

Global Trade Reallocation and Welfare Implications of the Russia-Ukraine War for Cereal Grains and Oilseeds

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- **Ukrainian grains appear to exhibit a lower degree of substitutability** compared to Ukrainian oilseeds.

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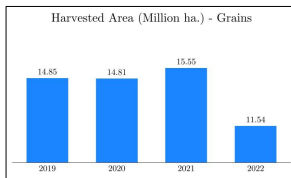
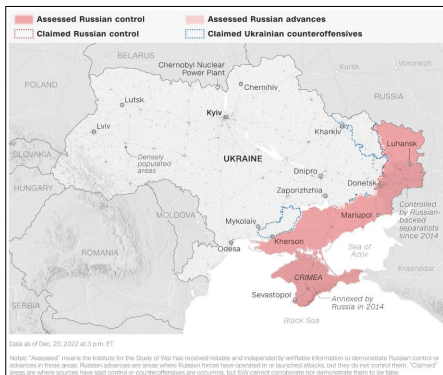
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- **Since 2014, Russia controls Crimea** and supports pro-Russian separatist forces who took control of parts of the Donetsk and Luhansk regions of eastern Ukraine (the Donbas).

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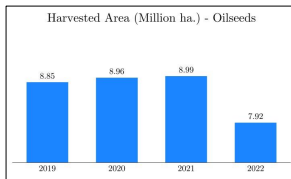
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- **More than 55% of Ukraine's land area is arable land**, and agriculture provides employment for 14% of its population (USDA 2022).



↓
**22-25%
lower in
2023**



↓
**11-12%
lower in
2023**

Note. The map of Ukrainian land controlled by Russia is taken from CNN (2023). Harvested area statistics is taken from FAO (2024). Grains include: Barley, Buckwheat, Maize (corn), Oats, Rice, Rye, Sorghum, and Wheat. Oilseeds include: Flax, raw or retted, Rape or colza seed, Soya beans, and Sunflower seed

Research Questions

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- ① What are the **implications of the Russia-Ukraine war on the global international market for grains and oilseeds?**
- ② **Who are the winners and losers** resulting from the adjustments in the global international market due to the Russia-Ukraine war? - (*Welfare analysis pending*)

Contribution

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- **Ahn, Kim, and Steinbach (2023)** use a **commodity-level empirical model** to assess the counterfactual trade effects and evaluate trade reallocation effects of the conflict.

Contribution

- A growing body of literature explores the economic **consequences of the Russia-Ukraine war**.
- **Steinbach (2023) uses a product-level empirical model** to examine trade re-allocations as a result of the Russia-Ukraine war.
- **Ahn, Kim, and Steinbach (2023) use a commodity-level empirical model** to assess the counterfactual trade effects and evaluate trade reallocation effects of the conflict.
- We assess the implications of the Russia-Ukraine conflict on the global markets of grains and oilseeds, **focusing on major importers and exporters**.
- We employ a gravity framework as outlined by Ridley and Devadoss (2023), which, in turn, builds upon the **General Equilibrium PPML (GEPPL)** estimator developed by Anderson, Larch, and Yotov (2018).

Data

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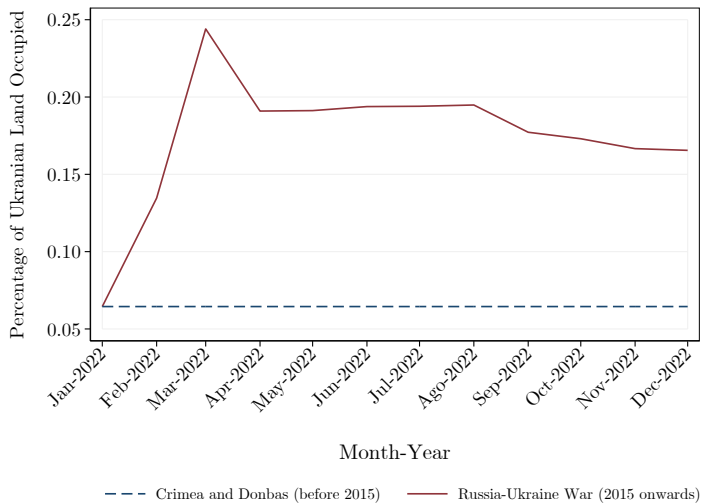
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- The data covers flows between more than **190 countries and 2,000 commodities** at the HS6 level.
- We use the classification of food imports from the USDA ERS (2023) to identify two groups of goods: **Grains**, and **Oilseeds**.
- We also obtain the **monthly area of Ukrainian land occupied by Russia in 2022** (excluding Crimea and the Donbas) from the French Newspaper Le Monde (2023).

