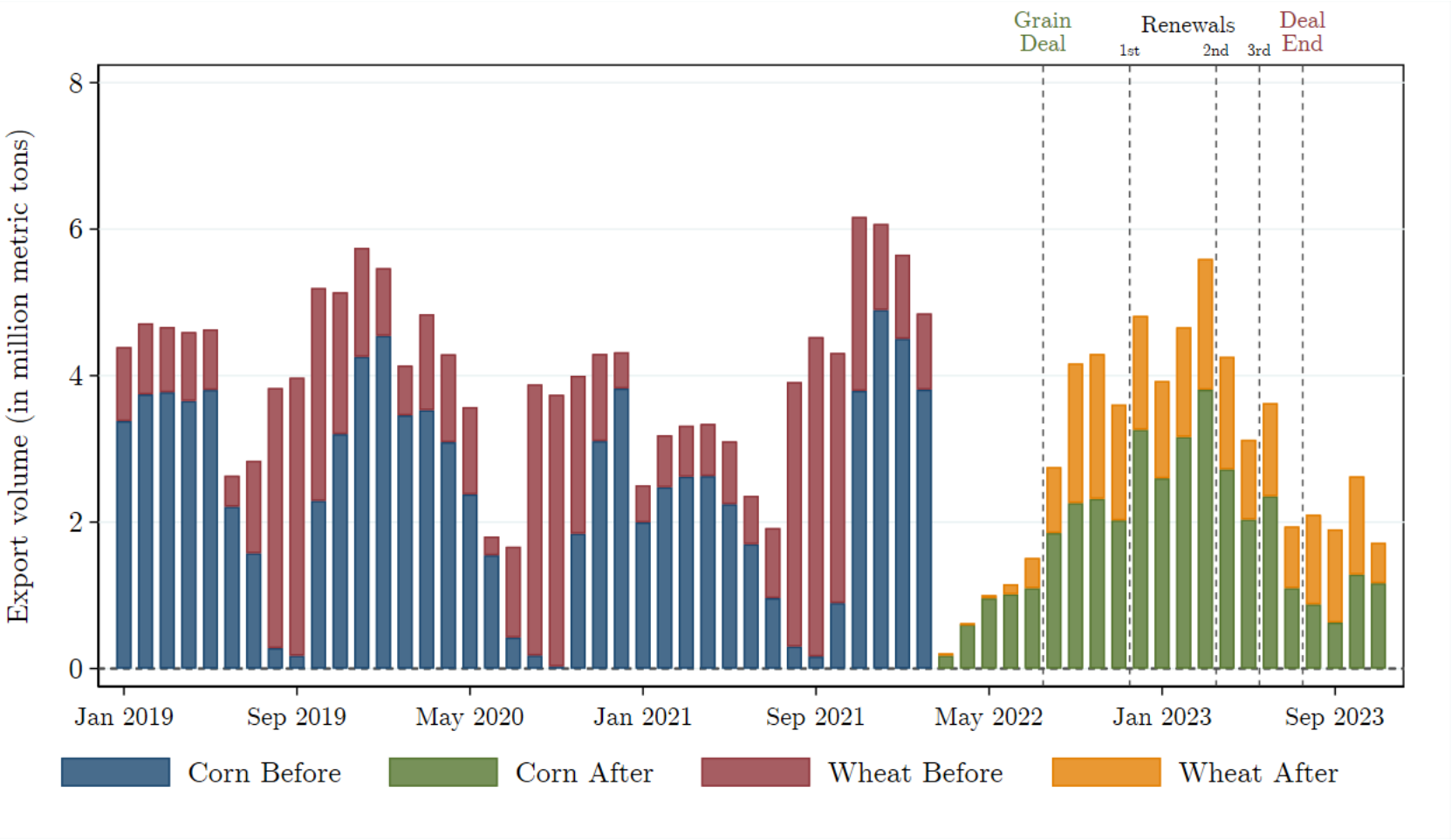
Black Sea Grain Initiative (22 July 2022 – 17 July 2023)

- The first shipment of Ukrainian grain departed from Odesa port on Aug 1st, 2022.
- Renewed three times till the termination.
- Around 33 million metric tons of agricultural products exported through Black Sea under the Grain Deal
- After one-year in operation, the deal was unilaterally terminated by Russia.

