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Economic Sanctions and Export Margins

Rishav Bista[1] | Brandon Sheridan[2]

[1]Department of Economics, Texas Christian University, Fort Worth, Texas, USA | [2]Department of Economics, Elon University, Elon, North Carolina, USA

Correspondence: Brandon Sheridan (r.bista@tcu.edu)

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ABSTRACT

As global integration has increased over time, so too has the use of economic sanctions as a policy tool. Sanctions have the potential to affect trade flows regardless of other intended objectives. We use a gravity model framework and the updated Global Sanctions Data Base to characterize the heterogeneous response of exports to various types of sanctions. Specifically, we use disaggregated product-level trade flows for 247 countries over the period 1962–2019 and focus primarily on exporter and importer sanctions. We extend the literature by showing that, when looking separately at the extensive and intensive margins of trade, complete sanctions have the strongest impact on the extensive margin, while partial sanctions matter most for the intensive margin. We also explore whether the effects of sanctions are anticipated and/or persist over time, and we find some evidence of both effects. We further add to the existing literature by using quantile regression in a panel data context with fixed effects to allow for heterogeneity in the impact of sanctions on trade margins. We find that complete sanctions disproportionately reduce exports for countries with low initial export volume, while partial sanctions are more likely to reduce exports in countries with high initial export volume.

JEL Classification: F1, C1

1 | Introduction

The use of economic sanctions has increased over time because they offer an attractive diplomatic option for foreign policy disputes, humanitarian concerns, and an alternative to military intervention (Hufbauer and Jung 2020). Felbermayr, Kirilakha, Syropoulos, et al. (2020) [1–2] explain that economic sanctions are "actions (or threats) undertaken by sanctioning states or international organizations (the senders) to punish, constrain, or, more generally, to influence the behavior of sanctioned states, private entities, and/or powerful elites (the targets)." Along with sanctions, global trade has also increased sharply in recent decades. While this integration has benefited the global economy in numerous ways, it has also led countries to become more vulnerable to disruptions in their trading relationships.

Economic sanctions are one such disruption, as they can introduce uncertainty both for the targeted economy and the country imposing sanctions. Therefore, sanctions are a type of trade cost and can impact the nature and number of bilateral trading relationships, that is, export margins. In some sense, sanctions may function similarly to other trade costs in that the most efficient firms may be able to lobby their governments for exceptions or identify other potential markets for their goods. However, sanctions are also unique because they are costs imposed by the sending country's government on *their own* producers, in contrast to, say, tariffs or anti-dumping duties (Felbermayr et al. 2019). Research suggests that changes in exports may happen along two margins of adjustment, the extensive and intensive margins (Besedeš and Prusa 2011; Chaney 2008), and sanctions, by their very nature, may impact the margins of trade differently. For example, sanctions can be placed on individual people, firms, or entire products or countries. We explore the impact of trade sanctions on the extensive and intensive margins for exporting countries at the product level over the period 1962–2019. Many recent studies on economic sanctions focus on the specific cases

of Russia or Iran (Bělín and Hanousek 2021; Larch et al. 2022; Nguyen and Do 2021), and while these are helpful studies, we add to this literature by taking a more comprehensive view of how sanctions may heterogeneously affect exporting countries. We use the gravity model of trade and the Global Sanctions Data Base (GSDB) (Felbermayr, Kirilakha, Syropoulos, et al. 2020; Kirilakha et al. 2021; Syropoulos et al. 2022) to characterize the nature of disruptions to exports more fully than previous studies.

Our primary contributions are as follows. First, throughout our analysis we focus on the intensive and extensive margins of trade for a large number of countries over a long time period. Identifying changes along the export margins is important, as previous studies show an increase in the extensive margin is positively associated with lower economic volatility (Buch, Döpke, and Strotmann 2009) and higher productivity (Hummels and Klenow 2005; Regis 2018), while the intensive margin is found to be important for export growth (Besedeš and Prusa 2011). Generally, we find that the negative impact of trade sanctions works mostly through the intensive margin. Second, within trade sanctions we focus on exporter and importer sanctions. That is, does the exporting country face sanctions from within (exporter sanctions) or from outside (importer sanctions), and do these sanctions affect their exports differently? We find that exporter sanctions have a large negative effect on the intensive margin, while importer sanctions have a negative impact on the extensive margin. The latter result may be indicative of increases in trade uncertainty. Third, we look at whether there are anticipatory or persistence effects of sanctions (Dai et al. 2021; Gutmann, Neuenkirch, and Neumeier 2021), and we find some evidence for both. Finally, building on recent trade literature (Bas, Mayer, and Thoenig 2017; Novy 2013), we allow for exports to respond to sanctions heterogeneously across countries based on a country's existing volume of exports and find that countries with the lowest trade volumes are the most harmed by complete exporter sanctions, while countries with the highest trade volume are the most harmed by partial exporter sanctions.