◀ Details

Percentage of Ukrainian Land Occupied by Russia



Note. The percentage of Ukrainian land occupied by Russia was taken from Le Monde (2023).

Gravity Framework

- Following Anderson and Wincoop (2003) and Olivero and Yotov (2012), we depict trade flows from exporter i to importer j in month t like:

$$X_{ijt} = \frac{Y_{it}E_{jt}}{Y_t} \left(\frac{\varphi_{ijt}}{\Pi_{it}P_{jt}} \right)^{1-\sigma} \quad (1)$$

where X_{ijt} is an import flow measured in million tonnes (t).

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- Π_{it} and P_{jt} are the multilateral resistance terms, and $\sigma > 1$ is the elasticity of substitution.

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Following Ridley and Devadoss (2023), we propose a three-way structural gravity model

$$\begin{aligned} X_{ijt} = \exp \left(\alpha_0 + \alpha_1 PTA_{ijt} \right. \\ + \sum_{j \in J} \beta_j^{ukr} \mathbb{1}\{\text{Exp} = \text{UKR}\} \times \mathbb{1}\{\text{Imp} = j\} \times \ln(\text{OccLandUkr}_t + 1) \\ + \sum_{j \in J} \beta_j^{rus} \mathbb{1}\{\text{Exp} = \text{RUS}\} \times \mathbb{1}\{\text{Imp} = j\} \times \ln(\text{OccLandUkr}_t + 1) \quad (2) \\ + \dots \\ \left. + \zeta_{it} + \eta_{jt} + \theta_{ij} \right) + \varepsilon_{ijt}. \end{aligned}$$

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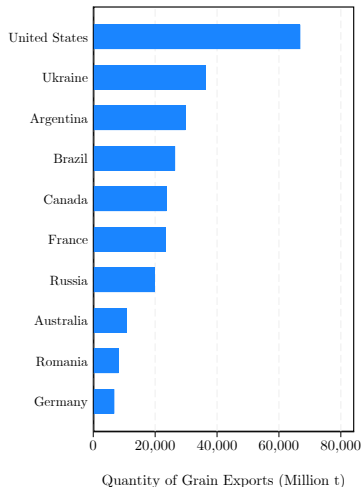
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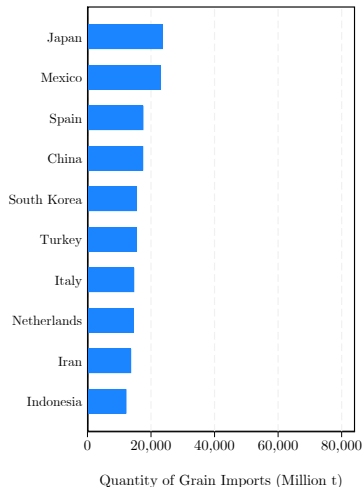
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- We repeat the interactions for **eight additional exporters**.

Major Exporters and Importers of Grains in 2019



(a) Major Exporters of Grains.



(b) Major Importers of Grains.

Note. The values are expressed in millions of tonnes (t).

