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Economic Sanctions and Agricultural Trade

Abstract

Combining two new datasets on sanctions and agricultural trade and implementing step-by-step the latest developments in the empirical structural gravity literature, we investigate the effects of sanctions on international trade of agricultural products. We find that trade sanctions have been effective in impeding agricultural trade, while other sanctions do not show any significant effects. The complete trade sanctions in our sample have led to about a 73% decrease in the agricultural trade between the sanctioned and sanctioning countries, or a corresponding tariff equivalent of 38.8%, but we also obtain significant estimates for partial sanctions. At the industry level, we find substantial heterogeneity depending on the sanctioning and sanctioned countries, the type of sanctions used, and the direction of trade flows. Focusing on the sanctions on Russia, we find that these sanctions substantially decreased bilateral trade of Russia, mainly due to reduced trade with the EU.

JEL-Codes: F140, F510, Q170.

Keywords: structural gravity, sanctions, agriculture, Russia, heterogeneity.

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1 Introduction

Governments have utilized sanctions against foreign countries since the Peloponnesian War (431–404 BC), but, until recently, their infrequent use was typically an added dimension of a war effort (Hufbauer et al., 1990). With the Cold War ending in 1991, as an alternative to military action when international conflicts arose, policy makers frequently deployed comprehensive economic sanctions as a foreign policy tool to punish or coerced foreign governments into altering their behavior (Weiss, 1999; Winkler, 1999).[1] The comprehensive economic sanctions of this 1990s era typically involved deliberate suspension of normal relations with foreign countries across the majority of trade and financial industries (Heine-Ellison, 2001; Elliott, 2010; Boomen, 2014; Coates, 2020).[2] However, ethical concerns of these comprehensive policies arose because restricting or outright banning food and medicine exports to the sanctioned county created undue hardship for citizens.[3] Furthermore, many questioned the effectiveness of comprehensive sanctions in impacting the behavior of the offending foreign governments (Weiss, 1999; Gordon, 2011; Boomen, 2014).[4] At the same time, the expansion of restrictions on food and agricultural exports alarmed farm groups and agribusiness who responded by lobbying the US government to exclude agri-food products from economic sanctions to protect their financial interest (HCA, 1998; Peterson and Haugen, 2016).

The confluence of the ethics, effectiveness, and lobbying of farm groups, agribusiness, and pharmaceutical companies resulted in many governments abandoning comprehensive sanctions for targeted sanctions that exclude food and medical products circa 2000 (Drezner, 2011). For example, the Trade Sanctions Reform and Export Enhancement Act passed in

[1]The sudden upsurge resulted in the 1990s being deemed the "Sanctions Decade."

[2]For example, in the 1990s, comprehensive sanctions were imposed on Iraq, Haiti, and Yugoslavia.

[3]Comprehensive economic sanctions are permitted under international law. As a result, scholars have argued the ethics and legality of these sanctions under human rights law, international humanitarian law, or the World Trade Organization (WTO) agreements (Peterson and Haugen, 2016). Within WTO, the Security Exception allows member countries to implementing sanctions that violate the Most-Favoured-Nation Treatment for reasons on national security (WTO, 2021). Also, WTO rules do not apply to non-member states, and targeted sanctions against non-state terrorist groups do not violate WTO agreements.

[4]See Peterson and Haugen (2016) for a review of the extensive literature on the ethical, legal, and effectiveness of sanctions.

the United States in 2000, which terminated unilateral agricultural and medical sanctions and banned future sanctions from including these products (US Department of the Treasury, 2021). While targeted sanctions are designed to lessen the ethical and humanitarian harm, they may still impact food and medicine trade because financial, insurance, and transportation restriction create difficulties for the exporters of such products to conduct business in sanctioned countries.[5] While scholars agree that comprehensive sanctions are both unethical and ineffective, no consensus exists on the ethics or effectiveness of targeted sanctions (Peterson and Haugen, 2016). However, the connection between agricultural commodities and humanitarian concerns have been integral in shaping how economic sanctions are implemented throughout the world.

Given the role food products have played in the evolution of sanctions, the main purpose of this study is to quantify the impact of economic sanctions on agricultural trade. We further investigate the heterogeneous impact of sanctions on agricultural trade based on type, direction, both type and directions of sanctions, and at the industry level. In doing so, we highlight the step-by-step progression of the applied gravity literature—from naive OLS to the latest structural gravity estimation techniques—over the last several decades. In addition to examining the overall impact of a complete set of sanctions on global agricultural trade, we provide a detailed analysis of the recent economic sanctions by Europe, North American, Japan, and allied countries on Russia in 2014 over the Ukraine conflict. The sanctions against Russia mainly related to foreign credit and investment; however, these sanctions triggered a sever depreciation of the Ruble, causing inflation as the import price of food and other good increased (Liefert and Liefert, 2015). Furthermore, this inflationary event coincided with a drop in the world oil price, straining the value of Russia's principal export, oil. Russia

[5] In addition to minimizing the negative impact on ordinary citizens, there is literature suggesting targeted sanctions are more effective at achieving their goals (Cortright and Lopez, 2002; Heine-Ellison, 2001; Elliott, 2010). For example, the Joint Comprehensive Plan of Action (commonly known as the Iran nuclear deal) is recent evidence that targeted sanctions influenced foreign government to alter their behavior (Katzman, 2010; Laub, 2015). However, there is also evidence that some targeted sanctions fail when states ignore them (Early, 2015).

responded by placing food embargoes on agricultural trade with the sanctioning countries.[6]

Our empirical analysis implements two novel data sets: the 2020 edition of the International Trade and Production Database for Estimation (ITPD-E) (Borchert et al., 2021b) and the 2021 edition of the Global Sanctions Database (GSDB) (Felbermayr et al., 2020; Kirilakha et al., 2021).[7] Furthermore, the main results are based on structural gravity models with cutting-edge estimation techniques as, for example, described in Yotov et al. (2016), to ensure consistency with the underlying theory. As such, the gravity model implements the Poisson Pseudo Maximum Likelihood (PPML) estimator for consistent estimates with heteroskedasticity in the trade data and the inclusion of zero trade flows;[8] data for both international trade flows and domestic sales; and three sets of fixed effects: (i) exporter-industry-time and importer-industry-time fixed effects to control for the inward and outward multilateral resistance terms and all unobservable exporter-industry-time and importer-industry-time effects; (ii) country-pair-industry fixed effects to control for all time-invariant bilateral trade costs and to mitigate endogeneity in policy variables by capturing all unobservable country-pair-industry effects; and (iii) time-industry-varying bilateral border fixed effects to account for the impact of globalization on trade. This econometric approach allows us to quantify the impacts of sanctions while controlling for many other confounding effects.

From a methodological perspective, our analysis shows that the gravity specification can have a substantial impact both on the magnitude and sign of the coefficient estimates for

[6]The embargo on agricultural products were at the HS-4 level and covered the following products: 0103 “Swine, live”, 0203 “Meat of swine, fresh, chilled or frozen”, 0201 “Meat of bovine animals, fresh or chilled”, 0202 “Meat of bovine animals, frozen”, 0207 “Meat and edible offal of poultry”, 0210 “Meat, salted, in brine, dried or smoked”, 0301–0308 “Fish and crustaceans, molluscs and other aquatic invertebrates”, 0401–0406 “Milk and dairy products”, 0701–0714 “Vegetables and edible roots and tubers”, 0801–0811, 0813 “Fruit and nuts”, 1601 “Sausages and similar products, of meat, meat offal or blood”, 1901 “Food preparations, including cheeses and curd, based on vegetable fats”, and 2106 “Food preparations, based on vegetable fats and containing milk”.

[7]We describe the two databases in detail in Section 2.

[8]See Santos Silva and Tenreyro (2006) for a detailed discussion and Monte Carlo analysis of the PPLM estimator. Also see Head and Mayer (2014) and Martin (2020) for alternatives to PPLM for estimating gravity models.

policy variables. For example, WTO membership increases agricultural trade by only 1.4% for PPML with exporter-industry-time, importer-industry-time, and country-pair-industry fixed effects compared to 36.4% when we include domestic sales and globalization trends that vary across industries. Furthermore, non-trade sanctions appear to hinder agricultural trade until the model captures the globalization effects.

We also find that trade sanctions have been effective in impeding agricultural trade between the sanctioned and sanctioning countries by reducing trade volumes around 10%, while other sanctions do not systematically affect trade. Focusing on trade sanctions, while complete sanctions reduce trade by about 73% on average, partial sanctions also show negative effects as trade declines by about 9.5%. This later result has important policy implications as partial sanctions typically do not include agricultural products over humanitarian concerns.

Furthermore, sanctions in both directions hinder agricultural trade substantially more compared to sanctions on only imports or only exports. In fact, the results indicate that partial or complete sanctions on export alone can boost agricultural trade. Substantial heterogeneity transpires at the industry level depending on the sanctioning and sanctioned countries, the type of sanctions used, and the direction of trade flows. Concerning the sanctions involving Russia, the results reveal substantial negative effects as agricultural trade with Russia falls, particularly for EU-Russian trade which declines by about 51%.

The agricultural gravity literature has primarily examined the impact of global and regional trade agreements (Zahniser et al., 2002; Koo et al., 2006; Sarker and Jayasinghe, 2007; Grant and Lambert, 2008; Lambert and McKoy, 2009) and non-tariff measures (Swann et al., 1996; Disdier et al., 2008; Otsuki et al., 2001; Chevassus-Lozza et al., 2008; Anders and Caswell, 2009; Disdier and Marette, 2010).[9] Thus, from a policy perspective, our first

[9]See Santeramo and Lamonaca (2019) for a review of literature and meta analysis on the impact of non-tariff measures on agri-food trade. Several papers also examine the impact of SPS measures (Peterson et al., 2013; Grant et al., 2015), tariffs (Cipollina and Salvatici, 2020), and standard friction variables (Jayasinghe et al., 2010) on agricultural commodity trade with only one importer or one exporter. Tong et al. (2019) examine the impact of US subsidies on US state-level exports to the 100 largest destination countries. Finally, Raimondi and Olper (2011) quantify trade elasticities for 18 food industries using tariff data and a gravity model.

contribution to this literature is the focus on the impact of economic sanctions.

Our second contribution to the agricultural gravity literature is methodological. The estimates in the existing literature are based on different specifications and different estimators too, with some authors still relying on the OLS estimator.[10] Furthermore, there is no uniform treatment of the use of fixed effects, and the theoretically-consistent use of domestic (in addition to international) trade flows in gravity estimations is rare.[11] With the wide range of approaches in the agricultural trade literature, one objective is to chronicle the advancements in the application of the gravity model—from naive OLS to the latest advancement in structural gravity estimation—and discuss how each advancement influences the estimated coefficients in the context of the impacts of sanctions on agricultural trade.