The rest of the paper is organized as follows. We begin by providing a brief overview of economic sanctions, how their use has evolved over time, and how recent literature has characterized the impact of sanctions on the extensive and intensive margins of trade. We then outline our empirical strategy, followed by a discussion of results. We conclude in the final section with implications for policymakers and potential extensions for future research.

2 | Export Margins and Economic Sanctions

A robust literature has emerged demonstrating the importance of the intensive and extensive margins of trade, building on the work of Melitz (2003), Eaton, Kortum, and Kramarz (2004), and Chaney (2008), among many others. They demonstrate that firm-level heterogeneity can lead to differences in the decision over whether, and to what extent, to export to various markets in the face of variable and/or fixed costs. Sanctions act as a fixed cost because firms have to either find new markets in unsanctioned countries or lobby their government for an exception to the sanctions. Dutt, Mihov, and Zandt (2013) show that a reduction in fixed costs can lead to firm entry and, therefore, an increase in the extensive margin. Furthermore, there are simultaneously fewer exports per firm due to the higher number of firms in the market, leading to a decrease in the intensive margin. Changing trade costs can lead to differing changes in the margins of trade that may be masked by aggregation of trade flows. In this paper, we look at the effect of sanctions placed on exports by either the exporting country (exporter sanction) or the importing country (importer sanction). In either case, it is likely that sanctions are put in place on products that are currently being traded, which should lead to a decrease in export volume for that product. This is a decrease in the intensive margin. Likewise, if entire product categories are sanctioned, then the extensive margin should decline as well, assuming that alternative products are not exported in their place.

Although sanctions often have political objectives, there are usually economic consequences in the form of reduced GDP growth and reduced trade volume for the sanctioned countries. Neuenkirch and Neumeier (2015) find that sanctions can reduce annual GDP growth rates in sanctioned countries by up to 5 percentage points, depending on the nature of the sanctions, and these negative effects can persist for a decade. Gutmann, Neuenkirch, and Neumeier (2021) similarly find that the level of GDP per capita declines 4% within the first couple of years after the sanctions are imposed and persists for several years. Therefore, we explore the possibility that sanctions may have anticipatory or persistent effects on a sender country's exports. As imports and exports comprise part of GDP, and because some sanctions are specifically targeted towards trade, it is natural to consider how such sanctions affect the trade performance of a country. Many studies show that the imposition of sanctions causes trade to decline between the sender and target countries (Felbermayr et al. 2019; Gutmann, Neuenkirch, and Neumeier 2021; Larch et al. 2022). We confirm some of the empirical findings of these existing studies and also identify new effects when allowing for a more heterogeneous response of exports to sanctions. Larch, Luckstead, and Yotov (2021) find that partial and complete sanctions both significantly reduce the trade volume of agricultural products, implying the intensive margin is important. Our study differs by including all trade, rather than just agricultural trade. As Larch, Luckstead, and Yotov (2021) explain, a US law exempted many agricultural products from unilateral sanctions post-2000, so it is worth considering whether the effect they find generalizes when also considering products not subject to the law.

We provide more detail in Section 3.1, but briefly we view the extensive margin as a measure of export diversification—number of products exported—and the intensive margin as a measure of how deep a relationship is—export volume per product. Sanctions act as a non-tariff trade barrier and, as such, are expected to reduce exports. However, it is less clear whether this decline occurs because of a declining extensive margin, an intensive margin, or some combination of the two. Within our dataset, we observe the number of products exported per country pair. For the extensive margin, one way a decrease could occur is due to the product being directly sanctioned. There could also be a decrease in the extensive margin due to increased uncertainty (Handley 2014) regarding future potential sanctions. Firms may view sanctioned countries as risky investments and attempt to find alternative markets for their products, even if their particular product is not among those sanctioned. Crozet et al. (2021)

look at data from French firms that were doing business with Russia and Iran when the latter two countries became subject to economic sanctions. They find that the extensive margin is significantly impacted, with a huge reduction in products traded during the sanctioned period. However, they also find that the impact is lessened for multinational firms, who have locations in multiple countries. Le (2022) finds that sanctions reduce export survival, which would also imply a decrease in the extensive margin. This effect was stronger for trading partners with a longer distance between them and reduced if the firms were part of a multinational corporation.