Background


Ukraine Country Boundary 2019
Functioning Ports
Ukraine Grain Suply Chain Roads
Black Sea Shipping Lanes
2554 - 1
MOLDOVA
ROMANIA
BULGARIA
MYKOLAYIV
PORT OKTYABRSK
DNIPRO-BUZKYY
YUZHNYY
ODESA
ILLICHIVSK
BELGOROD-DNESTROVSKY
UST-DUNAISK
SKADOVS'K
MARIUPOL
BERDYANSK
KYRYLIVKA
HENICHESK
Azov Sea
KRASNODAR KRAI
KRASNODARSKIY KRAY
Ukraine Grain Exports by Ports (Tons)
ILLICHIVSK
MYKOLAYIV
YUZHNYY
ODESA
PORT OKTYABRSK
BERDYANSK
MARIUPOL
KHERSON
UST-DUNAISK
BELGOROD-DNESTROVSKY
SKADOVS'K
DNIPRO-BUZKYY
HENICHESK
KHORLY
KYRYLIVKA
0
4,000,000
8,000,000
Before & After the War
January 2021-December 2021
August 2022-April 2023
Esri, HERE, Garmin, USGS

Background


Grain Deal
Renewals
1st
2nd
3rd
Deal End
Export volume (in million metric tons)
0
2
4
6
8
Jan 2019
Sep 2019
May 2020
Jan 2021
Sep 2021
May 2022
Jan 2023
Sep 2023
Corn Before
Corn After
Wheat Before
Wheat After

Navigating through the talk

- What have researchers done so far?
- The war offers a natural experiment for testing the market
- We ask the following questions:
  - Did the grain futures market anticipate the shock?
  - What role the Grain Deal play in stabilizing the prices?
  - Did traders behave rationally around the termination week?
- We find traders anticipapted the termination and took their place in a timely manner.
- A limited effect of the deal on the futures prices
- There is no evidence of increased speculative pressure around the termination
- Traders did not perceive the termination as a major risk.

Literature

Grain Futures Prices

speculation: Sanders et al. (2010), Haase, Zimmermann & Zimmermann (2016)

components: Karali & Thurman (2010), Etienne, Irwin & Garcia (2015)

Russia-Ukraine Conflict

global food security: Behnassi & Haiba (2022) Hall (2022) Yatsiv et al. (2023)

global trade effects: Ahn et al. (2023) Steinbach (2023)

volatility in c. markets: Legrand (2022) Wang et al. (2022) Fang & Shao (2022)

impact on stock markets: Sun & Zhang (2022) Boungou & Yatie (2022)

Black Sea Grain Initiative

Carter & Steinbach (2023) Poursina et al. (2023) Goyal & Steinbach (2023)

Objective

Our goal is to evaluate the response of agricultural commodity markets to the termination. We use high-frequency commodity data and event study methods to analyze the impacts on key agricultural commodity market metrics, including futures prices, historical and implied volatility, and speculative pressure.

We offer two significant contributions to the existing literature;

First,
a detailed analysis of commodity markets' immediate responses to the expiration, a newly occurred topic lacking empirical exploration.

Second,
additional measures on the market providing a more nuanced assessment of the war and the BSGI implementation.

Data

Our main analysis focuses on four different metrics of 11 agro-commodities from 2006 to 2023, sourced from Bloomberg(2023);

Daily closing commodity futures prices[1]

Historical volatility computed as the deviation from the average futures price within a 30-day timeframe.

Implied volatility calculated as the average of the daily call and put implied volatilities for 6 agro-commodities [2]