To the best of our knowledge, the agricultural gravity literature examining the impact of sanctions on food and agri-food trade focuses on the case of sanctions imposed on Russia and Russia's retaliatory embargos on food-product imports resulting from the 2014 Ukraine conflict.[12] For example, Crozet and Hinz (2016) exploit both country-level and French firm-level bilateral trade data to analyze this sanction event on the sending countries. For the country-level analysis, Crozet and Hinz (2016) utilize monthly (January 2012 to June 2015) UN Comtrade bilateral trade flow data with products aggregated at two levels: embargoed[13] and not embargoed. Their results show that exports of both embargoed and nonembargoed agricultural products at both the industry and firm-level fell, which provides evidence of collateral damage of this sanction event. Cheptea and Gaigné (2020) also utilize the monthly UN Comtrade trade data for all agri-food commodities (HS chapters 1-23) to implement a log-linear gravity model without domestic sales to analyze the impacts of the Russian food

[10] Studies that employ PPML include Sun and Reed (2010), Grant and Boys (2012), and Luckstead (2021).

[11] Luckstead (2021) is a recent exception.

[12] A related literature examines the impact of sanctions on food security. Based on evidence linking food security and trade (Dorosh, 2001; Koc et al., 2007; Dithmer and Abdulai, 2017), Afesorgbor (2021) use panel data from 1950 to 2014 to show that sanctions increased the global hunger index by between 1.25 and 2.22 points. The previous research on the Russian food embargo primarily relied on *ex post* computable general equilibrium analysis (see for example, Boulanger et al., 2016).

[13] See footnote 6 for a list of embargoed agricultural commodities.

sanctions on EU food exports and Russian food imports. Their triple-difference approach shows that the Russian sanctions caused EU food exports of banned commodities to Russia to decline by an average of 80%. Our paper complements this literature by moving past a case-study approach by considering the overall impacts of a complete set of sanctions on agricultural trade. We then focus on the impacts of sanctions on and by Russia as a particular case. In doing so, we examine the Russian sanctions using annual data and latest developments in the structural gravity literature which allow us to examine heterogeneity across several dimensions.

Finally, our study builds on Felbermayr et al. (2020) and Larch et al. (2021) who implement theoretically consistent gravity models to quantify the impact of sanctions on aggregate trade and trade in the energy and mining industries, respectively.[14] Specifically, Felbermayr et al. (2020) highlight the new GSDB by examining the impact of sanctions against Iran—one of the most sanctioned countries in terms of country coverage, targets of commodities, industries, individuals, and time—on aggregate trade. Their results show that sanctions with Iran impact bilateral trade differently depending on the sanctioning country and direction of trade. Larch et al. (2021) extend Felbermayr et al. (2020) by using GSDB to show that sanctions reduce energy and mining trade by an average of 44%, although significant heterogeneity exists across several dimension, including mining industries, specific episodes or cases, sanction type, and direction of trade.[15] The current paper differs from these two papers by examining the impact of sanctions on agri-food commodities, which are typically excluded from comprehensive sanctions.

The rest of the paper is organized as follows. In section 2, we describe the two new dataset employed. Section 3 presents our results, were we first present the estimations at the

[14]See Jing et al. (2003) and Sobel (1998) for detailed analysis on the choice of sanctions and their impacts on exchange rates.

[15]Other papers, such as Caruso (2003) and Slavov (2007), have implemented gravity models to examine the impact of sanctions on trade. However, their results are likely biased and unreliable because they estimate log-linear models, exclude zeros in trade flows and domestic sales, and do not properly account for multilateral resistances.

pooled level introducing the developments from the gravity literature step-wise (subsection 3.1), and then allow for heterogeneity along several dimensions (subsection 3.2). The last section concludes.

2 Data: Description and Sources

The two main datasets that we use to perform the empirical analysis are the International Trade and Production Database for Estimation (ITPD-E) (Borchert et al., 2021b) and the Global Sanctions Database (GSDB) (Felbermayr et al., 2020; Kirilakha et al., 2021). The ITPD-E dataset includes international and domestic trade data for 243 countries over the years 2000-2016.[16] The trade data is consistently constructed for 170 industries, including 26 agricultural and food commodities, which are the focus of our analysis. For clarity and expositional simplicity, while preserving a sufficient number of degrees of freedom, for some of the analyses of heterogeneity we classify and aggregate the 26 agricultural industries in the original data into five broad agricultural sectors, including Bulk commodities (BULK), Live animals, meat, and animal products (ANIMAL), Labor-intensive (LABOR), Processed foods (PRCSSD), and sugars (SUGARS). Table 7 lists the disaggregated industries in our sample and offers a concordance between them and the five aggregated categories.

The original data for the 26 agricultural industries in ITPD-E come from the Food and Agriculture Organization of the United Nations Statistics Division (FAOSTAT). Reported import flows are used as main source and mirror exports reported by partner countries are used to fill missing import values. Domestic trade is calculated as the difference between the values of total (gross value) production and total exports. ITPD-E is balanced across the exporter, importer, industry dimension by filling missing observations with zeros. The period covered are the 17 years from 2000 to 2016. In order to drop irrelevant zeros, the final dataset keeps only observations that are retained when estimating a gravity model using the

[16] ITPD-E can be downloaded at https://www.usitc.gov/data/gravity/itpde.htm. The webpage also contains more information about ITPD-E.

PPML estimator with exporter-time, importer-time, and directional bilateral fixed effects. Additionally, all countries not included in the geopolitical Dynamic Gravity Database of the USITC are dropped.

Overall, there are 2,685,696 observations in the 26 agricultural industries, with 1,548,324 observations where trade flows are zero. The largest industry is industry 26 "Other agricultural products, nec" with 271,908 observations, followed by industries 12 "Fresh fruit", 22 "Beverages, nec", and 25 "Spices", which all have around 200,000 observations. The industries with the fewest observations are 9 "Raw and refined sugar and sugar crops", 18 "Live Swine", and 15 "Prepared vegetables" with less than 20,000 observations. For industries 5 "Cereal products", 8 "Animal feed ingredients and pet foods", 14 "Prepared fruits and fruit juices", 16 "Nuts", 17 "Live Cattle", and 18 "Live Swine" ITPD-E does not include intra-national trade flows. The number of distinct exporters varies substantially over industries: while there are about 200 distinct exporters in industries 7 "Other oilseeds (excluding peanuts)", 12 "Fresh fruit", 13 "Fresh vegetables", 20 "Other meats, livestock products, and live animals", 22 "Beverages, nec", 25 "Spices", and 26 "Other agricultural products, nec", there are only about 80 distinct exporters in industries 9 "Raw and refined sugar and sugar crops" and 18 "Live Swine". These differences have to be kept in mind when we discuss results based on the most disaggregate level.

The second major database that we use is the 2021 edition of the Global Sanctions Database (GSDB) (Felbermayr et al., 2020; Kirilakha et al., 2021).[17] The GSDB covers all publicly traceable sanctions between 1950 and 2019, and classifies them according to their objectives, type, and success. The GSDB distinguishes between six broad types of sanctions, including: trade, financial, arms, military assistance, travel, and other sanctions. Of particular importance for our analysis, the GSDB includes several categories of trade sanctions based on their coverage, i.e., partial versus complete sanctions, and depending on

[17]More details about the GSDB can be found at https://www.globalsanctionsdatabase.com, and the data can be requested by e-mail from GSDB@drexel.edu.

the the direction of trade, i.e., on exports, on imports, and in both directions of trade. We capitalize on this feature of the GSDB in the empirical analysis to obtain estimates of the effects of each type of trade sanction.

Due to the shorter period covered by the ITPD-E, we only utilize a subsample of the GSDB dataset, i.e., the years between 2000 and 2016. While we do control for all possible (types of) sanctions during this period, our focus is on trade sanctions. We list all trade sanctions that were active between 2000 and 2016 in Table 8. The table includes information about the target/sanctioned country or region, the sender/sanctioning country or region, the start and end of the sanction, and also about the type of trade sanction. Out of the 201 possible trade sanctions from the GSDB that were active during the period of investigation, there were only 6 cases for which there was no corresponding trade data in the ITPD-E.[18] Finally, a drawback of the GSDB is that it does not include information about the sectors that were targeted by partial sanctions. Thus, in our empirical analysis, we cannot identify partial sanctions that target agriculture. To overcome this challenge, we obtain average estimates of the impact of all partial sanctions as well as estimates of the effects of some specific partial sanctions, i.e., the sanctions involving Russia due to the Crimean crisis.

Finally, in addition to the two main datasets on trade and sanctions, we rely on the Dynamic Gravity Dataset (DGD) of the US International Trade Commission, cf. Gurevich and Herman (2018), for data on some standard gravity variables (e.g., distance, contiguity, etc.), and on the Regional Trade Agreements Database of Egger and Larch (2008) for data on regional trade agreements (RTAs).[19]

[18]As will become clear shortly, while we will not be able to identify the impact of the trade sanctions that entered before the period of investigation, we will fully control for them in our preferred econometric model, which will include pair fixed effects.

[19]The DGD and the RTA datasets are downloadable for free at https://catalog.data.gov/dataset/dynamic-gravity-dataset-1948-2016 and https://www.ewf.uni-bayreuth.de/de/forschung/RTA-daten/index.html, respectively.

3 Estimation Results and Analysis

The objective of this section is twofold. First, in Section 3.1, we capitalize on the latest developments in the empirical gravity literature to sequentially introduce the most important modeling elements that must be included when estimating the gravity model of trade, and we discuss their implications. This leads to our main econometric specification, which delivers our benchmark estimate of the impact of economic sanctions on agricultural trade. Second, in Section 3.2, we zoom in on the impact of sanctions on agricultural trade by exploring various dimensions of the data (e.g., sanction types, industry variation, direction of trade, etc.) to obtain a series of heterogeneous estimates of the effects of sanctions.

3.1 Estimating the Impact of Sanctions on (Agricultural) Trade

We start the analysis by estimating a version of the most widely used empirical gravity equation, which links bilateral trade flows to bilateral trade frictions and size. This model is analogous to Newton's law of universal gravitation, where the closer and the larger countries are, the more they will trade with each other:

$$\begin{aligned}\ln(X)^k_{ij,t} &= \alpha_0 + \alpha_1 \ln(DIST)_{ij} + \alpha_2 CNTG_{ij} + \alpha_3 LANG_{ij} + \alpha_4 CLNY_{ij} + \alpha_5 RTA_{ij,t} \\ &+ \alpha_6 WTO_{ij,t} + \alpha_7 TRADE\_SANCT_{ij,t} + \alpha_8 OTHER\_SANCT_{ij,t} + \\ &+ \alpha_9 \ln(Y)^k_{i,t} + \alpha_{10} \ln(E)^k_{j,t} + \epsilon^k_{ij,t}. \qquad (1)\end{aligned}$$

Following most of the existing literature, the dependent variable in equation (1), $\ln(X)^k_{ij,t}$, is the logarithm of nominal international trade flows in agricultural industry k (e.g., 'wheat' or 'cotton') from exporter i to importer j at time t. Due to the separability property of the structural gravity model, equation (1) can be estimated at any desired level of aggregation (e.g., at the product, sector, industry, and/or aggregate levels).[20] The results in this subsec-

[20] See Anderson and van Wincoop (2004) for a derivation of an industry-level gravity model from a demand-side perspective; Costinot et al. (2012) for a derivation of an industry-level gravity model from a supply-side perspective; and Yotov et al. (2016) for a demonstration that the demand-side and supply-side industry-level

tion are obtained with all available data by stacking the 26 agricultural industries together. In the next subsection, we also obtain estimates of the effects of sanctions for each of the individual agricultural industries in our sample.