PPML Gravity Regression Coefficient Estimates - Grains

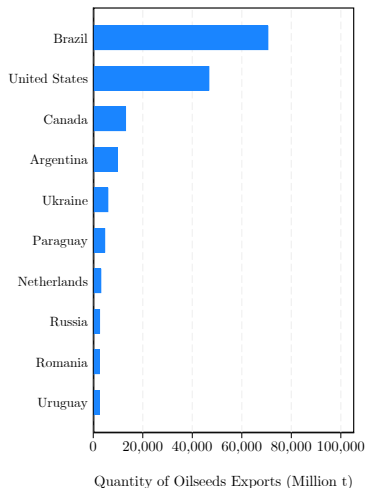
Major Importers of Grains

	JPN	MEX	ESP	CHN	KOR	TUR	ITA	NLD	IRN	IDN	TOTAL
USA	0.02	0.03	0.09	0.10	-0.04	-0.15	-0.06	0.02	-1.42	-0.02	0.06
UKR*	-0.14	-1.60	0.06	-0.00	0.01	0.16	-0.01	-0.02	-1.63	-0.18	0.01
ARG	0.02	-0.02	0.01	0.11	0.02	0.11	-0.14	-0.04	-1.20	-0.00	0.06
BRA	-0.04	-0.02	0.03	-0.12	-0.08	0.21	0.08	-0.00	-0.14	-0.04	-0.01
CAN	0.00	-0.14	0.06	0.01	-0.01	-0.27	-0.05	-0.05	-0.26	-0.02	-0.00
FRA	-0.03	-0.55	-0.01	-0.03	-0.30	0.09	-0.04	-0.02	-0.34	-1.09	-0.03
RUS*	-0.17	-1.66	0.06	0.07	-0.11	0.08	-0.09	-0.46	0.04	-0.21	0.01
AUS	-0.05	-1.62	0.14	-0.04	-0.06	0.22	-0.12	0.33	-1.38	-0.05	-0.03
ROU	-1.51	-0.44	-0.02	-0.28	0.03	-0.03	-0.02	-0.04	-1.44	-1.34	-0.03
DEU	-0.14	-0.85	-0.00	-0.05	0.13	0.09	-0.04	0.02	0.03	-0.36	0.01
TOTAL	-0.02	0.00	0.03	0.03	-0.03	0.09	-0.03	-0.00	0.01	-0.03	0.01

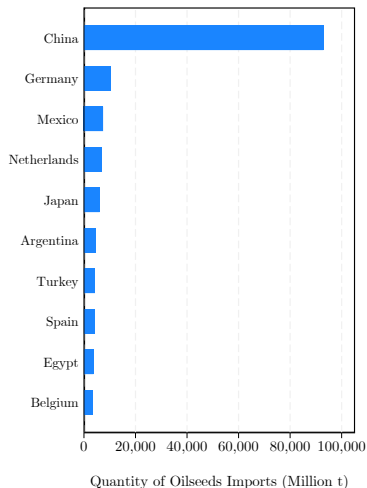
■ Positive and significant
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 Not Significant

Note. Major exporters and exporters importers are picked based on 2019 data. Cells contain the values of the estimated gravity regression coefficients of the interaction between the exporter and importer indicators and the log of the Ukrainian land occupied by Russia. Regression results are derived from 656,371 observations, with an R^2 of 0.918. * Marked to highlight.

Major Exporters and Importers of Oilseeds in 2019



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Note. The values are expressed in millions of tonnes (t).

PPML Gravity Regression Coefficient Estimates - Oilseeds

Major Importers of Oilseeds

	CHN	DEU	MEX	NLD	JPN	ARG	TUR	ESP	EGY	BEL	TOTAL
BRA	-0.02	-0.05	-0.12	-0.07	-0.04	-0.30	0.08	-0.06	0.05	0.09	-0.04
USA	0.06	0.05	0.04	0.00	0.01	-0.47	-0.03	0.01	0.08	-0.34	0.04
CAN	-0.01	-0.08	0.04	-0.11	-0.03	-0.21	-0.26	0.02	-0.10	-0.03	-0.02
ARG	-0.07	-0.05	0.02	-0.01	-0.04		0.06	-0.06	-0.22	-0.00	-0.09
UKR*	-0.01	-0.10	-1.51	-0.18	-1.23	-1.20	0.02	-0.05	-0.24	-0.10	-0.09
PRY	-0.13	-0.02	-0.10	-0.04	0.05	-0.24	-0.23	-0.23	-0.32	-0.46	-0.05
NLD	-0.30	0.06	-1.02		-1.02	-1.04	-0.01	0.04	-1.14	0.03	0.06
RUS*	0.07	0.01	-1.03	-0.15	0.03		-0.08	-0.07	-0.02	0.00	0.01
ROU	0.19	-0.02		0.02	0.10	-0.15	0.02	-0.00	-1.35	0.04	0.02
URY	-0.03	-1.69	-1.06	-0.08	-1.24	-0.10	-0.10	-0.52	0.00	-0.87	-0.03
TOTAL	0.00	-0.01	0.00	-0.05	-0.03	-0.22	0.05	-0.03	0.02	-0.02	-0.02

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Note. Major exporters and exporters importers are picked based on 2019 data. Cells contain the values of the estimated gravity regression coefficients of the interaction between the exporter and importer indicators and the log of the Ukrainian land occupied by Russia. Regression results are derived from 628,834 observations, with an R^2 of 0.967. * Marked to highlight.