The intensive margin refers to the volume of exports for a given product, and we think about it similarly as with the extensive margin. As with the extensive margin, a decrease can occur for a sanctioned product, but we are not sure whether to expect a large or small decrease overall. An affected firm may seek out a new market, which would take the intensive margin to zero for that particular country-pair, or they may simply lobby for a full or partial exception, which would result in a smaller decrease. For both margins, an important consideration is that sanctions could potentially increase uncertainty associated with exports. Firms may view a sanction on one product to a country as increasing the probability that other products will soon receive similar treatment. As such, firms may then decide to reduce their exporting relationship with the sanctioned country, even for products that are not necessarily covered by the sanctions. Handley (2014) shows that uncertainty costs could particularly harm the extensive margin.

3 | Methodology and Data

3.1 | Gravity Model of Trade

Using the most recent advancements in the gravity model of trade, we first follow Felbermayr, Syropoulos, et al. (2020) and estimate a model with the following general form:

$$\ln T_{ijt} = \alpha_0 + \alpha_1 S_{ijt} + \beta X_{ijt} + \sum \alpha_2 EXP_{it} + \sum \alpha_3 \text{IMP}_{jt} + \sum \alpha_4 \text{ExIm}_{ij} + \epsilon_{ijt} \quad (1)$$

In our model, T represents export flows from country i to j in time t and S represents a vector of various measures of sanctions. It is important to emphasize that we are focusing on the *exporting* country, i, and how they respond to various forms of sanctions. Our starting point is to define S as an indicator variable that takes the value of 1 for the various types of sanctions that country i may experience in time t. These include sanctions on arms, military, travel, finance, trade, and "other" as defined by Felbermayr, Kirilakha, Syropoulos, et al. (2020); we provide more details in Section 3.3 about the sanction data. We extend our definition of S to allow for heterogeneity in the type of trade sanction. More precisely, we have measures for whether a sanction is complete or partial, exporter- or importer-imposed, and the combination thereof (e.g., partial exporter sanction, etc.). We expect exports to experience a large reduction in response to a complete sanction, but it is less clear how much exports may decrease in response to partial sanctions. The latter are also more common since 2000, so we are particularly interested in that response. Exporter sanctions are imposed on exporting firms in the sending country, whereas importer sanctions are imposed by the receiving country on firms in the exporting country. Therefore, it is possible that responses may differ depending on the origin of the sanction.

X_{ijt} is a vector of common time-varying gravity controls to account for any change in trade policy between countries during our time period, which includes dummy variables for whether a country in the bilateral pair is in an economic integration agreement (EIA_{ijt}), a member of the European Union (EU_{ijt}), or is a member of the World Trade Organization (WTO_{ijt}). Following common practice, we include exporter-time (EXP_{it}) and importer-time (IMP_{jt}) fixed effects to capture any time-varying characteristics specific to the exporting or importing country, respectively (Anderson and van Wincoop 2003). Finally, ExIm_{ij} are country-pair fixed effects that account for time-invariant bilateral trade-costs. In our context, these country-pair fixed effects help mitigate potential endogeneity concerns with respect to economic sanctions (Baier and Bergstrand 2007). We cluster standard errors at the country-pair level.

As discussed in 2, a potential limitation of using aggregate trade data is that it masks important underlying heterogeneity along the margins of exports. To accommodate this possibility and extend the trade sanctions literature, we use the four-digit Standard International Trade Classification (SITC) Revision 2 product-level trade data to construct the extensive and the intensive margins of exports. We use the count method (Bernard et al. 2007; Dutt, Mihov, and Zandt 2013) to decompose total exports T_{ijt} into the extensive and intensive margins of exports as follows:

$$\ln T_{ijt} = \ln N_{ijt} + \ln \frac{T_{ijt}}{N_{ijt}} \quad (2)$$

where the product-level extensive margin, N, represents the number of products country i exports to j – essentially a measure of export diversification. The intensive margin is the average volume of exports per product from country i to j and so therefore captures the "intensity" of a trading relationship.