To capture the effects of bilateral frictions, we introduce two sets of covariates.[21] The first set includes the most widely used time-invariant gravity variables, i.e., the logarithm of bilateral distance between i and j, $\ln(DIST)_{ij}$, and indicator variables for contiguous borders, $CNTG_{ij}$, for common official language, $LANG_{ij}$, and for colonial relationships, $CLNY_{ij}$. The second set consists of time-varying (policy) covariates such as the presence of regional trade agreements (RTAs) between i and j at time t, $RTA_{ij,t}$, whether the two trading partners are members of the World Trade Organization (WTO), $WTO_{ij,t}$, and, most important for our purposes, whether there are trade sanctions, $TRADE\_SANCT_{ij,t}$, or sanctions of any other type, $OTHER\_SANCT_{ij,t}$, between i and j. In addition to bilateral frictions, to capture the impact of size, we include the logarithm of the value of output on the exporter side, $\ln(Y)^k_{i,t} = \ln(\sum_j (X)^k_{ij,t})$, and the logarithm of the value of expenditure on the importer side, $\ln(E)^k_{j,t} = \ln(\sum_i (X)^k_{ij,t})$.[22]

Our estimation results based on specification (1) are presented in column (1) of Table 1.[23] Several findings stand out. First, in terms of sign and significance, our results are consistent with the standard results from the voluminous gravity literature. For example, Head and Mayer (2014) offer meta analysis of gravity estimates, while Borchert et al. (2021a) obtain disaggregated gravity estimates for a large number of industries. Specifically, as expected,

gravity models are identical from an estimation point of view and for a discussion on the challenges and best practices for estimating industry-level/disaggregated gravity models.

[21]For modeling trade costs in the gravity model, we refer the reader to Anderson and van Wincoop (2004) and Egger et al. (2021).

[22]Most papers that explicitly control for country size in gravity regressions use data on GDP. This practice, however, has two potential caveats. First, it is not consistent with theory, cf. Arkolakis et al. (2012), because the theoretically correct size controls should be measured as gross values (just like exports), while GDP is a value added variable. Second, using GDP likely introduces endogeneity concerns due to reversed causality, as the degree of openness to trade may influence GDP (see for example Frankel and Romer, 1999).

[23]Standard errors in all of our specifications are clustered by industry-country-pair. Following the recommendations of Egger and Tarlea (2015), we also extend the standard errors to accommodate gravity regressions that use pooled industry data. Specifically, we also obtain similar results with four-way clustered standard errors, i.e., by exporter, importer, industry, and time.

the estimates in column (1) reveal that distance is a significant impediment to agricultural trade, while the presence of common borders, common official language, colonial relationships, RTAs, and WTO membership promote agricultural trade. Somewhat surprisingly, our estimates suggest that trade sanctions promote trade in the agricultural sectors in our sample, while other sanctions hinder it. The magnitudes of the estimates of some of the gravity variables also differ from the established indexes in the literature. For example, the estimated coefficient on distance, which can be interpreted as an elasticity, is about three times smaller than the standard estimate of -1. Below, we demonstrate that these counter-intuitive results and biases disappear once we implement the latest developments for gravity estimations. Also, while positive and statistically significant, the estimated coefficients on the size variables are also about a third the magnitude of corresponding results from the literature and the unit elasticity that is predicted by theory.

One of the most important contributions to gravity estimations is the introduction of the theory-motivated inward and outward multilateral resistance (MR) terms by Anderson and van Wincoop (2003). Intuitively, the multilateral resistances capture the fact that, all else equal, two countries that are more remote from the rest of the world will trade more with each other. However, before we control comprehensively for the MR terms, we introduce a-theoretical proxies for inward and outward remoteness commonly found in the literature. Specifically, following Wei (1996) and Baier and Bergstrand (2009), in column (2) of Table 1, we construct exporter and importer 'remoteness' indexes as size-weighted bilateral distances.[24] Two main findings stand out from column (2). First, the estimates on the remoteness indexes are statistically significant, where remote exporters export more and

[24] Even with time-invariant bilateral distance measures, the remoteness indexes will vary over time because the weights used for their construction are time-varying. Note also that the remoteness indexes on the importer and on the exporter side will differ since, consistent with theory, we use the value of output as weights for the remoteness indexes on the importer side and expenditures for the weights for the exporter remoteness indexes. Felbermayr and Yotov (2021) demonstrate this proper accounting for aggregate trade imbalances is crucial for the success of gravity model in predicting bilateral trade imbalances. Finally, consistent with gravity theory, the remoteness indexes that we construct vary not only on the exporter and on the importer side but also for each agricultural industry.

remote importers import less. Second, we observe significant changes in the estimates on some of the other gravity variables, e.g., the estimates on the impact of distance and trade sanctions increase significantly in absolute value and common language declines marginally.

The estimates in column (3) of Table 1 are obtained with exporter-industry-time and importer-industry-time fixed effects. The theoretical motivation for the use of these fixed effects in gravity regressions is that they fully control for the unobservable multilateral resistance terms.[25] In addition to controlling for the structural MRs, the exporter-industry-time and the importer-industry-time fixed effects in column (3) will also absorb the size variables from the previous specifications, and they will control for any other country-industry-specific characteristics on the exporter and on the importer side that may affect bilateral trade flows. Comparison between the results in columns (2) and (3) reveal significant differences, thus underscoring the importance to properly control for the structural multilateral resistances, cf. Anderson and van Wincoop (2003) and Baldwin and Taglioni (2006), and other non-time-varying exporter-industry and importer-industry characteristics in order to identify the effects of bilateral trade cost variables. Specifically, we see that the estimates of the negative impact of distance and of the positive impact of common language and WTO have more than doubled in absolute value. Importantly, the estimate of the effects of trade sanctions is now negative, large, and statistically significant. The negative estimate of the effects of other sanctions is also larger in absolute value.

In column (4) of Table 1, in addition to proper controls for MRs, we introduce country-pair-industry fixed effects which we allow to vary by industry. The motivation for this is twofold. First, the country-pair-industry fixed effects will control for and absorb all possible time-invariant bilateral determinants of trade flows. This is potentially important in light of the findings from Egger and Nigai (2015) and Agnosteva et al. (2019) who show that the standard gravity variables (e.g., distance, colonial relationships, etc.) are poor proxies

[25] See Hummels (2001) and Feenstra (2004) for discussions of the use of exporter and importer fixed effects to control for the MRs. Baldwin and Taglioni (2006) show that the exporter and importer fixed effects should also be time-varying when the gravity model is estimated with panel data.

for bilateral trade costs. Second, on a related note, as famously demonstrated by Baier and Bergstrand (2007), the use of country-pair fixed effects mitigates potential endogeneity concerns in relation to bilateral trade policies.[26] The use of country-pair-industry fixed effects leads to significant changes in the estimates of the bilateral policy variables in our model. Notably, all estimates decrease in magnitude and in statistical significance, with other sanctions becoming insignificant. In addition, the estimates on RTA and WTO become negative. While country-pair fixed effects control for endogeneity in policy parameters in this specification, this model does not allow for trade diversion from domestic sales, which we address in one of our subsequent specifications.

The results in column (5) of Table 1 are obtained with the Poisson Pseudo Maximum Likelihood (PPML) estimator, which, owing to Santos Silva and Tenreyro (2006, 2011), has two main advantages for gravity estimations. First, and most importantly, Santos Silva and Tenreyro (2006) demonstrate that the PPML estimator addresses the problem that, due to heteroskedasticity, gravity estimates that are obtained with the standard OLS estimator are inconsistent. Second, due to its multiplicative form, the PPML estimator takes into account the information contained in the zero trade flows, which are omitted in OLS gravity regressions.[27] The PPML estimate on trade sanctions in column (5) is similar to its counterpart in column (4). However, we also see some differences in comparing the other estimates between the two columns. For example, the estimate of the effect of WTO becomes positive, but is statistically insignificant, while the RTA estimate turns positive and is marginally statistically significant.[28] The results in column (6) are also obtained with PPML, however, only

[26] The intuition for this is that the country-pair fixed effects will absorb much of the unobserved/unmodeled correlation between the endogenous policy variables and the error term.

[27] We perform our estimations in Stata, where we utilize the command *ppmlhdfe*, due to Correia et al. (2020), which is specifically designed to handle PPML estimations with high-dimensional fixed effects.

[28] Estimating a gravity model using PPML without domestic sales but with country-pair and time fixed effects, Sun and Reed (2010) examine the impact of specific RTAs (i.e., ASEAN-China, EU-15, EU-25, NAFTA, and Southern African Development Community) on aggregate agricultural trade. Their results show substantial heterogeneity of the trade benefits of RTAs (trade between member countries expands by between 0% and 166.4%) and as to whether an RTA leads to trade creation, trade diversion, or has no impact on trade with nonmember countries. Using a similar modeling approach, Grant and Boys (2012) find that the WTO increases aggregate agricultural trade by 39.1% when both the importer and exporter are

with data on positive trade flows. We observe no notable differences between the PPML results with and without zero trade flows in columns (5) and (6).[29]

To obtain the estimates in column (7) of Table 1, we add observations for domestic trade flows to our dependent variable. The use of domestic trade flows is consistent with all theoretical foundations of the gravity model and has a number of advantages for gravity estimations.[30] Three findings stand out from column (7). First, we see that the estimate of the effects of WTO remain positive, but is now highly statistically significant and much larger as compared to the corresponding estimates from columns (5) and (6). The coefficient estimate implies that WTO membership increases agricultural trade by $57\% = (\exp(0.452)-1)\times 100$, on average, across all product lines. This result is consistent with the findings of Larch et al. (2019), where WTO memberships increases aggregate manufacturing trade by about 60%. The intuition for this result is that the introduction of domestic trade flows allows for quantification of the trade diversion effects of trade policies from domestic sales. Similarly, and consistent with the findings of Dai et al. (2014), the introduction of domestic trade flows leads to larger estimates of the effects of RTAs. Finally, we do not see significant changes in the estimates on sanctions, which suggests that the imposition of sanctions does not have strong differential effects on international relative to domestic/internal trade.

Bergstrand et al. (2015) argue that the estimates of trade agreements in gravity regressions may be biased upward because they potentially capture common globalization

members, which is similar to our finding. Furthermore, their results suggest that RTAs increase aggregate agricultural trade by 58%, which is in contrast to our finding that RTAs boost agricultural trade by only 4.2%, with is marginally insignificant.

[29] There are at least two possible explanations for the similar estimates in columns (5) and (6). First, PPML weights larger observations more than smaller ones. Hence, zero trade flows are weighted minimally when estimating the multiplicative model using PPML. Second, the extensive margin—whether to trade or not with a specific country—and the intensive margin—how much to trade with a specific country—may be driven by the same determinants/data-generating process.