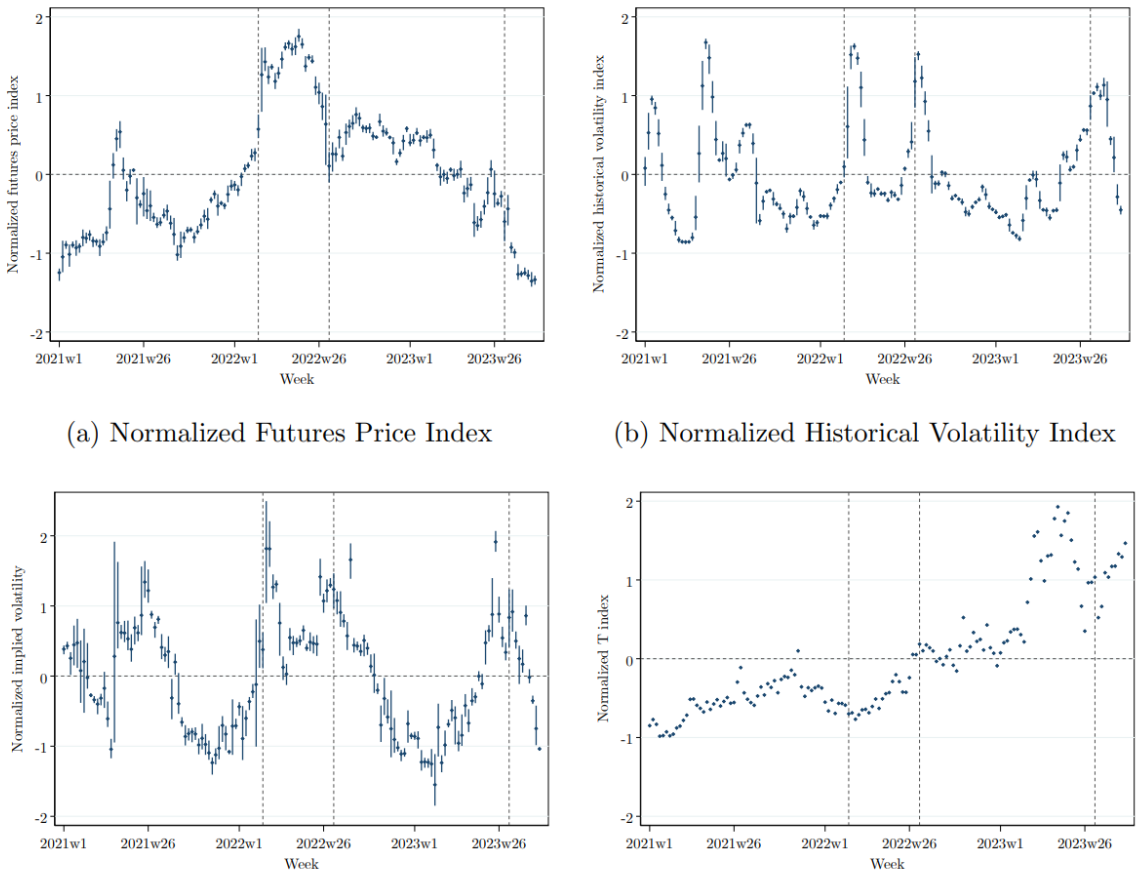
Speculative Pressure measured by constructing Working's T index using the weekly Commitment of Traders reports from the Commodity Futures Trading Commission (2023)[3]

[1] A continuous price series was created by rolling over contracts on the last trading day.

[2] Based on the data availability

[3] T = 1 + (n-c. shorts) / (c. longs + c. shorts) **or** 1 + (n-c. longs) / (c. longs + c. shorts) **if** c. longs greater than c. short

Data



(a) Normalized Futures Price Index

(b) Normalized Historical Volatility Index

(c) Normalized Implied Volatility Index

(d) Normalized Speculative Pressure Index

Figure 1: Futures Price, Historical and Implied Volatility, and Speculative Pressure Indexes. [4]

[4] normalized by subtracting the mean of the measure and dividing it by the standard deviation between 2021 and 2023. This way, each measure has a mean of 0 and a standard deviation of 1. The presented indexes represent the global weighted average of all series. We used average global production at the commodity level averaged for 2017 to 2021 as analytical weights (USDA 2023).

Data

Table A.2: Descriptive Comparison of Futures Prices.

	Before the Event			After the Event		
	2022w8	2022w29	2023w29	2022w8	2022w29	2023w29
Barley	2,245.14	3,166.68	1,953.14	2,515.24	3,059.84	1,926.57
	(208.00)	(22.78)	(67.11)	(547.90)	(50.30)	(68.69)
→ Canola	1,019.43	1,086.34	718.42	1,132.10	822.57	795.74
	(24.78)	(108.65)	(44.14)	(43.29)	(24.98)	(29.74)
Corn	615.54	763.69	595.62	754.56	647.77	489.72
	(20.43)	(21.31)	(29.30)	(35.48)	(40.07)	(29.07)
→ Rapeseed Meal	3,139.91	3,664.14	3,430.58	4,000.90	3,534.81	3,912.89
	(198.53)	(149.78)	(353.50)	(226.81)	(258.57)	(204.99)
→ Rapeseed	739.70	776.32	430.08	926.78	622.25	459.02
	(38.91)	(59.12)	(25.52)	(93.53)	(26.69)	(17.66)
Rice	14.58	16.74	17.86	15.90	17.20	15.92
	(0.48)	(0.52)	(0.77)	(0.39)	(0.30)	(0.38)
Soybeans	1,426.02	1,683.09	1,413.23	1,675.59	1,523.11	1,403.86
	(101.85)	(50.17)	(81.94)	(38.73)	(70.16)	(70.51)
→ Soybean Oil	60.46	76.44	55.68	76.52	67.72	66.10
	(4.18)	(7.39)	(8.09)	(5.01)	(3.46)	(2.65)
Sunflower	10739.67	10706.68	8,489.53	11058.38	10591.05	9,141.47
	(735.67)	(229.95)	(290.09)	(685.50)	(388.51)	(157.77)
→ Vegetable Oil	28.25	28.68	25.57	28.61	28.97	24.10
	(0.51)	(0.48)	(0.32)	(0.63)	(1.01)	(1.11)
Wheat	780.58	1,050.91	641.18	1,081.96	810.76	627.48
	(19.24)	(134.97)	(36.27)	(111.01)	(41.24)	(57.69)