As is common practice in the trade literature, we use a Poisson pseudo-maximum likelihood (PPML) rather than a log-linear specification (Santos Silva and Tenreyro 2006). In the PPML specification, the dependent variable enters in levels and our estimating equation from 1 can be expressed as follows:

$$T_{ijt} = \exp\Big(\alpha_0 + \alpha_1 S_{ijt} + \beta X_{ij} + \sum \alpha_2 EXP_{it} + \sum \alpha_3 \text{IMP}_{jt} + \sum \alpha_4 \text{ExIm}_{ij}\Big) + \epsilon_{ijt} \quad (3)$$

Our count method decomposition for the exports margins Equation (2) is adjusted analogously:

$$T_{ijt} = N_{ijt} \times \frac{T_{ijt}}{N_{ijt}} \quad (4)$$

We discuss the results of applying these estimating equations in Table 3 of Section 4, but we first discuss our data in more detail.

3.2 | Data: Exports and Gravity Controls

We use an unbalanced panel of 247 countries over the time period 1962–2019. Following recent practice, we use annual data rather than time-interval data (Egger, Larch, and Yotov 2022). The Dynamic Gravity Database (DGD) of the US International Trade Commission (Gurevich et al. 2021) contains data for many variables commonly used in gravity model estimation, including our variables for whether a country is in an EIA, the EU, or the WTO.[1] The disaggregated product-level export data are from Simoes and Hidalgo (2011) and the World Integrated Trade Solutions Database (2013) and are at the 4-digit SITC level.[2] We follow others (Baier, Bergstrand, and Feng 2014; Foster, Poeschl, and Stehrer 2011; Kehoe and Ruhl 2013) and use these data to construct our extensive and intensive margin measures. Summary statistics for these data are available in Table 1. Interestingly, approximately 2.6% of our sample experiences some sort of trade sanction, meaning there are over 25,000 trade sanctions between country pairs during our time period. Exporter sanctions, for which the sanctioning country is limiting *its own* exports, are about twice as common in our data as importer sanctions, for which a country's exports are sanctioned by its importing partner. Partial sanctions are nearly three times as common as complete sanctions, partly reflecting the decreased use of the latter from 2000 onward.

3.3 | Data: The Global Sanctions Data Base

Felbermayr, Syropoulos, et al. (2020) created, and then updated (Kirilakha et al. 2021; Syropoulos et al. 2022), the Global Sanctions Data Base (GSDB), which provides rich detail on 1325 sanctions for more than 190 countries over the period 1950–2022 across multiple dimensions: type, political objective, and extent of success. As our trade data only cover the period 1962–2019, our sanction coverage is likewise limited to this time period. This leaves us with information on 1032 unique sanctions. However, one country may be sanctioned by multiple different entities (e.g., the United Nations) or countries. For example, China was sanctioned in 1962 by the Organization of American States (OAS), which shows up as multiple sanctions in our data. This is a single sanction within the GSDB database, but a large contingent of countries within the OAS were signatories, meaning the trade sanction could directly affect bilateral trade between China and those signatory countries. This makes it look as though the number of sanctions in our data is larger than in the GSDB, but it is due to the disaggregation of those multilateral and plurilateral sanctions. Second, some sanctions end prior to 1962 or begin after 2019. Therefore, for a few of the sanctions in our data, we observe the beginning point or ending point, but not necessarily both. For example, Cuba has two trade sanctions from the United States—one from 1960–1964 and another from

TABLE 1 | Summary statistics.

	(1)	(2)	(3)	(4)	(5)
Variables	**Obs**	**Mean**	**SD**	**Min**	**Max**
Total exports	978,237	1,576,110	17,272,921	0	2,054,004,864
Extensive margin	978,237	79	143	0	775
Intensive margin	978,237	10,579	212,774	0	110,830,952
Sanction type					
All sanctions	978,237	0.068	0.251	0.000	1.000
Arms	978,237	0.044	0.206	0.000	1.000
Military	978,237	0.028	0.165	0.000	1.000
Travel	978,237	0.026	0.160	0.000	1.000
Financial	978,237	0.033	0.179	0.000	1.000
Trade	978,237	0.026	0.159	0.000	1.000
Other	978,237	0.013	0.115	0.000	1.000
Exporter sanction	978,237	0.022	0.147	0.000	1.000
Importer sanction	978,237	0.011	0.104	0.000	1.000
Complete sanction	978,237	0.009	0.094	0.000	1.000
Complete exporter sanction	978,237	0.004	0.063	0.000	1.000
Complete importer sanction	978,237	0.005	0.071	0.000	1.000
Partial sanction	978,237	0.024	0.152	0.000	1.000
Partial exporter sanction	978,237	0.018	0.133	0.000	1.000
Partial importer sanction	978,237	0.006	0.076	0.000	1.000
Gravity controls					
EIA member	978,237	0.046	0.209	0.000	1.000
EU member	978,237	0.015	0.122	0.000	1.000
WTO member	978,237	0.370	0.483	0.000	1.000

Note: Total exports and the intensive margin are in real 1984 dollars.