[30] For recent contributions emphasizing the importance of taking into account domestic trade flows see Coşar and Demir (2016); Coşar and Fajgelbaum (2016); Ramondo et al. (2016); Donaldson (2018). Yotov (2021) surveys the literature to offer 15 reasons to estimate gravity equations with domestic, in addition to international, trade flows. Some potentially important implications of the use of domestic trade flows for quantifying the impact of various policies on agricultural trade include the possibility to study the effects of certain country-specific policies, cf. Beverelli et al. (2018), such as Sanitary and Phytosanitary Standards (SPS) and Maximum Residue Limits (MRL).

trends. To account for such trends, in columns (8) and (9) of Table 1, we follow Bergstrand et al. (2015) to introduce time-varying border dummy variables to our econometric model. Specifically, in column (8), we add a set of border dummies, which take a value of one for international trade for each year in our sample and they are equal to zero otherwise. Due to the presence of the country-pair-industry fixed effects in our specification, we can only obtain relative estimates for our border dummy variables, and we select 2016 as our reference year. Accordingly, all border estimates in column (8) should be interpreted relative to the border effects in 2016. The border estimates are negative, significant and decreasing over time, thus reflecting significant common globalization trends, which is consistent with the findings of Bergstrand et al. (2015). Also consistent with their results, we note that the estimates of the effects of WTO and RTAs are now smaller in magnitude. Furthermore, the coefficient estimates for trade sanctions also moves close to zero and other sanctions becomes marginally positive.

The results in column (9) of Table 1 are obtained after allowing for the globalization trends to vary across industries and time. With this final adjustment, our preferred econometric model to estimate the average impact of sanctions on agricultural trade becomes:

$$\begin{aligned} X_{ij,t}^{k} \quad =& \exp[\pi_{i,t}^{k} + \chi_{j,t}^{k} + \mu_{ij}^{k} + \sum_{t} \alpha_{t}^{k} BRDR_{ij,t} + \alpha_1 RTA_{ij,t} + \alpha_2 WTO_{ij,t}] \times \\ & \exp[\alpha_3 SANCT\_TRADE_{ij,t} + \alpha_4 SANCT\_OTHER_{ij,t}] \times \epsilon_{ij,t}^{k}, \end{aligned} \tag{2}$$

where, $X_{ij,t}^{k}$ is industry bilateral agricultural trade in levels including domestic trade flows for every year in our sample.[31] The estimator is PPML. $\pi_{i,t}^{k}$ and $\chi_{j,t}^{k}$ are exporter-industry-time and importer-industry-time fixed effects, respectively. μ_{ij}^{k} denotes the set of country-pair-industry fixed effects. $\sum_t \alpha_t^k BRDR_{ij,t}$ is the set of time-varying industry-specific border

[31] Cheng and Wall (2005) criticize fixed effects gravity specifications with consecutive-year data "on the grounds that dependent and independent variables cannot fully adjust in a single year's time" (Footnote 8, p. 52, Cheng and Wall, 2005). However, more recently, Egger et al. (2021) offer econometric and economic arguments for the use of pooled/consecutive-year data and we follow their recommendation to obtain our main results. In the robustness analysis, we experiment by using interval data and we obtain similar results.

indicators. Based on the specification in equation (2), our estimates in column (9) imply that, *ceteris paribus*, the trade sanctions that were in existence during the period of investigation have resulted in about a 10% decrease in the volume of agricultural trade between the sanctioned and sanctioning countries. Using a representative value for the trade elasticity ($\theta = 4$, cf. Simonovska and Waugh, 2014), the corresponding tariff equivalent of the average impact of sanctions in our sample is about 3%.[32]

In comparing the coefficient estimates of the naive gravity in column (1) to those from the theoretically consistent model that counts for both endogeneity and the globalization effects in column (9), we note the stark contrast of the coefficient estimates for trade sanctions—a statistically significant estimate of 0.089 in (1) versus a statistically significant estimate of -0.105 in (9)—and other sanctions—a statistically significant estimate of -0.059 in (1) versus an insignificant estimate of 0.037 in (9). This comparison highlights the importance of the developments in the empirical gravity literature for quantifying the impact of the determinants of agricultural trade.

3.2 The Heterogeneous Effects of Sanctions on Agricultural Trade

Building on our preferred econometric specification (2), in this section, we zoom in on the impact of sanctions on agricultural trade by exploring two dimensions of the data. First, we capitalize on the dimensionality of the GSDB dataset to obtain heterogeneous estimates of the effects of sanctions depending on their type. Then, we use the industry dimension of the ITPD-E dataset to obtain estimates for each agricultural industry in our sample. We conclude the analysis by examining the sanctions levied between Russia and Europe, North American, Japan, and allied countries over the Ukraine conflict.

To ease comparison, we reproduce the estimates from the last column of Table 1 in column (1) of Table 2. Given the important role food commodities played in shaping the

[32]The trade volume effect is obtained as $(\exp(-0.105) - 1) \times 100 = -9.97$, and the formula that we use for the tariff equivalent is $(\exp(-0.105/-4) - 1) \times 100 = 2.66$. See Yotov et al. (2016) for further discussion and details on the interpretation of gravity estimates.

implementation and scope of economic sanctions throughout the world starting in the early 2000s, in column (2) of Table 2, we allow for differential effects of complete vs. partial trade sanctions. Despite many countries abandoning complete sanctions in favor of partial sanction starting in early the 2000s, of the 201 sanction included in the study (see Table 8), 162 started after 1999 of which 6.8% (or 11) were complete sanctions. For the sanctions that started in or before 1999, 28.2% (or 11) were complete sanctions. Thus, while we see a dramatic drop in complete sanction after 1999, complete sanctions are still utilized.[33] Similar to Felbermayr et al. (2020), who analyze the impact of sanctions on aggregate trade, we find that complete trade sanctions have significantly stronger negative impact on agricultural trade as compared to partial trade sanctions.[34] Specifically, our estimates imply that, *ceteris paribus*, the complete trade sanctions in our sample have led to about a 73.0% decrease in the volume of bilateral trade between the sanctioned and sanctioning countries, or a corresponding tariff equivalent of 38.8%.

The specification that we use to obtain the results in column (3) of Table 2 distinguishes between the impact of sanctions depending on the direction of trade flows, i.e., sanctions on exports, sanctions on imports, or sanctions on trade in both directions. Based on these results, we conclude that sanctions that are imposed on trade in both directions have significant negative effects on agricultural trade while, on average, export sanctions expand agricultural trade and import sanctions alone do not impact agricultural trade. This result is in contrast to the findings for aggregate trade from Felbermayr et al. (2020), who find that import sanctions do have significant negative impact on aggregate trade and negative effects of export sanctions that are sizable and statistically significant. Thus, while sanc-

[33] For example, Russia levied complete import and export sanctions against Georgia between 2006 and 2011, and the United States levied a complete import sanctions on North Korea products between 2011 and 2019. It is worth noting that the US government banning imports from North Korea does not carry the same ethical concerns surrounding complete sanctions on food and medicine exports to developing countries.

[34] We find this result intuitive since, by definition, complete trade sanctions apply to all industries. Unfortunately, the GSDB does not allow us to identify the specific industries to which partial trade sanctions are applied. Below we address this challenge by obtaining estimates of the effects of some specific partial sanctions, e.g., the sanctions on Russia.

tions in only one direction hinder trade in general, these one-way sanctions do not hinder agricultural exports or imports as other countries that are not involved in the sanction import and export agricultural products to the sanctioned country. This result highlights the importance of examining the impact of policies on individual industries as well as to study the heterogeneous effects of sanctions for specific food industries, which we will do later.

In column (4) of Table 2, we simultaneously allow for the effects of sanctions to differ depending on their coverage (i.e., partial versus complete) and depending on the direction of trade flows that they target (i.e., exports, imports, or trade in both directions). Several findings stand out. First, we see that complete sanctions that target trade in both directions have the strongest negative impact on agricultural trade, while the impact of partial trade sanctions is also negative and significant but much smaller. We find these results intuitive. Second, we see that the impact of complete import sanctions is negative and significant, but partial import sanctions is positive and statistically insignificant. Thus, our gravity results are consistent with the anecdotal evidence in the introduction that partial sanctions, in contrast to complete sanctions, are specifically designed to exclude food products. Finally, we obtain a positive, large and significant estimate on complete export sanctions. This result seems quite interesting, however, it should be interpreted with caution because the only complete export sanction in our sample is the one imposed on Fiji by Australia and New Zealand in 2000.

One of the recent high-profile sanction cases that largely focused on food products is the conflict between Europe, North American, Japan, and allied countries with Russia that started in 2014 over the Ukraine conflict. Therefore, our next specification delivers a separate estimate for the impact of the sanctions imposed on and imposed by Russia starting in 2014. Specifically, to obtain the estimates in column (5) of Table 2, we generate a new dummy variable for the sanctions involving Russia in 2014,[35] RUS_ALL,[36] and we set the rest of the trade sanction dummies in our specification to zero when RUS_ALL is equal to one. Thus, we can interpret the estimate that we obtain for the sanctions on Russia as a level rather than as a deviation from the effects of the other trade sanction variables in our specification.[37] The estimates in column (5) suggest that the sanctions between Russia and the US, EU, and allied countries decreased Russia's international trade of agricultural products by about 45.9% (with a corresponding tariff equivalent of about 16.6%).

In columns (6) and (7) of Table 2, we zoom in on the impact of the sanctions involving Russia by distinguishing between the impact of the sanctions that were with EU versus non-EU countries, in column (6), and by obtaining country-specific estimates in column (7). The estimates in column (6) reveal the negative impact of the EU-Russian sanctions (RUS_EU) on agricultural trade have been significantly strong as trade declined by about 51%, while the non-EU sanctions (RUS_NONEU) did not have a significant impact on agricultural trade with Russia, on average. In comparison, Crozet and Hinz (2016) find that, after August 2014, the targeted sanctions reduced Western countries' exports to Russia of all commodities 27.7%, on average. When distinguishing EU versus Non-EU countries, their results show exports fell on average by 24.9% and 35.1%, respectively.

Interestingly, the results in column (7) show that the common estimate on RUS_NONEU masks significant heterogeneity. Specifically, we see from column (7) that the impact of the sanctions with the United States, Canada, Switzerland, Norway, Japan, and Ukraine was not significant, while agricultural trade between Russia and Australia actually increased after the sanctions. Inspection of the disaggregated industry trade data reveals that the positive

[35] Please see details about these sanctions in the data section. Also, while the ITPD-E database has the advantage of including domestic sales, the industry classifications do not allow us to correctly identify sanctioned agricultural industries versus non-sanctioned industries. Therefore, we focus on the average impact of the Russian food embargo across all agricultural industries.

[36] Note that for this row, "RUS_ALL", "RUS_NONEU", and "RUS_REST" are the coefficient names for column (5), (6), and (7), respectively.

[37] We note that even though the sanctions on Russia are present for only two years in our sample, we are gaining efficiency by pooling the individual agricultural industries together in our estimating sample.

estimate for Australian exports is driven by an increase in Australian exports to Russia in the following industries: 16 "Nuts", 17 "Live Cattle", 25 "Spices", and 26 "Other agricultural products". Note that the coefficient estimates for all non-Russian sanctions are very similar across columns (4)-(7).