PPML Gravity Reg. Coeff. Estimates - Grains (UKR)

Major Importers of Ukrainian Grains

	ESP	CHN	NLD	TUR	IDN	ITA	DEU	PHL	EGY	GBR	TOTAL
USA	0.08	0.08	0.01	-0.16	-0.04	-0.07	-0.02	0.00	-0.19	-0.00	0.05
UKR*	0.05	-0.02	-0.03	0.14	-0.19	-0.02	0.03	-0.37	-0.08	0.02	-0.01
ARG	-0.01	0.09	-0.06	0.10	-0.02	-0.16	-0.08	-0.08	-0.10	-0.04	0.01
BRA	0.05	-0.11	0.02	0.23	-0.02	0.10	0.07	-0.00	-0.00	0.05	0.04
CAN	0.07	0.01	-0.04	-0.26	-0.01	-0.04	-0.20	0.03	-0.10	0.10	0.01
FRA	-0.01	-0.03	-0.01	0.09	-1.08	-0.04	-0.02	-0.60	0.07	0.01	-0.01
RUS*	0.06	0.07	-0.46	0.08	-0.21	-0.09	-0.22	-0.41	-0.01	-0.05	0.02
AUS	0.16	-0.03	0.35	0.24	-0.03	-0.10	-0.51	0.00	-0.10	0.01	-0.02
ROU	-0.01	-0.27	-0.03	-0.02	-1.33	-0.01	-0.03	-1.59	0.02	0.02	0.01
DEU	-0.00	-0.05	0.02	0.09	-0.36	-0.04		-0.16	0.20	0.04	0.02
TOTAL	0.03	0.03	-0.00	0.09	-0.03	-0.03	-0.01	-0.01	-0.03	0.04	0.01

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Note. Major exporters and exporters importers are picked based on 2019 data. Cells contain the values of the estimated gravity regression coefficients of the interaction between the exporter and importer indicators and the log of the Ukrainian land occupied by Russia. Regression results are derived from 656,371 observations, with an R^2 of 0.918. A blank cell means that the coefficient is empty. * Marked to highlight.

PPML Gravity Reg. Coeff. Estimates - Oilseeds (UKR)

Major Importers of Ukrainian Oilseeds

	TUR	NLD	DEU	BEL	BLR	FRA	EGY	POL	ITA	GRC	TOTAL
BRA	0.11	-0.03	-0.01	0.12		0.02	0.08	-1.07	0.04	0.12	0.03
USA	-0.06	-0.03	0.01	-0.37	-0.99	-0.13	0.05	-0.42	-0.03	-0.06	0.00
CAN	-0.25	-0.10	-0.07	-0.02		-0.04	-0.10	0.03	0.04	0.02	-0.02
ARG	0.13	0.06	0.03	0.07	-0.32	-0.01	-0.15	-0.34	-0.15	0.07	-0.05
UKR*	0.00	-0.20	-0.12	-0.11	-0.02	-0.12	-0.26	0.04	-0.13	-0.15	-0.10
PRY	-0.22	-0.03	-0.01	-0.45	-0.11	-0.17	-0.31	0.20	-0.16	-0.22	-0.11
NLD	0.00		0.07	0.03	-1.09	0.01	-1.13	0.01	0.10	0.04	0.07
RUS*	-0.11	-0.19	-0.02	-0.03	0.14	-0.18	-0.05	0.01	-0.05	-0.24	-0.06
ROU	0.02	0.02	-0.02	0.04	-1.03	-0.02	-1.36	0.09	-0.01	-0.09	0.02
URY	-0.08	-0.06	-1.66	-0.85		0.02	0.02		-1.60	-1.51	-0.03
TOTAL	0.06	-0.04	-0.01	-0.01	0.14	-0.04	0.02	0.08	0.00	-0.01	-0.00