Note. The table compares the mean and standard deviation (reported in brackets) of the futures price nine weeks before and after the event. 2022w8 indicates the Russian invasion of Ukraine, 2022w29 the BSGI enforcement, and 2023w29 the BSGI termination.

Data

Table A.3: Descriptive Comparison of Historical Volatility.

	Before the Event			After the Event		
	2022w8	2022w29	2023w29	2022w8	2022w29	2023w29
Barley	958.35	322.39	750.44	2,692.98	458.52	371.97
	(1,052.03)	(104.59)	(163.03)	(2,406.62)	(125.83)	(235.80)
Canola	259.43	532.22	421.65	418.16	474.18	376.78
	(59.71)	(398.25)	(111.13)	(163.28)	(294.69)	(128.47)
Corn	146.82	242.83	374.42	431.02	588.84	408.04
	(35.97)	(52.98)	(54.36)	(148.77)	(248.43)	(149.73)
Rapeseed Meal	1,675.70	2,225.66	1,969.23	2,785.80	1,684.12	2,246.81
	(343.11)	(562.59)	(1,009.93)	(717.15)	(1,004.20)	(935.78)
Rapeseed	427.07	846.41	267.02	786.45	308.62	218.64
	(92.84)	(310.59)	(32.08)	(295.01)	(90.05)	(28.37)
Rice	4.40	5.14	7.41	4.22	3.98	10.67
	(0.54)	(0.80)	(1.17)	(0.87)	(0.96)	(5.05)
Soybeans	651.39	435.24	782.32	718.80	943.87	620.71
	(236.49)	(83.25)	(159.71)	(284.98)	(74.66)	(158.43)
Soybean Oil	32.23	55.23	46.75	55.46	48.49	37.85
	(6.18)	(13.88)	(22.51)	(12.99)	(22.32)	(22.06)
Sunflower	4,205.99	2,740.64	2,382.76	9,559.91	3,397.15	2,841.75
	(1,825.89)	(485.87)	(561.89)	(2,554.94)	(1,305.69)	(1,201.27)
Vegetable Oil	5.07	7.13	3.89	6.49	8.75	7.59
	(1.13)	(1.07)	(0.26)	(1.13)	(2.02)	(4.13)
Wheat	255.75	878.61	369.05	1,519.95	533.31	514.84
	(33.82)	(219.61)	(119.74)	(813.59)	(378.84)	(94.72)

Note. The table compares the mean and standard deviation (reported in brackets) of the historical volatility nine weeks before and after the event. 2022w8 indicates the Russian invasion of Ukraine, 2022w29 the BSGI enforcement, and 2023w29 the BSGI termination.

Data

Table A.4: Descriptive Comparison of Implied Volatility.

	Before the Event			After the Event		
	2022w8	2022w29	2023w29	2022w8	2022w29	2023w29
Canola	20.18	30.88	24.13	28.05	33.63	29.34
	(1.80)	(1.76)	(1.46)	(3.11)	(2.52)	(6.16)
Corn	25.11	34.35	31.70	36.07	33.18	29.40
	(3.47)	(6.15)	(5.58)	(7.67)	(5.44)	(5.81)
Rice	13.71	19.90	23.73	15.51	17.88	17.42
	(2.72)	(2.62)	(8.81)	(2.75)	(1.68)	(2.34)
Soybeans	22.61	24.59	23.19	24.06	28.34	22.43
	(3.57)	(5.12)	(6.73)	(2.96)	(4.29)	(3.63)
Soybean Oil	30.74	36.60	41.05	35.28	39.16	36.15
	(2.29)	(7.05)	(6.86)	(3.96)	(7.49)	(5.94)
Wheat	30.75	42.27	36.91	52.91	42.56	39.36
	(6.60)	(4.96)	(5.46)	(15.09)	(4.37)	(7.19)

Note. The table compares the mean and standard deviation (reported in brackets) of the implied volatility nine weeks before and after the event. 2022w8 indicates the Russian invasion of Ukraine, 2022w29 the BSGI enforcement, and 2023w29 the BSGI termination.