We conclude the empirical analysis by obtaining industry-specific estimates of the impact of sanctions on agricultural trade. Tables 3 and 4 produce estimates that correspond to specifications (1)-(4) from Table 2 at the most disaggregated level in the ITPD-E, i.e., for all of the 26 agricultural industries. Specifically, the estimates in Panel A of Tables 3 are obtained with the same specification that is used to obtain the results in column (1) of Table 2, while the estimates in panels B and C correspond to the results in columns (2) and (3) of Table 2. Finally, due to the large number of estimates, we report the results that correspond to column (4) of Table 2 in a separate Table 4. For brevity and clarity of exposition, in Tables 3 and 4, we only report the results that are of central interest to us, i.e., the estimates of sanctions. The estimates of all other variables from each specification are available by request.

Overall, the estimates at the industry level from Tables 3 and 4 largely reinforce our conclusions thus far. However, the main message from the analysis with disaggregated data is that the effects of sanctions vary widely across the agricultural commodities in our sample and depending on the different types of sanctions. Accordingly, a potentially important policy implication of the industry analysis is that aggregate estimates of the effects of sanctions on agricultural trade may mask significant heterogeneity at the industry level.

Turning to specific results, we see from panel A of Table 3 that the estimates of trade sanctions are negative in most agricultural industries (15 out of 26) and statistically significant in 6 of them. The strongest significant negative impact of sanctions is for industries 21 ("Cocoa and cocoa products") and 5 ("Cereal products"), followed by 18 ("Live Swine"), 12 ("Fresh fruit"), 20 ("Other meant, etc."), and 26 ("Other agricultural products"). Interestingly, we also obtain one positive and statistically significant estimate in industry 2 ("Rice (raw)"). A possible explanation for this result is that "Rice" may not respond to complete or partial sanctions in the same way as other agricultural commodities because it is a key staple food commodity in many countries, particularly in Asia, and is used in humanitarian aid. Given high levels of domestic consumption in the largest rice producing countries and high level of domestic and international policy distortions, the international rice market is thinly traded and often does not respond in an economically consistent way to market signs.

The estimates from panel B of Table 3 confirm our previous finding that complete trade sanctions (with 15 negative and statistically significant coefficient estimates) are more effective in impeding agricultural trade as compared to partial trade sanctions (with only five negative and statistically significant coefficient estimates). Given that some partial trade sanctions are also found to have significant negative effects on agricultural trade, this finding has important policy implications because, given partial sanctions are typically designed to exclude food products, these results provide evidence that financial and transportation sanctions can indirectly impede agricultural trade. Furthermore, complete sanctions generally impede trade in bulk and sugar commodities (industries 1-11 and 23), but partial sanctions generally do not influence trade of these commodities. This may occur because bulk and sugar commodities are easy to transport and store. Furthermore, bulk commodities are staple food items that are central to humanitarian relief efforts and central to the ethical concerns of complete sanctions. Similar observations are made with industries 17, 22, 24, and 26. We also observe some outliers. For example, for complete sanctions in column (2), we obtain positive and significant estimates for industry 15 ("Prepared vegetables") and 21 ("Cocoa and cocoa products"), and a very large negative and significant estimate for industry 17 ("Live Cattle").

Panel C reveals that most of the estimates on the effects of sanctions that apply simultaneously to both imports and exports are negative and many of them are statistically significant. The disaggregated results show substantial heterogeneity in the impact of export and import sanctions by industry, with only four negative and five positive and statistically coefficient estimates for export sanctions and one negative and six positive for import sanctions. A possible explanation for this result is that once we move to the disaggregated industry level, the estimates of the effects of import and export sanctions are obtained with a relatively small number of degrees of freedom and, therefore, they are subject to the impact of outliers. Industry 15 is a case in point, because identification for the estimate on sanctions that apply simultaneously to exports and imports is only due to the sanction between Sierra Leone and Gambia.

Several findings stand out from the results reported in Table 4, where we allow for the effects of sanctions to vary simultaneously depending on the direction of sanctioned trade flows and depending on whether the sanctions are complete or partial. Complete trade sanctions that apply in both directions of trade have the strongest negative impact on agricultural trade, followed by partial sanctions that apply simultaneously to exports and to imports. The estimates on the import complete and import partial sanctions are mostly negative with many of them also statistically significant. However, we note that once we introduce all the interactions in Table 4, we can no longer identify the impact of many import complete sanctions. This also casts doubt on the robustness of the rest of the estimates in this table, and may explain the positive estimates that we obtain for some complete and partial export sanctions.

Given these difficulties with the disaggregated data, we proceed with the remainder of the analyses by grouping the 26 industries into five more aggregated categories, which we label Bulk commodities (BULK), Live animals, meat, and animal products (ANIMAL), Labor-intensive (LABOR), Processed foods (PRCSSD), and sugars (SUGARS). Table 7 offers a concordance between the fives aggregated categories and the underlying disaggregated industries.

Table 5 presents the estimated coefficients for the five aggregated groups (columns 1-5) for the impact of all trade sanctions (panel A), complete versus partial trade sanctions (panel B), sanctions based on the direction of trade (panel C), and both coverage and direction (panel

D). Based on the results in panel A, while trade sanctions reduce trade for all five groups, only animal and meat (column 2) and labor-intensive products (column 3) are statistically significant. However, as seen in panel B, complete sanctions restrict trade in all five groups with four being statistically significant. The tariff equivalents for complete sanctions range between about 29.5% for labor-intensive commodities to 171.4% for sugars. However, as with the results from panel A, partial sanctions hinder trade only for the animal and meat and labor-intensive product groups. Therefore, combining complete and partial sanction masks the negative impacts complete sanctions have on trade in these commodities.

Panel C further confirms our results on the impact of sanctions based on the direction of trade in Table 2 column (3) and Table 3 columns (4)-(6). Namely, sanctions concurrently on imports and exports hinder trade for all five groups, as seen by the negative coefficient estimates, and are statistically significant for four groups. By contrast, individually export and import sanctions generally do not impact trade for these groups, and even increase trade for labor-intensive goods.

The coefficient estimates presented in panel D for both coverage and direction largely confirms our results from the pooled analysis in Table 2 column (4) and individual industry results in Table 4 that both complete and partial sanctions on both imports and exports contract trade for all five groups and is statistically significant in four groups. Complete sanctions on both imports and exports reduce trade by between 71% for labor-intensive goods and 99% for sugars. Partial sanctions that apply to both imports and exports can also have large impacts, reducing trade by between 13.7% for bulk goods and 73.7% for sugars. These results for partial sanctions are surprising considering the importance of bulk goods as staple food in many developing countries and partial sanctions typically pertain to non-food items, financial, insurance, and transportation restriction.

Next, we consider the impact the 2014 sanctions between Russia and the EU, US, and allied countries for the five aggregate groups. Table 6 reports our estimates. The results in panel A and B of Table 6 correspond to columns (5) and (6) of Table 2, respectively.

Consistent with our pooled results from Table 2, the estimates in panel A of Table 6 are negative for four of the five groups and statistically significant for labor-intensive (trade reduction of 71.6%) and processed food (trade reduction of 33.6%) groups.[38] Thus, while the group-specific results do generally agree with the pooled results, heterogeneity exists in the estimates. Interestingly, the coefficient estimates on animal and meat products reported in column (2), the primary target of Russia's sanction against the EU, US, and allied countries, is positive, though insignificant. This result may arise because the data sets do not allow for the isolation of the specific commodities targeted by the sanctions.

The estimates in panel B of Table 6 allow for differential impact of sanctions between Russia and EU versus sanctions between Russia and the non-EU countries involved. The Russia-EU results are largely consistent with those from panel A, except trade of sugars rises significantly. Furthermore, the sanctions between Russia and non-EU countries is quite heterogeneous, with trade rising for the bulk column (1) and animal and meat groups column (2), with animal and meat being statistically significant, and declining for labor-intensive, processed food, and sugars, with sugars being statistically significant.

4 Conclusion

Trade sanctions are frequently used as foreign policy tool to punish or coerced foreign governments into altering its behavior. We investigate empirically whether trade sanctions affect agricultural trade. Our main findings are that trade sanctions are effective in impeding agricultural trade. However, the effectiveness varies by type, with complete sanctions being more effective than partial trade sanctions, by industry, by sanctioning and sanctions countries, and by the direction of trade flows. While partial sanctions reduce trade by a smaller degree than complete sanctions, this is an important finding because ethical concerns of heightened

[38] For comparison, Crozet and Hinz (2016) find that exports of embargoed agricultural products fell between 89.2% for EU countries and 91.9% for non-EU countries subject to the embargo. Collateral damage exists as trade in commodities not subject to the Russian embargo fell for EU countries by about 15%.

food insecurity following an embargo on food products was the primary impetus for governments to switch to partial sanctions that explicitly exclude agricultural products. We also show the effects of the bilateral trade sanctions involving Russia, which reduced trade substantially, particularly between the EU and Russia.

In order to quantify the effects of sanctions, we utilized two novel datasets—the 2020 edition of the International Trade and Production Database for Estimation (ITPD-E) and the 2021 edition of the Global Sanctions Database (GSDB) and employed the latest developments in the structural gravity literature. To understand which elements are crucial for a proper quantification of the trade effects of sanctions, we introduce the various developments over the last decades sequentially: control for multilateral resistance terms, introduce country-(industry) fixed effects, introduce bilateral-(industry) fixed effects, use the PPML estimator, include intra-national trade flows, and control for (industry-specific) globalization trends.

We believe that the usage of the databases and the described methods are useful for additional quantification of other sanctions. Additionally, the obtained estimates, together with a suitable underlying theoretical structure, would allow one to perform counterfactual analysis of the effects of sanctions on prices for producers and consumers, as well as for welfare. For example, this opens up the possibility to quantify the arguments that US economic sanctions "[...] are an increasing menace to US business" (Rarick, 2007, Abstract).