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PPML Gravity Reg. Coeff. Estimates - Grains (RUS)

Major Importers of Russian Grains

	TUR	IRN	AZE	EGY	KEN	BLR	GEO	IDN	JOR	ZAF	TOTAL
USA	-0.18	-1.46	-0.39	-0.21	-0.04	-1.27	-0.23	-0.07	-0.12	-0.10	-0.08
UKR*	0.15	-1.64	-0.30	-0.07	-0.05	-0.08	0.00	-0.19	-0.16	-0.30	-0.01
ARG	0.08	-1.24	-0.24	-0.12	-0.02	-0.21	-0.06	-0.04	-0.06	-0.07	-0.05
BRA	0.21	-0.14	-1.00	-0.02	-1.03			-0.04	-0.03	0.08	-0.00
CAN	-0.27	-0.26		-0.11	-0.06	-0.97		-0.02	-0.08	-0.36	-0.02
FRA	0.11	-0.32	-0.01	0.08	-0.31	0.10	0.15	-1.07	0.01	-0.33	0.09
RUS*	0.09	0.05	-0.02	-0.01	0.03	-0.00	-0.03	-0.20	-0.16	-0.14	0.02
AUS	0.26	-1.35	-0.60	-0.08	0.09	-0.82	0.14	-0.01	0.15	0.13	0.03
ROU	0.00	-1.42	0.07	0.04	0.13	0.01	-0.78	-1.31	0.06	-0.32	0.06
DEU	0.09	0.03	-0.24	0.20	-0.34	-0.00	0.12	-0.37	-1.38	-0.01	0.03
TOTAL	0.09	0.00	-0.03	-0.03	0.01	-0.00	-0.03	-0.04	-0.01	-0.01	0.01

■ Positive and significant
 ■ Negative and significant
 Not Significant

Note. Major exporters and exporters importers are picked based on 2019 data. Cells contain the values of the estimated gravity regression coefficients of the interaction between the exporter and importer indicators and the log of the Ukrainian land occupied by Russia. Regression results are derived from 656,371 observations, with an R^2 of 0.918. A blank cell means that the coefficient is empty. * Marked to highlight.

PPML Gravity Reg. Coeff. Estimates - Oilseeds (RUS)

Major Importers of Russian Oilseeds

	CHN	TUR	BLR	BEL	KAZ	BGR	DEU	POL	NLD	ITA	TOTAL
BRA	0.00	0.10		0.11		-0.16	-0.02	-1.08	-0.04	0.03	-0.00
USA	0.05	-0.04	-0.97	-0.35	0.02	0.09	0.03	-0.41	-0.01	-0.02	0.04
CAN	-0.00	-0.25		-0.02	0.12	0.06	-0.07	0.03	-0.10	0.03	-0.01
ARG	-0.03	0.10	-0.34	0.04	-0.19	0.00	-0.00	-0.37	0.03	-0.18	-0.03
UKR*	0.03	0.07	0.05	-0.05	-0.05	0.24	-0.05	0.10	-0.14	-0.07	0.00
PRY	-0.11	-0.22	-0.10	-0.44	-0.44	0.16	-0.01	0.20	-0.02	-0.16	-0.08
NLD	-0.29	-0.00	-1.09	0.03	-0.09	-0.08	0.06	0.01		0.09	0.07
RUS*	0.07	-0.08	0.18	0.00	0.06	-0.37	0.01	0.04	-0.15	-0.02	0.01
ROU	0.19	0.02	-1.03	0.03	0.13	0.01	-0.03	0.08	0.01	-0.01	0.00
URY	-0.06	-0.13		-0.90		-1.12	-1.72		-0.11	-1.66	-0.07
TOTAL	0.02	0.07	0.15	0.00	0.06	0.10	0.00	0.09	-0.04	0.01	0.01

■ Positive and significant
 ■ Negative and significant
 Not Significant

Note. Major exporters and exporters importers are picked based on 2019 data. Cells contain the values of the estimated gravity regression coefficients of the interaction between the exporter and importer indicators and the log of the Ukrainian land occupied by Russia. Regression results are derived from 628,834 observations, with an R^2 of 0.966. A blank cell means that the coefficient is empty. * Marked to highlight.