TABLE 2 | Country-pair-year sanctions.

Variable	Count
Exporter sanction	21,601
Importer sanction	10,650
Complete sanction	8772
Partial sanction	23,267
Complete exporter sanction	3891
Complete importer sanction	4963
Partial exporter sanction	17,710
Partial importer sanction	5687

Note: The total sample size is 978,237.

1962 to the present. Therefore, we see some variation in our data from the former sanction but not from the latter (because the sanction is always in place during our time period). Third, our primary focus is on trade sanctions, of which there are 394 unique events during our time period. Finally, our unit of observation is country-pair-year, which means our data show many more than 394 sanctions because many sanctions are in place for multiple years. For example, a single trade sanction lasting five years will be counted once per year for a total of five sanctions for that particular country-pair. Collectively, this yields a maximum of 32,251 country-pair-year trade sanctions in our data, of which 21,601 are exporter sanctions (exporting country prohibits exports to sanctioned trading partner) and 10,650 are importer sanctions (sanctioned country prohibits imports from sanctioning country). Therefore, approximately 3.3% of the country pairs in our sample experience an exporter or importer sanction within our time period. A detailed breakdown can be seen in Table 2.

There are data for numerous types of sanctions, including trade, financial, travel, arms, and a few miscellaneous types of sanctions that Felbermayr, Syropoulos, et al. (2020) classify simply as 'other.' Within trade sanctions, we focus on sanctions directed at exports, but we also report results for the other types of sanctions because they may also impact exports. For example, while we expect that export sanctions will have a larger negative impact on export flows than other types of sanctions, it is quite possible that financial sanctions may also reduce exports because financial markets are often crucial to facilitating exports (Beck 2002). Sanctions can also be classified as complete or partial, which refers to sanctions on all exports or a smaller range of specific products, respectively. Also, as shown in Felbermayr, Syropoulos, et al. (2020), sanctions tend to be imposed by higher-income countries against lower-income countries. For example, they show that countries in western Europe impose the most sanctions and that these sanctions are levied mostly against countries in Africa and Eastern Europe.[3] As one might expect, Felbermayr, Kirilakha, Syropoulos, et al. (2020) find that complete export sanctions reduce trade much more (76%) between the sender and target countries than partial trade sanctions (14%), but they investigate the narrow case of sanctions on Iran. Furthermore, Felbermayr, Syropoulos, et al. (2020) only have results for partial *trade* sanctions; we extend this by including results for partial export and import sanctions separately. We also incorporate more trading relationships in our analysis to see if that empirical relationship holds up more generally. It is important to note that complete sanctions are less common after the year 2000, when the U.S. passed a law to prevent certain products from being included in sanctions due to humanitarian concerns (Larch, Luckstead, and Yotov 2021). Thus, even if we expect complete sanctions to decrease exports more than partial sanctions, it is less likely that newer sanctions will be complete in nature. As such, we are especially interested in the impact of partial sanctions.

TABLE 3 | Economic sanctions and trade margins.

	Total exports (1)	Extensive margin (2)	Intensive margin (3)
EU member	0.42***	0.03	0.65***
	(0.04)	(0.01)	(0.06)
WTO member	0.16***	0.06**	0.62***
	(0.07)	(0.02)	(0.09)
EIA member	0.11***	−0.11***	0.26***
	(0.03)	(0.01)	(0.03)
Arms sanction	−0.07	−0.04***	0.17
	(0.05)	(0.02)	(0.12)
Military sanction	0.05	0.03	0.04
	(0.04)	(0.02)	(0.10)
Travel sanction	−0.05	−0.09***	−0.01
	(0.07)	(0.02)	(0.10)
Financial sanction	−0.04	0.03**	−0.22**
	(0.04)	(0.01)	(0.07)
Other sanction	0.11	−0.05***	0.14
	(0.07)	(0.02)	(0.12)
Trade sanction	−0.13***	−0.02	−0.13*
	(0.03)	(0.01)	(0.08)
N	978,237	978,237	978,237

Notes: The dependent variable is real exports in levels, and all estimates are obtained with the PPML estimator. Exporter-time, importer-time, and country-pair fixed effects are included. Robust standard errors, clustered by country pairs, are in parentheses.
***$p < 0.01$. **$p < 0.05$. *$p < 0.10$.