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Table 1: Sanctions and Agricultural Trade: A Gravity Approach

	(1) NAIVE	(2) REMOTE	(3) CNTRY_FES	(4) PAIR_FES	(5) PPMML	(6) NOZERO	(7) INTRA	(8) GLOBZN	(9) GLOBZN_SECT
LN_DIST	-0.337	-0.442	-0.968						
	(0.009)**	(0.009)**	(0.010)**						
CNTG	0.918	0.887	0.788						
	(0.029)**	(0.029)**	(0.027)**						
LANG	0.192	0.133	0.396						
	(0.016)**	(0.016)**	(0.017)**						
CLNY	0.245	0.227	0.253						
	(0.022)**	(0.021)**	(0.020)**						
WTO	0.266	0.229	0.521	-0.094	0.042	0.018	0.452	0.285	0.310
	(0.016)**	(0.016)**	(0.045)**	(0.043)*	(0.079)	(0.076)	(0.045)**	(0.043)**	(0.044)**
RTA	0.259	0.250	0.254	-0.050	0.061	0.064	0.094	0.042	0.039
	(0.016)**	(0.016)**	(0.015)**	(0.015)**	(0.025)*	(0.025)*	(0.025)**	(0.025)$^{+}$	(0.025)
TRADE_SANCT	0.089	0.136	-0.246	-0.131	-0.141	-0.122	-0.127	-0.099	-0.105
	(0.033)**	(0.032)**	(0.044)**	(0.028)**	(0.034)**	(0.033)**	(0.031)**	(0.033)**	(0.033)**
SANCT_OTHER	-0.059	-0.053	-0.095	-0.005	-0.036	-0.020	-0.011	0.044	0.037
	(0.018)**	(0.018)**	(0.021)**	(0.016)	(0.025)	(0.025)	(0.025)	(0.024)$^{+}$	(0.024)
LN_OUTPUT	0.328	0.320							
	(0.002)**	(0.002)**							
LN_EXPNDR	0.327	0.327							
	(0.002)**	(0.002)**							
LN_EXP_REM		0.728							
		(0.019)**							
LN_IMP_REM		-0.263							
		(0.022)**							
BRDR_2000								-0.658	
								(0.042)**	
BRDR_2001								-0.615	
								(0.041)**	
BRDR_2002								-0.614	
								(0.039)**	
BRDR_2003								-0.539	
								(0.037)**	
BRDR_2004								-0.534	
								(0.036)**	
BRDR_2005								-0.482	
								(0.034)**	
BRDR_2006								-0.468	
								(0.032)**	
BRDR_2007								-0.424	
								(0.033)**	
BRDR_2008								-0.289	
								(0.037)**	
BRDR_2009								-0.244	
								(0.027)**	
BRDR_2010								-0.271	
								(0.028)**	
BRDR_2011								-0.284	
								(0.028)**	
BRDR_2012								-0.228	
								(0.024)**	
BRDR_2013								-0.146	
								(0.023)**	
BRDR_2014								-0.062	
								(0.023)**	
BRDR_2015								-0.042	
								(0.016)**	
N	1106626	1106626	1086425	1043012	2607463	1043012	2661771	2661771	2661771
R^2	0.256	0.265	0.573	0.847					

Notes: This table offers a series of specifications that sequentially introduce various developments from the empirical gravity literature. Specifically, the results in column (1) are from an OLS specification with standard gravity variables and without controls for the structural multilateral resistances (MRs). Column (2) introduces a-theoretical controls for the MRs. Column (3) uses exporter-industry-time and importer-industry-time fixed effects. Column (4) adds country-pair-industry fixed effects. Column (5) employs the PPML estimator, while the estimates in column (6) are also obtained with PPML but without zero trade flows. Column (7) adds observations for domestic trade flows to our dependent variable. Column (8) controls common (across countries and sectors) globalization effects. Finally, the specification in column (9) allows for the globalization trends to vary across industries. Standard errors are clustered by industry-country-pair and are reported in parentheses, $^{+}$ $p < 0.10$, * $p < .05$, ** $p < .01$. See text for further details.

Table 2: On the Heterogeneous Effects of Sanctions on Agricultural Trade

	(1) MAIN	(2) COMPLT	(3) DIRCTN	(4) BOTH	(5) RUSSIA	(6) RUS_EU	(7) RUS_ALL
WTO	0.310	0.310	0.321	0.320	0.343	0.342	0.342
	(0.044)**	(0.044)**	(0.044)**	(0.044)**	(0.044)**	(0.044)**	(0.044)**
RTA	0.039	0.039	0.050	0.049	0.042	0.042	0.042
	(0.025)	(0.025)	(0.025)$^{+}$	(0.025)$^{+}$	(0.025)$^{+}$	(0.025)$^{+}$	(0.025)$^{+}$
TRADE_SANCT	-0.105						
	(0.033)**						
SANCT_OTHER	0.037	0.037	0.031	0.031	0.039	0.039	0.039
	(0.024)	(0.024)	(0.024)	(0.024)	(0.024)$^{+}$	(0.024)	(0.024)
COMPL_SANCT		-1.311					
		(0.379)**					
PARTL_SANCT		-0.100					
		(0.033)**					
EXPRT_IMPRT_SANCT			-0.264				
			(0.044)**				
EXPRT_SANCT			0.137				
			(0.079)$^{+}$				
IMPRT_SANCT			0.059				
			(0.044)				
EXPRT_IMPRT_COMPL_SANCT				-1.417	-1.360	-1.360	-1.361
				(0.395)**	(0.389)**	(0.389)**	(0.389)**
EXPRT_IMPRT_PARTL_SANCT				-0.255	-0.172	-0.172	-0.172
				(0.045)**	(0.048)**	(0.048)**	(0.048)**
IMPRT_COMPL_SANCT				-0.334	-0.265	-0.265	-0.266
				(0.150)*	(0.148)$^{+}$	(0.148)$^{+}$	(0.148)$^{+}$
IMPRT_PARTL_SANCT				0.058	0.058	0.057	0.057
				(0.044)	(0.044)	(0.044)	(0.044)
EXPRT_COMPL_SANCT				0.818	0.821	0.821	0.821
				(0.265)**	(0.265)**	(0.265)**	(0.265)**
EXPRT_PARTL_SANCT				0.135	0.145	0.144	0.143
				(0.079)$^{+}$	(0.080)$^{+}$	(0.080)$^{+}$	(0.080)$^{+}$
RUS_ALL/RUS_NONEU/RUS_REST					-0.614	-0.124	-0.262
					(0.099)**	(0.183)	(0.436)
RUS_EU						-0.713	-0.706
						(0.097)**	(0.098)**
RUS_CAN							-0.589
							(0.377)
RUS_USA							-0.165
							(0.253)
RUS_CHE							-0.069
							(0.409)
RUS_NOR							0.158
							(0.266)
RUS_AUS							1.006
							(0.306)**
RUS_JPN							0.123
							(0.338)
RUS_UKR							-0.203
							(0.507)
N	2661771	2661771	2661771	2661771	2661771	2661771	2661771

Notes: This table reports estimates for the heterogeneous effects of sanctions. For comparison, column (1) reproduces our benchmark results from column (9) of Table (1), and all subsequent estimates are obtained with the same specification but with different sanction variables. Specifically, column (2) distinguishes between the effects of complete and partial trade sanctions. Column (3) obtains results for sanctions that are imposed in both directions, export sanctions, and import sanctions. Column (4) simultaneously allows for the effects of sanctions to differ depending on whether they are complete or partial and depending on the direction of trade flows. Column (5) obtains a separate estimate of the impact of the sanctions on Russia, while column (6) distinguishes between the effects of the sanctions on Russia between EU and non-EU members. Finally, column (7) obtains country-specific estimates of the effects of the sanctions on Russia. Standard errors are clustered by industry-country-pair and are reported in parentheses, $^{+}$ $p < 0.10$, * $p < .05$, ** $p < .01$. See text for further details.

Table 3: Industry Estimates of the Effects of Sanctions on Agricultural Trade

Sect.ID	A. TRADE	B. COMPLETE vs. PARTIAL		C. EXPORT vs. IMPORT		
		CMPLT	PARTL	EXP_IMP	EXPRT	IMPRT
	(1)	(2)	(3)	(4)	(5)	(6)
1	-0.134	-1.569*	-0.112	-.302*	0.314	-0.177
2	2.105*	-2.355*	2.105*	2.298*	-0.326	-0.769
3	0.113	-0.275	0.113	-0.00200	0.367	0.233
4	0.00500	-4.477*	0.00800	-0.0590	.574*	-0.0240
5	-1.001*	-2.261*	-.996*	-1.134*	-0.792	-0.781
6	-0.150	-1.047*	-0.150	-0.217	-2.497*	-0.0380
7	-0.0620	-2.091*	-0.0610	-.226*	-.698*	0.134
8	-0.110	-8.396*	-0.110	-0.179	-0.273	-0.0740
9	-0.170	-30.69	-0.170	-1.996*	-18.278*	1.531
10	-0.328	-3.994*	-0.321	-1.348*	0.394	0.193
11	0.0550	-1.205*	0.0600	-0.0410	-0.184	.521*
12	-.309*	-1.416*	-.3*	-.744*	.457*	.125*
13	-0.0200	-.846*	-0.0190	-.806*	0.312	.22*
14	0.117	0.0770	0.118	0.0630	-0.597	.2*
15	1.589	10.493*	1.589	1.829	-1.377	-0.352
16	0.0200	-0.143	0.0210	-0.106	0.182	0.0740
17	0.151	-19.093*	0.150	0.518	0.295	-0.784
18	-.978*	1.054	-.985*	-3.713*	0.330	-.817*
19	0.191	0.842	0.185	-0.619	0.0520	.57*
20	-.234*	-1.002	-.234*	-.409*	-0.148	-0.137
21	-1.015*	12.762*	-1.015*	-1.072*	3.527*	1.241*
22	0.0670	-1.948*	0.0700	0.0810	.601*	-0.104
23	-0.0300	-1.430	-0.0300	0.0780	-.215*	0.0510
24	-0.149	-1.614*	-0.149	-.336*	0.199	0.0650
25	0.00900	-0.382	0.0100	0.0110	.283*	-0.177
26	-.163*	-1.552*	-0.163	-0.188	-0.230	-0.0790

Notes: This table reproduces some of the specifications from Table (2) for each disaggregated agricultural industry in our sample. Specifically, the estimates in Panel A correspond to the results in column (1) of Table (2), but for brevity we only report the estimates on trade sanctions. The results in Panel B correspond to the results from column (2) of Table (2). Finally, the estimates in Panel C are obtained with the same specification as column (3) of Table (2). For brevity, we do not report standard errors, however, those are clustered by industry-country-pair and are available upon request, $^{+}$ $p < 0.10$, * $p < .05$, ** $p < .01$. See text for further details.

Table 4: Industry Estimates of the Effects of Sanctions on Agricultural Trade

	(1)	(2)	(3)	(4)	(5)	(6)
Sect.ID	EXP_IMP_CMPL	EXP_IMP_PRTL	EXP_CMPL	EXP_PRTL	IMP_CMPL	IMP_PRTL
1	-1.637*	-0.248	-2.254	0.310		-0.182
2	-2.271*	2.299*	-12.16	-0.326		-0.769
3	-0.358	-0.00100	-0.116	0.365		0.233
4	-4.578*	-0.0540	8.919*	.571*		-0.0220
5	-2.25*	-1.127*		-0.791		-0.781
6	-1.11*	-0.214	6.866*	-2.503*		-0.0420
7	-2.343*	-.224*	2.3*	-.703*	-14.22	0.134
8	-21.591*	-0.180	5.558*	-0.276	-22.678*	-0.0740
9	-27.62	-2*		-21.37		1.529
10	-4.729*	-1.334*	1.429	0.394		0.191
11	-1.36*	-0.0330	1.741*	-0.186	-12.058*	.523*
12	-1.512*	-.733*	0.677	.458*	-10.735*	.124*
13	-2.551*	-.804*	1.094*	0.307	-1.023*	.22*
14	0.00400	0.0640	0.507	-0.605		.2*
15	11.45*	1.828	6.334*	-1.377		-0.352
16	-0.220	-0.104	0.743	0.182	-8.733*	0.0750
17	-18.841*	0.564		0.290		-0.799
18	0.239	-3.757*		0.299		-.822*
19	0.770	-0.650	2.126*	0.0330		.57*
20	-1.125	-.408*	6.376*	-0.149		-0.137
21		-1.072*	12.771*	3.527*		1.241*
22	-1.937*	0.0840	-.882*	.593*		-0.103
23	-3.62*	0.0780	0.647	-.215*		0.0510
24	-1.252	-.336*	-5.249*	0.199		0.0650
25	-.588*	0.0130	1.414	.278*	3.121*	-0.180
26	-1.814*	-0.187	0.477	-0.232	-.364*	-0.0790

Notes: This table reproduces the estimates from column (4) of Table (2) for each disaggregated agricultural industry in our sample. For brevity, we do not report standard errors, however, those are clustered by industry-country-pair and are available upon request, $^{+}$ $p < 0.10$, * $p < .05$, ** $p < .01$. See text for further details.