Data

Table A.5: Descriptive Comparison of Speculative Pressure.

	Before the Event			After the Event		
	2022w8	2022w29	2023w29	2022w8	2022w29	2023w29
Canola	1.04	1.07	1.09	1.04	1.03	1.11
	(0.01)	(0.01)	(0.02)	(0.01)	(0.01)	(0.01)
Corn	1.05	1.08	1.21	1.04	1.09	1.22
	(0.00)	(0.01)	(0.03)	(0.00)	(0.01)	(0.02)
Rice	1.11	1.14	1.07	1.12	1.13	1.05
	(0.03)	(0.02)	(0.03)	(0.01)	(0.02)	(0.01)
Soybeans	1.05	1.06	1.13	1.05	1.09	1.09
	(0.01)	(0.01)	(0.02)	(0.00)	(0.01)	(0.01)
Soybean Oil	1.09	1.07	1.11	1.04	1.07	1.09
	(0.01)	(0.01)	(0.03)	(0.01)	(0.01)	(0.01)
Wheat	1.35	1.34	1.47	1.34	1.39	1.48
	(0.01)	(0.02)	(0.05)	(0.01)	(0.01)	(0.04)

Note. The table compares the mean and standard deviation (reported in brackets) of the speculative pressure nine weeks before and after the event. 2022w8 indicates the Russian invasion of Ukraine, 2022w29 the BSGI enforcement, and 2023w29 the BSGI termination.

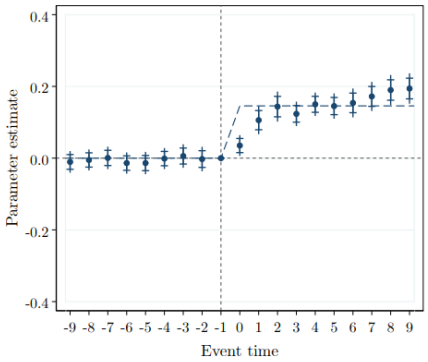
Method

- We use the following log-linear panel regression model:

$$y_{c,t} = \nu_{c,dy} + \phi_{c,wk} + \psi_{c,yr} + \sum_{r \neq 0} \mathbb{1}\{R_{c,t} = r\} \beta_r + \epsilon_{c,t} \quad (1)$$

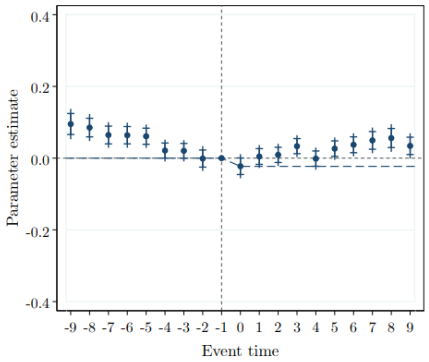
- where $y_{c,t}$ is the price, implied/historical volatility, or spec pressure.
- Fixed effects: day of week ($\nu_{c,dy}$), week ($\phi_{c,wk}$), controls for seasonality & event year (ψ_{cy}), controls for unobserved market shifts.
- central identifying assumption is that treatment timing is independent of the error $\epsilon_{c,t}$, conditional on the fixed effects.
- $\sum_{r \neq 0} \mathbb{1}\{R_{c,t} = r\} \beta_r$ measures the dynamic response to the invasion.
- time relative to treatment is $R_{c,t}$ & event window is +/- 9 weeks.

Results



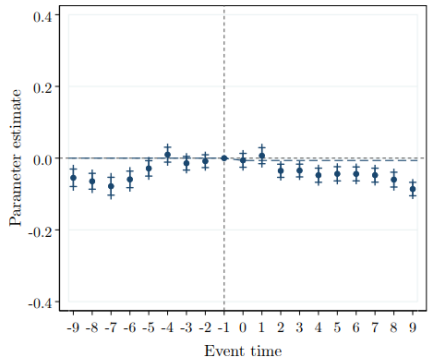
Pre-trends p-value: 0.538 -- Leveling off p-value: 0.812 -- Static effect p-value: 0.000
Adjusted R-squared: 0.999 -- Observations: 8,432

(a) Futures Price, Russian Invasion of Ukraine (Week 8, 2022)



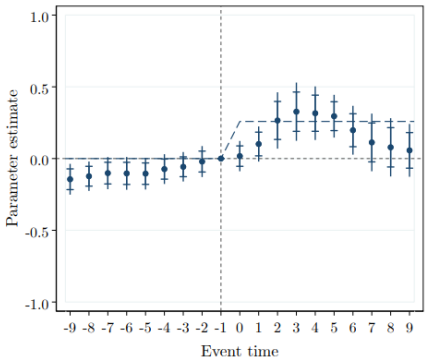
Pre-trends p-value: 0.000 -- Leveling off p-value: 0.116 -- Static effect p-value: 0.000
Adjusted R-squared: 0.999 -- Observations: 7,923