Conclusions i

- We observe **no significant evidence of overall re-allocation in Ukrainian grain imports.**

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- While additional occupied Ukrainian land reduces imports of Ukrainian grains in at least a dozen markets, there is **no evidence of substitution with grains from alternative sources.**

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Conclusions i

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- While additional occupied Ukrainian land reduces imports of Ukrainian grains in at least a dozen markets, there is **no evidence of substitution with grains from alternative sources.**
- Imports of Russian grains decrease as the area of occupied Ukrainian land increases. However, this reduction is **compensated with imports from other sources**, such as Brazil in Italy, Germany, and South Africa.
- These shifts in import patterns suggest dynamic changes in *individual* market, with **Ukrainian grain demonstrating limited substitutability.**

Conclusions ii

- Among the major importers of oilseeds, **imports of Ukraine oilseeds have decreased or remained unchanged for all destinations except Bulgaria.**

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Conclusions ii

- Among the major importers of oilseeds, **imports of Ukraine oilseeds have decreased or remained unchanged for all destinations except Bulgaria.**
- A 1 percent point increase in occupied Ukrainian land corresponds to a 0.14-0.16 percent point **rise in Bulgaria's imports of Ukrainian oilseeds.**
- **USA, Argentina, Brazil and Romania seem to cover the reduction of supply of Ukrainian oilseeds** to Germany, Japan Belgium and Greece
- A 1 percent point increase in occupied Ukrainian land corresponds to a 0.07 percent point rise in **China's imports of Russian grains.** Similarly, imports of Russian oilseeds increase in Belarus and Kazakhstan.

Conclusions ii

- Among the major importers of oilseeds, **imports of Ukraine oilseeds have decreased or remained unchanged for all destinations except Bulgaria.**
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- **USA, Argentina, Brazil and Romania seem to cover the reduction of supply of Ukrainian oilseeds** to Germany, Japan Belgium and Greece
- A 1 percent point increase in occupied Ukrainian land corresponds to a 0.07 percent point rise in **China's imports of Russian grains.** Similarly, imports of Russian oilseeds increase in Belarus and Kazakhstan.
- **Oilseeds from Ukraine have a higher degree of substitutability.** Russian seems to have increased exports to its allies.

Outlook

- **Gravity Regressions** needs to control for other bilateral trade cost variables, such as tariffs.
- Use **export data** instead of import data, but filling out the missing export flows from Ukraine using available import data following a similar approach as Gaulier and Zignago (2010).
- **Calculate welfare implications** using the analysis from Larch and Yotov (2016).
- Disaggregate the analysis by **product type**.






Thank you!

Questions and comments are highly appreciated

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Appendix - Contribution with Citations

- ...Including international trade (Grant et al. 2023), economic growth (Mahlstein et al. 2022), stock market performance (Boungou and Yatié 2022), commodity markets (Fang and Shao 2022), and food security (Behnassi and Haiba 2022; Carriquiry, Dumortier, and Elobeid 2022)

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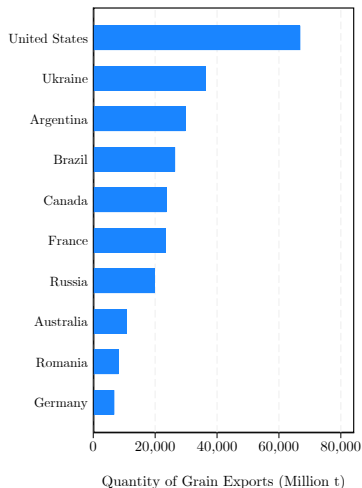
Appendix - Grains and Oilseeds

- Grains include HS4 codes:
 - 1001: Wheat and meslin.
 - 1002: Rye.
 - 1003: Barley.
 - 1004: Oats.
 - 1005: Corn (maize).
 - 1006: Rice.
 - 1007: Grain sorghum.
 - 1008: Buckwheat, millet and canary seeds; other cereals (including wild rice).
- Oilseeds include HS4 codes:
 - 1201: Soybeans, whether or not broken.
 - 1203: Copra.
 - 1204: Flaxseed (linseed), whether or not broken.
 - 1205: Rape or colza seeds, whether or not broken.
 - 1206: Sunflower seeds, whether or not broken.
 - 1207: Other oil seeds and oleaginous fruits, whether or not broken.
 - 1208: Flours and meals of oil seeds or oleaginous fruits, other than those of mustard.