Table 5: On the Effects of Sanctions on Agricultural Trade by Industry

	(1) BULK	(2) ANIMAL	(3) LABOR	(4) PRCSSD	(5) SUGARS
A. Trade Sanctions					
TRADE_SANCT	-0.064	-0.154	-0.190	-0.097	-0.328
	(0.053)	(0.090)$^{+}$	(0.061)**	(0.061)	(0.315)
B. Coverage: Complete vs. Partial Sanctions					
COMPL_SANCT	-1.350	-0.989	-1.033	-1.168	-3.994
	(0.454)**	(1.067)	(0.238)**	(0.239)**	(0.670)**
PARTL_SANCT	-0.057	-0.153	-0.185	-0.096	-0.321
	(0.053)	(0.090)$^{+}$	(0.061)**	(0.061)	(0.315)
C. Direction: Export vs. Import Sanctions					
EXPRT_IMPRT_SANCT	-0.163	-0.453	-0.676	-0.116	-1.349
	(0.070)*	(0.169)**	(0.065)**	(0.075)	(0.511)**
EXPRT_SANCT	0.051	0.036	0.350	-0.008	0.391
	(0.115)	(0.223)	(0.142)*	(0.113)	(0.434)
IMPRT_SANCT	0.021	-0.017	0.160	-0.050	0.194
	(0.080)	(0.098)	(0.041)**	(0.075)	(0.344)
D. Sanctions by Coverage and Direction					
EXPRT_IMPRT_COMPL_SANCT	-1.411	-1.138	-1.241	-1.292	-4.729
	(0.462)**	(1.180)	(0.208)**	(0.275)**	(0.637)**
EXPRT_IMPRT_PARTL_SANCT	-0.147	-0.451	-0.670	-0.115	-1.336
	(0.071)*	(0.170)**	(0.066)**	(0.075)	(0.516)**
IMPRT_COMPL_SANCT	-18.515	0.000	-0.644	-0.146	0.000
	(406.015)		(0.167)**	(0.158)	
IMPRT_PARTL_SANCT	0.019	-0.017	0.160	-0.050	0.192
	(0.080)	(0.098)	(0.041)**	(0.075)	(0.344)
EXPRT_COMPL_SANCT	0.333	2.083	1.031	0.216	1.430
	(1.381)	(0.441)**	(0.243)**	(0.455)	(0.961)
EXPRT_PARTL_SANCT	0.048	0.035	0.349	-0.010	0.390
	(0.115)	(0.223)	(0.143)*	(0.113)	(0.434)

Notes: Panels A through D of this table reproduce the estimates from columns (1) through (4) from Table (2), respectively, for each of the five broad agricultural sectors in our sample. Standard errors are clustered by industry-country-pair and are reported in parentheses, $^{+}$ $p < 0.10$, * $p < .05$, ** $p < .01$. See text for further details.

Table 6: On the Effects of Sanctions on Russia's Agricultural Trade

	(1) BULK	(2) ANIMAL	(3) LABOR	(4) PRCSSD	(5) SUGARS
A. Overall impact of the sanctions on Russia					
RUS_ALL	-0.160	0.317	-1.260	-0.410	-1.928
	(0.159)	(0.234)	(0.101)**	(0.154)**	(1.344)
N	632333	212243	416719	688044	66626
B. Impact of EU vs. non-EU sanctions on Russia					
RUS_EU	-0.284	0.201	-1.326	-0.401	2.351
	(0.177)	(0.240)	(0.102)**	(0.169)*	(1.098)*
RUS_NONEU	0.250	0.800	-0.542	-0.447	-3.806
	(0.244)	(0.430)$^{+}$	(0.377)	(0.313)	(0.627)**
N	632333	212243	416719	688044	66626

Notes: Panels A and B of this table reproduce the estimates from columns (5) and (6) from Table (2), respectively, for each of the five broad agricultural sectors in our sample. For brevity, we only report the estimates of the effects of the sanctions on Russia. All other estimates are available upon request. Standard errors are clustered by industry-country-pair and are reported in parentheses, $^{+}$ $p < 0.10$, * $p < .05$, ** $p < .01$. See text for further details.

Table 7: Agricultural Industries ITPD-E: Classification and Concordance

ID	Disaggregated Industry Description	Aggregated Industry Description
1	Wheat	Bulk commodities
2	Rice (raw)	Bulk commodities
3	Corn	Bulk commodities
4	Other cereals	Bulk commodities
5	Cereal products	Bulk commodities
6	Soybeans	Bulk commodities
7	Other oilseeds (excluding peanuts)	Bulk commodities
8	Animal feed ingredients and pet foods	Bulk commodities
9	Raw and refined sugar and sugar crops	Sugars
10	Other sweeteners	Sugars
11	Pulses and legumes, dried, preserved	Bulk commodities
12	Fresh fruit	Labor-intensive crops
13	Fresh vegetables	Labor-intensive crops
14	Prepared fruits and fruit juices	Processed foods
15	Prepared vegetables	Processed foods
16	Nuts	Labor-intensive crops
17	Live Cattle	Live animals, meat, and animal products
18	Live Swine	Live animals, meat, and animal products
19	Eggs	Live animals, meat, and animal products
20	Other meats, livestock products, and live animals	Live animals, meat, and animal products
21	Cocoa and cocoa products	Labor-intensive crops
22	Beverages, nec	Processed foods
23	Cotton	Bulk commodities
24	Tobacco leaves and cigarettes	Processed foods
25	Spices	Processed foods
26	Other agricultural products, nec	Processed foods

Notes: This table lists the disaggregated industries in our sample, as well as the five broad sectoral categories that correspond to them.

Table 8: Trade Sanctions, GSDB, 2000-2016

(1) Case ID	(2) Target(s)	(3) Sender(s)	(4) Start	(5) End	(6) Type
3	Afghanistan	EU (+)	2001	2002	Exp.Partl.
8	Afghanistan	UN	2000	2002	Exp.Partl.
12	Afghanistan	United States	1999	2002	Exp.Partl., Imp.Partl.
18	Albania, Montenegro, Liechtenstein, Iceland	Russia	2015	2019	Imp.Partl.
24	Angola	UN	1993	2002	Exp.Partl.
25	Angola	UN	1997	2002	Exp.Partl.
26	Angola	UN	1998	2002	Imp.Partl.
28	Angola	United States	1993	2003	Exp.Partl., Imp.Partl.
33	Argentina	Iran	2003	2007	Exp.Partl.
41*	Armenia	Azerbaijan	1989	2019	Exp.Compl., Imp.Compl.
42	Armenia	Turkey	1993	2019	Exp.Compl., Imp.Compl.
44	Australia	Russia	2014	2019	Imp.Partl.
52	Belarus	Canada	2006	2016	Exp.Partl.
55	Belarus	EU (+)	2011	2016	Exp.Partl.
56	Belarus	Russia	2010	2010	Exp.Partl.
61	Belarus	United States	2006	2019	Exp.Partl., Imp.Partl.
62	Belize	EU	2001	2004	Imp.Partl.
63	Belize	EU	2014	2014	Imp.Partl.
64	Belize	United States	1997	2004	Imp.Partl.
65	Belize	United States	2012	2019	Exp.Partl., Imp.Partl.
73	Brazil	NAFTA	2001	2001	Imp.Partl.
96	Burundi	United States	2016	2019	Exp.Partl., Imp.Partl.
125	Canada	China	2003	2016	Imp.Partl.
126	Canada	Japan	2003	2006	Imp.Partl.
127	Canada	Korea, South	2015	2016	Imp.Partl.
130	Canada	Mexico	2003	2016	Imp.Partl.
133	Canada	Taiwan	2015	2016	Imp.Partl.
134	Canada	United States	2003	2005	Imp.Partl.
139	Central African Republic	Kimberly Process Participants	2013	2016	Imp.Partl.
148	Ceylon	United States	2012	2019	Exp.Partl., Imp.Partl.
193	Colombia	United States	2011	2014	Exp.Partl., Imp.Partl.
194	Colombia	United States	2014	2018	Exp.Partl., Imp.Partl.
214	Congo, Democratic Republic of the	United States	2006	2019	Exp.Partl., Imp.Partl.
224	Cote d'Ivoire	EU (+)	2005	2016	Exp.Partl.
228	Cote d'Ivoire	UN	2005	2014	Exp.Partl., Imp.Partl.
240	Cuba	United States	1962	2019	Exp.Compl., Imp.Compl.
253	Dominican Republic	United States	2011	2019	Exp.Partl., Imp.Partl.
258	EU	Canada	1996	2015	Imp.Partl.
259	EU	Russia	2014	2019	Imp.Partl.
268	Egypt, Arab Rep.	EU	2013	2019	Exp.Partl.
275	Egypt, Arab Rep.	Saudi Arabia	2016	2017	Exp.Partl.
297	Eritrea	Russia	2009	2018	Exp.Partl.
301	Eritrea	UN	2011	2018	Imp.Partl.
317	Fiji	Australia	2000	2000	Exp.Compl.
326	Fiji	EU	2007	2015	Exp.Partl.
331	Fiji	New Zealand	2000	2000	Exp.Compl.
336	Fiji	United Kingdom	2000	2003	Exp.Partl.
361	France	United States	1998	2017	Imp.Partl.
362	France	United States	2003	2003	Imp.Partl.
370	Georgia	Russia	2006	2011	Exp.Compl., Imp.Compl.
371	Georgia	Russia	2006	2013	Imp.Partl.
372	Georgia	Russia	2006	2013	Imp.Partl.
373	Georgia	Russia	2009	2011	Exp.Partl.
388	Greece	United States	2013	2019	Exp.Partl., Imp.Partl.
405	Guinea	EU (+)	2009	2014	Exp.Partl.
408	Guinea	Switzerland	2010	2014	Exp.Partl.
441	Honduras	Venezuela	2009	2009	Exp.Partl.
445	India	Canada	1974	2008	Exp.Partl., Imp.Partl.
453	India	United States	1974	2008	Exp.Partl.
455	India	United States	1998	2001	Exp.Partl.
457	Indonesia	Australia	2011	2011	Exp.Partl.
461	Indonesia	EU	1999	2000	Exp.Partl.
470	Indonesia	United States	2011	2019	Exp.Partl., Imp.Partl.
471	Iran	Australia	2008	2016	Exp.Partl., Imp.Partl.
472	Iran	Canada	2010	2016	Exp.Partl.
473	Iran	Canada	2011	2016	Exp.Partl.
475	Iran	Canada	2012	2016	Exp.Partl., Imp.Partl.
476	Iran	Canada	2013	2016	Exp.Compl., Imp.Compl.
477	Iran	Canada	2016	2019	Exp.Partl.
479	Iran	EU	2012	2016	Exp.Partl.
480	Iran	EU (+)	2012	2016	Exp.Partl., Imp.Partl.
482	Iran	Japan	2006	2016	Imp.Partl.
483	Iran	Korea, South	2010	2012	Imp.Partl.
485	Iran	Switzerland	2011	2016	Exp.Partl., Imp.Partl.
486	Iran	Switzerland	2016	2016	Exp.Partl.
487	Iran	UN	2006	2016	Exp.Partl., Imp.Partl.
490	Iran	UN	2010	2016	Exp.Partl.
493	Iran	United States	1984	2016	Exp.Partl.
495	Iran	United States	1995	2016	Exp.Compl., Imp.Compl.
496	Iran	United States	1996	2019	Exp.Partl.
499	Iraq	EU	1990	2003	Exp.Partl.
502	Iraq	UN	1990	2003	Exp.Compl., Imp.Compl.
503	Iraq	UN	1991	2003	Exp.Compl., Imp.Compl.
513	Ireland	United States	1998	2014	Imp.Partl.
518	Israel	League of Arab States	1950	2019	Exp.Compl., Imp.Compl.