(b) Futures Price, BSGI Enforcement (Week 29, 2022)



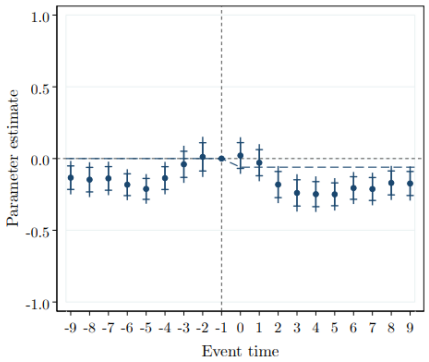
Pre-trends p-value: 0.000 -- Leveling off p-value: 0.017 -- Static effect p-value: 0.115
Adjusted R-squared: 0.999 -- Observations: 8,503

(c) Futures Price, BSGI Termination (Week 29, 2023)



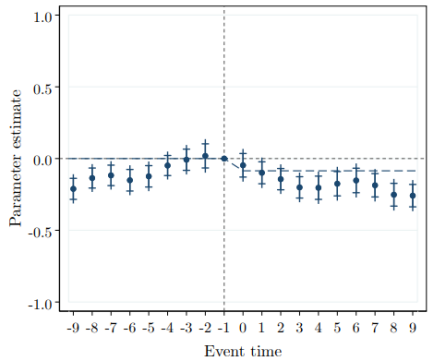
Pre-trends p-value: 0.001 -- Leveling off p-value: 0.805 -- Static effect p-value: 0.000
Adjusted R-squared: 0.541 -- Observations: 9,193

(d) Historical Volatility, Russian Invasion of Ukraine (Week 8, 2022)



Pre-trends p-value: 0.001 -- Leveling off p-value: 0.912 -- Static effect p-value: 0.000
Adjusted R-squared: 0.545 -- Observations: 8,902

(e) Historical Volatility, BSGI Enforcement (Week 29, 2022)



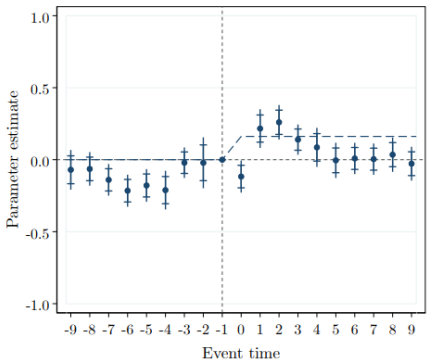
Pre-trends p-value: 0.003 -- Leveling off p-value: 0.852 -- Static effect p-value: 0.000
Adjusted R-squared: 0.569 -- Observations: 8,572

(f) Historical Volatility, BSGI Termination (Week 29, 2023)

Figure 2: Event Studies for Futures Price and Historical Volatility.

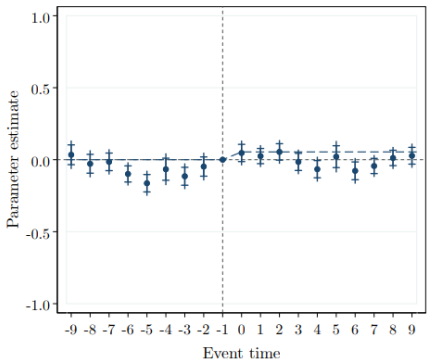
Note. The figure shows the dynamic treatment parameters, 95 percent confidence intervals, and uniform sup-t bands for the event-time coefficients. The event time is measured in weeks relative to the treatment. We report several Wald tests and regression statistics in the figure notes. We used a log-linear regression specification and included commodity-event-day, commodity-event-week, and commodity-event-year fixed effects in each regression.