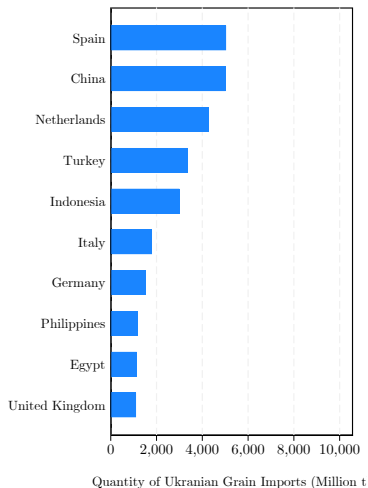
Appendix - Gravity Framework

- PTA_{ijt} is an indicator that i and j have a PTA at month t
- $Y_{it} = \sum_j X_{ijt}$ is total export supply and includes intra-national trade
- $E_{jt} = \sum_i X_{ijt}$ is total expenditures from the importer, and it also includes intra-national trade.
- $Y_t = \sum_i Y_{it} = \sum_j E_{jt}$ is Total world production.
- α_0 , is an intercept term.
- $\zeta_{it} = -(1 - \sigma) \ln(\Pi_{it}) + \ln(Y_{it})$ and $\eta_{jt} = -(1 - \sigma) \ln(P_{it}) + \ln(E_{jt})$ are exporter-time and importer-time fixed effects, respectively.
- $\theta_{ij} = (1 - \sigma)\lambda_{ij}$ is a country-pair fixed effect that controls for several time-invariant unobservables.
- ε_{ijt} is a mean-zero error term.

Appendix - Major Importers of Ukranian Grains in 2019



(a) Major Exporters of Grains.

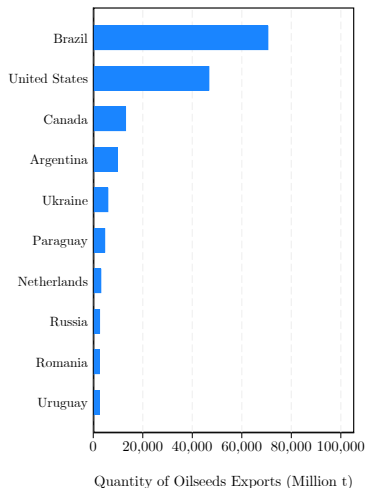


(b) Major Importers of Ukranian Grains.

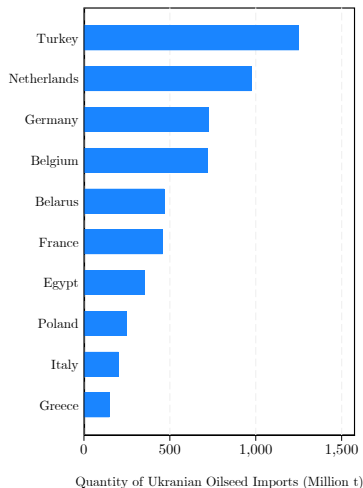
Note. The values are expressed in millions of tonnes (t).

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Appendix - Major Importers of Ukrainian Oilseeds in 2019



(a) Major Exporters of Grains.

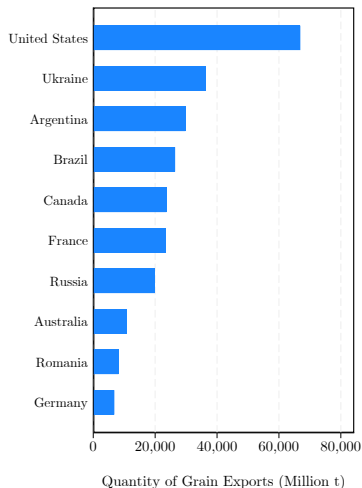


(b) Major Importers of Ukrainian Oilseeds.