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(1) Case ID	(2) Target(s)	(3) Sender(s)	(4) Start	(5) End	(6) Type
520	Israel	Spain, United Kingdom	2014	2019	Exp.Partl.
524	Jamaica	United States	2011	2019	Exp.Partl., Imp.Partl.
535	Korea, North	Australia	2006	2019	Exp.Partl., Imp.Partl.
537	Korea, North	Canada	2011	2019	Exp.Compl., Imp.Compl.
538	Korea, North	EU	2006	2019	Exp.Partl.
541	Korea, North	Japan	2006	2019	Imp.Compl.
542	Korea, North	Japan	2009	2019	Exp.Compl.
543	Korea, North	Korea, South	2010	2019	Exp.Compl., Imp.Compl.
545	Korea, North	UN	2006	2019	Exp.Partl., Imp.Partl.
548	Korea, North	United States	1955	2008	Exp.Compl., Imp.Compl.
549	Korea, North	United States	2002	2006	Exp.Partl.
551	Korea, North	United States	2008	2019	Exp.Partl.
552	Korea, North	United States	2011	2019	Imp.Compl.
560	Kyrgyzstan	Uzbekistan	1999	2000	Exp.Partl.
561	Kyrgyzstan	Uzbekistan	2000	2000	Exp.Partl.
562	Kyrgyzstan	Uzbekistan	2001	2001	Exp.Partl.
563	Kyrgyzstan	Uzbekistan	2005	2006	Exp.Partl.
564	Kyrgyzstan	Uzbekistan	2010	2010	Exp.Partl.
565	Kyrgyzstan	Uzbekistan	2013	2014	Exp.Partl.
566	Kyrgyzstan	Uzbekistan	2014	2014	Exp.Partl.
577*	Lebanon	Israel	2006	2006	Exp.Partl., Imp.Partl.
591	Liberia	EU	2001	2016	Imp.Partl.
594	Liberia	UN	2001	2007	Imp.Partl.
595	Liberia	UN	2003	2006	Imp.Partl.
599	Liberia	United States	2004	2015	Exp.Partl., Imp.Partl.
601	Libya	Canada	2011	2019	Exp.Partl., Imp.Partl.
604	Libya	EU (+)	2011	2019	Exp.Partl.
607	Libya	Switzerland	2011	2019	Exp.Partl.
608	Libya	UN	1992	2003	Exp.Partl.
609	Libya	UN	1993	2003	Exp.Partl.
612	Libya	United States	1978	2004	Exp.Partl.
613	Libya	United States	1981	2004	Exp.Partl.
614	Libya	United States	1982	2004	Exp.Partl., Imp.Partl.
615	Libya	United States	1986	2004	Exp.Partl., Imp.Partl.
616	Libya	United States	1996	2019	Exp.Partl.
621	Lithuania	Russia	2013	2014	Imp.Partl.
645	Mali	United States	2013	2013	Exp.Partl., Imp.Partl.
655	Moldova	Russia	2006	2007	Imp.Partl.
656	Moldova	Russia	2013	2019	Imp.Partl.
657	Moldova	United States	2012	2019	Exp.Partl., Imp.Partl.
661	Myanmar	Canada	2007	2012	Exp.Compl., Imp.Compl.
667	Myanmar	EU (+)	2000	2003	Exp.Partl.
668	Myanmar	EU (+)	2003	2010	Exp.Partl.
669	Myanmar	EU (+)	2010	2013	Exp.Partl., Imp.Partl.
670	Myanmar	EU (+)	2013	2019	Exp.Partl.
674	Myanmar	Switzerland	2000	2006	Exp.Partl.
675	Myanmar	Switzerland	2006	2012	Exp.Partl.
678	Myanmar	United States	1989	2016	Imp.Partl.
679	Myanmar	United States	1990	2016	Imp.Compl.
681	Myanmar	United States	2003	2016	Exp.Partl.
682	Myanmar	United States	2007	2016	Exp.Partl., Imp.Partl.
683	Myanmar	United States	2008	2016	Imp.Partl.
689	Nepal	India	2015	2016	Exp.Partl.
728	Nigeria	United States	2013	2019	Exp.Partl., Imp.Partl.
734	Norway	China	2010	2018	Imp.Partl.
735	Norway	Russia	2014	2019	Imp.Partl.
767	Palestine	United States	2012	2016	Exp.Partl., Imp.Partl.
830	Russia	Australia	2014	2019	Exp.Partl.
831	Russia	Canada	2014	2019	Exp.Partl.
832	Russia	EU	2014	2019	Exp.Partl., Imp.Partl.
834	Russia	EU (+)	2014	2019	Imp.Partl.
836	Russia	Japan	2014	2019	Imp.Partl.
839	Russia	Switzerland	2014	2019	Exp.Partl., Imp.Partl.
841	Russia	United States	2014	2019	Exp.Partl., Imp.Partl.
852	Sierra Leone	ECOWAS	1997	2003	Exp.Compl., Imp.Compl.
854*	Sierra Leone	Liberia	2001	2003	Imp.Partl.
857	Sierra Leone	UN	2000	2003	Exp.Partl.
863	Somalia	EU (+)	2012	2019	Imp.Partl.
864	Somalia	Switzerland	2009	2019	Imp.Partl.
865	Somalia	Switzerland	2013	2019	Imp.Partl.
868	Somalia	UN	2012	2019	Imp.Partl.
871	Somalia	United States	2010	2019	Imp.Partl.
872	Somalia	United States	2012	2019	Imp.Partl.
943	Sudan	United States	1997	2019	Exp.Compl., Imp.Compl.
944	Sudan	United States	2006	2017	Exp.Partl., Imp.Partl.
945	Sudan	United States	2006	2019	Exp.Partl.
953	Switzerland	Libya	2010	2011	Exp.Compl., Imp.Compl.
955	Syria	Australia	2011	2019	Exp.Partl., Imp.Partl.
956	Syria	Canada	2011	2019	Exp.Partl., Imp.Partl.
957	Syria	Canada	2012	2019	Exp.Partl.
958	Syria	Canada	2013	2019	Exp.Partl.
961	Syria	EU (+)	2011	2013	Exp.Partl., Imp.Partl.
962	Syria	EU (+)	2013	2019	Exp.Partl., Imp.Partl.
963	Syria	League of Arab States	2011	2019	Exp.Partl., Imp.Partl.
965	Syria	Switzerland	2011	2012	Exp.Partl.
966	Syria	Switzerland	2012	2019	Exp.Partl.
969	Syria	United States	2004	2019	Exp.Partl., Imp.Partl.
971	Syria	United States	2011	2019	Exp.Partl., Imp.Partl.

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(1) Case ID	(2) Target(s)	(3) Sender(s)	(4) Start	(5) End	(6) Type
977	Taiwan	United States	2013	2019	Exp.Partl., Imp.Partl.
978*	Tajikistan	Uzbekistan	2009	2009	Exp.Partl.
979*	Tajikistan	Uzbekistan	2010	2010	Exp.Partl.
980*	Tajikistan	Uzbekistan	2012	2012	Exp.Partl.
992	Thailand, South Vietnam	Cambodia	2004	2007	Imp.Partl.
1027	Ukraine	Canada	2014	2019	Exp.Partl., Imp.Partl.
1028	Ukraine	EU (+)	2014	2014	Exp.Partl.
1029	Ukraine	EU (+)	2014	2019	Exp.Partl., Imp.Partl.
1030	Ukraine	Japan	2014	2019	Imp.Partl.
1033	Ukraine	Russia	2006	2006	Exp.Partl.
1034	Ukraine	Russia	2009	2009	Exp.Partl.
1035	Ukraine	Russia	2014	2014	Exp.Partl.
1036	Ukraine	South Vietnam	2015	2018	Imp.Partl.
1038	Ukraine	Switzerland	2014	2019	Exp.Partl., Imp.Partl.
1039	Ukraine	United States	2014	2019	Exp.Partl., Imp.Partl.
1045	United States	Brazil	2003	2016	Imp.Partl.
1046	United States	Canada	2003	2006	Imp.Partl.
1047	United States	Japan	2003	2013	Imp.Partl.
1049	United States	Russia	2014	2019	Imp.Partl.
1052	Uzbekistan	EU	2005	2009	Exp.Partl.
1053	Uzbekistan	Switzerland	2006	2009	Exp.Partl.
1060	Venezuela	United States	2015	2019	Exp.Partl., Imp.Partl.
1076	Yugoslavia	EU	1998	2001	Exp.Partl., Imp.Partl.
1077	Yugoslavia	EU	1999	2000	Exp.Partl.
1090	Yugoslavia	United States	1999	2000	Exp.Partl.
1096	Zimbabwe	EU(+)	2002	2019	Exp.Partl.
1097	Zimbabwe	Switzerland	2002	2019	Exp.Partl.
1099	Zimbabwe	United Kingdom	2002	2019	Exp.Partl.

Notes: This table lists the active trade sanction cases from the GSDB during the period 2000-2019. Out of the 201 possible trade sanctions from the GSDB, there were only 6 cases (41, 577, 854, 978, 979, and 980) for which there was no corresponding trade data in the ITPD-E. These cases are denoted with '*' in column (1), which lists the case IDs, as they appear in the GSDB. The cases are sorted by the name of the sanctioned/target country in column (2). Column (3) lists the sanctioning/sender states. EU (+) in this column denotes cases where the EU was joined by other countries. Often these countries include Cyprus, Malta, Turkey, Croatia, Macedonia, Montenegro, Iceland, Albania, Serbia, Bosnia and Herzegovina, Liechtenstein, Norway, Ukraine, Moldova, Armenia, Georgia, Switzerland. However, not all of these countries join the EU sanctions at all times. For details, we refer the reader to the description of the original GSDB data at https://www.globalsanctionsdatabase.com. Columns (4) and (5) report the start and the end year of the sanction, respectively. Some sanctions do not actually end in 2019, however, this year is listed because it is the last year in the GSDB. The last year in our estimating sample is actually 2016, and it was predetermined by data availability in the ITPD-E. Finally, column (6) describes the type of trade sanctions.