Results



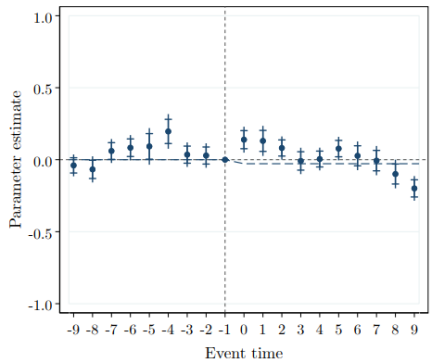
Pre-trends p-value: 0.001 -- Leveling off p-value: 0.120 -- Static effect p-value: 0.000
Adjusted R-squared: 0.651 -- Observations: 4,908

(a) Implied Volatility, Russian Invasion of Ukraine (Week 8, 2022)



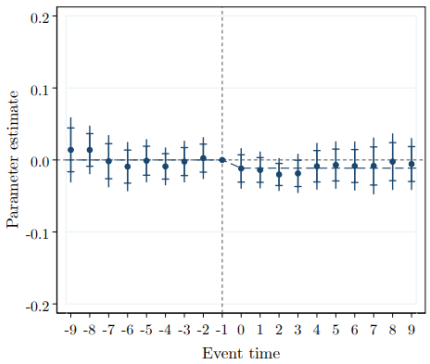
Pre-trends p-value: 0.010 -- Leveling off p-value: 0.524 -- Static effect p-value: 0.000
Adjusted R-squared: 0.748 -- Observations: 4,797

(b) Implied Volatility, BSGI Enforcement (Week 29, 2022)



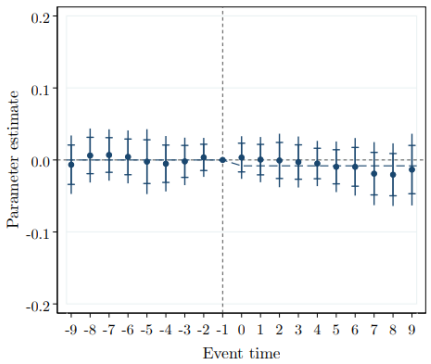
Pre-trends p-value: 0.046 -- Leveling off p-value: 0.003 -- Static effect p-value: 0.032
Adjusted R-squared: 0.825 -- Observations: 5,354

(c) Implied Volatility, BSGI Termination (Week 29, 2023)



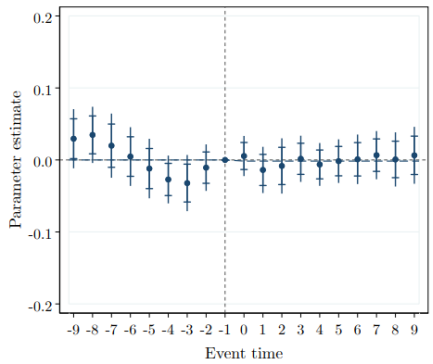
Pre-trends p-value: 0.903 -- Leveling off p-value: 0.835 -- Static effect p-value: 0.009
Adjusted R-squared: 0.902 -- Observations: 957

(d) Speculative Pressure, Russian Invasion of Ukraine (Week 8, 2022)



Pre-trends p-value: 0.948 -- Leveling off p-value: 0.721 -- Static effect p-value: 0.084
Adjusted R-squared: 0.868 -- Observations: 836

(e) Speculative Pressure, BSGI Enforcement (Week 29, 2022)



Pre-trends p-value: 0.921 -- Leveling off p-value: 0.706 -- Static effect p-value: 0.769
Adjusted R-squared: 0.865 -- Observations: 950

(f) Speculative Pressure, BSGI Termination (Week 29, 2023)

Figure 3: Event Studies for Implied Volatility and Speculative Pressure.

Note. The figure shows the dynamic treatment parameters, 95 percent confidence intervals, and uniform sup-t bands for the event-time coefficients. The event time is measured in weeks relative to the treatment. We report several Wald tests and regression statistics in the figure notes. We used a log-linear regression specification and included commodity-event-day, commodity-event-week, and commodity-event-year fixed effects in each regression.

Results

Table 1: Average Post-Event Treatment Effects for Futures Price and Historical Volatility.