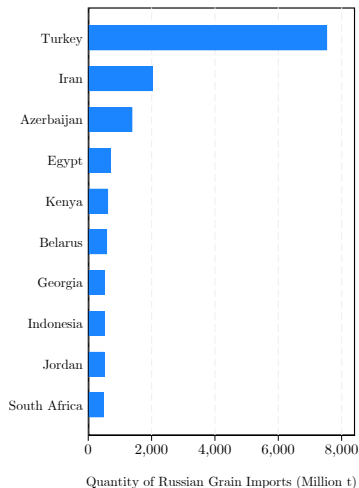
Note. The values are expressed in millions of tonnes (t).

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Appendix - Major Importers of Russian Grains in 2019



(a) Major Exporters of Grains.

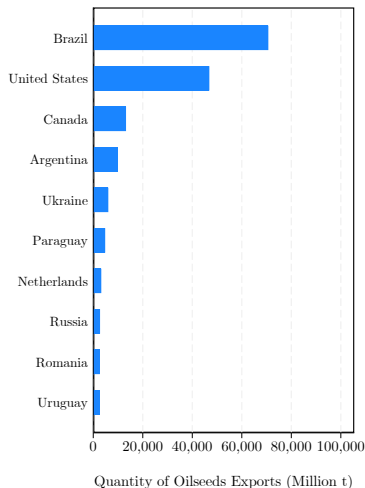


(b) Major Importers of Russian Grains.

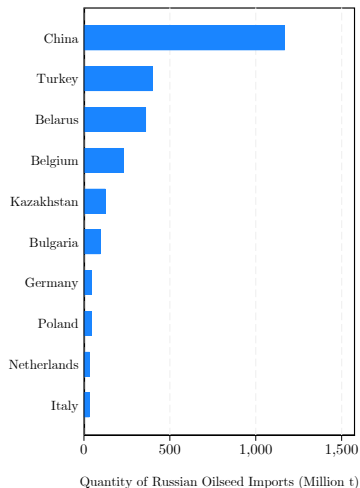
Note. The values are expressed in millions of tonnes (t).

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Appendix - Major Importers of Russian Oilseeds in 2019



(a) Major Exporters of Oilseeds.



(b) Major Importers of Russian Oilseeds.

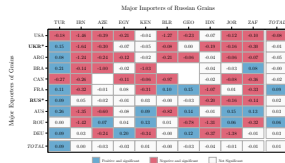
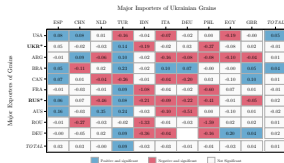
Note. The values are expressed in millions of tonnes (t).

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Appendix - PTA

- Overall Grains: The coefficient for PTA_{ijt} is 0.039 (s.e. = 0.018).
- Overall Oilseeds: The coefficient for PTA_{ijt} is 0.304 (s.e. = 0.106).
- Ukrainian grains: The coefficient for PTA_{ijt} is 0.060 (s.e. = 0.017).
- Ukrainian oilseeds: The coefficient for PTA_{ijt} is 0.308 (s.e. = 0.103).
- Russian grains: The coefficient for PTA_{ijt} is 0.041 (s.e. = 0.147).
- Russian oilseeds: The coefficient for PTA_{ijt} is 0.282 (s.e. = 0.107).

Appendix - Comparison of Results: Grains



(a) Major Importers of Grains from all Origins.

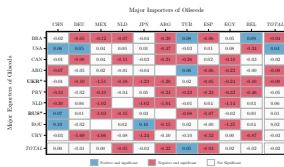
(b) Major Importers of Ukrainian Grains.

(c) Major Importers of Russian Grains.

Note. The figure shows estimated coefficients of a three-way structural gravity regression. Major exporters and importers of grains and oilseeds are based on data from the year 2019. Major exporters are the same in all panels.



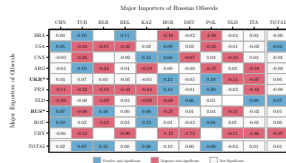
Appendix - Comparison of Results: Oilseeds



(a) Major Importers of Oilseeds from all Origins.



(b) Major Importers of Ukrainian Oilseeds.



(c) Major Importers of Russian Oilseeds.

Note. The figure shows estimated coefficients of a three-way structural gravity regression. Major exporters and importers of grains and oilseeds are based on data from the year 2019. Major exporters are the same in all panels.