	Futures Price			Historical Volatility		
	2022w8	2022w29	2023w29	2022w8	2022w29	2023w29
Panel (a): Aggregated Level						
Post-average	0.141***	0.023**	-0.044***	0.177***	-0.154***	-0.172***
	(0.008)	(0.009)	(0.007)	(0.032)	(0.033)	(0.033)
Adjusted R-squared	0.999	0.999	0.999	0.688	0.592	0.610
Observations	8,432	7,923	8,503	9,193	8,806	8,572
Panel (b): Commodity Level						
Barley	0.241***	-0.063***	0.027***	0.605***	-0.045	-0.110***
	(0.008)	(0.008)	(0.005)	(0.106)	(0.028)	(0.016)
Canola	0.106***	-0.003	0.034**	0.101***	-0.688***	-0.146***
	(0.007)	(0.015)	(0.016)	(0.014)	(0.032)	(0.023)
Corn	0.122***	-0.011	-0.077***	0.222***	0.488***	-0.044
	(0.007)	(0.042)	(0.021)	(0.025)	(0.072)	(0.051)
Rapeseed meal	0.124***	0.047***	-0.021	-0.067***	-0.081***	-0.671***
	(0.006)	(0.018)	(0.026)	(0.025)	(0.029)	(0.062)
Rapeseed	0.294***	-0.043***	-0.027***	0.169***	-0.358***	-0.127***
	(0.007)	(0.010)	(0.009)	(0.019)	(0.014)	(0.028)
Rice	0.042***	0.087***	-0.205***	-0.061***	-0.104***	0.136***
	(0.006)	(0.015)	(0.015)	(0.018)	(0.026)	(0.039)
Soybeans	0.039***	0.019	-0.026***	-0.283***	0.178***	-0.285***
	(0.007)	(0.019)	(0.008)	(0.031)	(0.039)	(0.027)
Soybean oil	0.107***	0.153***	-0.040***	0.114***	-0.525***	-0.957***
	(0.008)	(0.018)	(0.012)	(0.020)	(0.045)	(0.035)
Sunflowers	0.176***	0.023**	-0.026***	0.038	-0.093***	-0.154***
	(0.010)	(0.010)	(0.009)	(0.030)	(0.023)	(0.024)
Vegetable oil	-0.017	0.039***	-0.055***	-0.010	-0.015	0.110***
	(0.012)	(0.006)	(0.006)	(0.035)	(0.068)	(0.036)
Wheat	0.309***	0.015	-0.019	1.053***	-0.469***	0.271***
	(0.011)	(0.017)	(0.012)	(0.034)	(0.034)	(0.040)
Adjusted R-squared	0.999	0.999	0.999	0.688	0.590	0.610
Observations	8,432	7,923	8,503	9,193	8,727	8,572

Results

Table 2: Average Post-Event Treatment Effects for Implied Volatility and Speculative Pressure.

	Implied Volatility			Speculative Pressure		
	2022w8	2022w29	2023w29	2022w8	2022w29	2023w29
Panel (a): Aggregate Level						
Post-average	0.060*	-0.002	0.015	-0.010***	-0.008**	-0.001
	(0.033)	(0.024)	(0.024)	(0.003)	(0.003)	(0.003)
Adjusted R-squared	0.652	0.752	0.831	0.892	0.852	0.850
Observations	4,908	4,797	5,354	957	836	950
Panel (b): Commodity Level						
Canola	0.311***	0.069***	0.045*	-0.009	-0.014	0.002
	(0.041)	(0.023)	(0.027)	(0.012)	(0.021)	(0.021)
Corn	-0.153**	-0.115***	0.040	-0.015	-0.030*	-0.032**
	(0.065)	(0.026)	(0.026)	(0.013)	(0.018)	(0.015)
Rice	0.134***	0.201***	0.264***	0.010	-0.045***	0.003
	(0.041)	(0.049)	(0.028)	(0.010)	(0.014)	(0.009)
Soybeans	-0.201***	0.041	-0.168***	0.009	0.004	-0.019
	(0.056)	(0.031)	(0.041)	(0.013)	(0.009)	(0.012)
Soybean oil	0.096**	-0.208***	-0.202***	-0.053***	0.002	0.007
	(0.037)	(0.038)	(0.028)	(0.017)	(0.012)	(0.015)
Wheat	0.173**	0.001	0.115***	-0.005	0.036**	0.037**
	(0.088)	(0.028)	(0.020)	(0.009)	(0.017)	(0.018)
Adjusted R-squared	0.652	0.752	0.831	0.892	0.852	0.850
Observations	4,908	4,797	5,354	957	836	950

Note. The table shows average post-event treatment effects for implied volatility and speculative pressure. 2022w8 indicates the Russian invasion of Ukraine, 2022w29 the BSGI enforcement, and 2023w29 the BSGI termination. All regressions include commodity-event-day, commodity-event-week, and commodity-event-year fixed effects. Heteroskedasticity-robust standard errors clustered at the commodity level are reported in parenthesis. ***, **, and * indicate statistical significance at the 1 percent, 5 percent, and 10 percent confidence levels, respectively.

Conclusion

- a **6.2% increase** in the f.prices before the announcement of termination, and a subsequent decline returning to pre-termination levels.
- **No** heightened **speculation** around the termination, although responses differ across agri-commodities.
- Market participants did **not** see the threat to stop Black Sea grain shipments as **credible,** likely (mainly) because of the EU Solidarity Lanes.
- **Limited** impact of the deal in changing the perceptions of agricultural trade regarding market uncertainty caused by the Russia-Ukraine conflict.