4 | Results

4.1 | Trade Sanctions and Trade Margins

We begin our analysis in column 1 of Table 3 with a PPML estimation of a gravity model with sanctions. Our hypothesis is that sanctions likely have a heterogeneous impact depending on the goal of the specific sanction, so we disaggregate sanctions by type. Notice that trade sanctions are negatively associated with exports in a statistically and economically meaningful way; the coefficient estimate of −0.13 means that having a trade sanction in place is associated with a decline in exports from country i to j of approximately 12%.[4] In columns 2 and 3, we disaggregate total exports into the extensive and intensive export margins, and show that the intensive margin appears to be driving the decrease in total exports. While our focus is on trade sanctions, there are some other interesting sanctions results to discuss. Notice that arms and travel sanctions lead to a decrease in the extensive margin of approximately 3.9% and 8.6%, respectively. Based on the mean number of products traded per country in 2, this

corresponds to arms sanctions reducing the extensive margin, on average, by about three products and travel sanctions reducing the extensive margin by nearly seven products. We also see that financial sanctions are important for exports. Financial sanctions can make it more difficult to find the funding needed to develop trading relationships, can make it harder to pay workers, and can make it challenging to maintain production levels. Financial development is important for growth, so limiting that through sanctions is unsurprisingly associated with lower exports (Beck 2002). Our results suggest this is particularly important for existing trading relationships, which decline nearly 20% as a result of financial sanctions. We also see that there is a small increase in the extensive margin as a result of sanctions, meaning a larger variety of products are exported to the sanctioned country. One possible explanation is that the financial sanctions are targeted in such a way as to incentivize exporting products that are not affected by, or subject to, the financial sanctions in question. Besedeš, Goldbach, and Nitsch (2021) discuss financial sanctions in more detail. It is clear that different types of sanctions may impact exports differently. Our focus in this paper is trade sanctions, and so for the remainder of the paper we place our focus on the heterogeneous response of exports to various types of trade sanctions.

4.2 | Disaggregating Trade Sanctions

We further extend the current sanctions literature in Tables 4 and 5, and disaggregate trade sanctions into exporter and importer sanctions and complete and partial sanctions, respectively. We follow that by showing the combination in Table 6, looking at complete exporter and importer sanction, as well as partial exporter and importer sanction. First, recall that exporter sanctions are showing the impact of an exporting country placing sanctions on products they themselves export. Importer sanctions are imposed on the exporting country by the importer. Thus, the source of the sanction is a different country in each case and may therefore have a differing impact. While both types of sanctions, exporter and importer, increase uncertainty for exporting firms, it is possible that importer sanctions create relatively more uncertainty for exporting firms. Under exporter sanctions, more efficient firms could potentially lobby for exemptions or create special interest groups that could be granted beneficial provisions. These options are less viable under importer sanctions. At the very least, there might be asymmetric information between exporters and importers such that sanctions impact exporters differently depending on the origin. Complete sanctions are comprehensive across product categories, while partial sanctions are often much more targeted. As such, we expect complete sanctions to much more negatively affect exports.

In Table 4, exporter sanctions have a statistically significant effect on exports, showing a decrease in total export volume of about 11.3%. This appears to be driven entirely by the intensive margin, for which an exporter sanction is associated with a 21.3% decline in export volume per product. However, the exporter sanction has no statistically meaningful impact on the extensive (goods) margin. Even if an exporter sanction completely prohibits the export of certain items to a particular trade partner, there are often exceptions granted if firms can successfully lobby their government. So, even though the intensive margin declines, the fact that a given good is exported at all means the extensive margin will remain unaffected. Furthermore, in the initial year of the sanction, it is also likely that a good was at least exported for part of the year until the sanction went into effect. Again, this means there may be a volume effect, but the count of products exported to a country in the initial sanction year is unaffected.

TABLE 4 | Economic sanctions and trade margins.

	Total exports (1)	Extensive margin (2)	Intensive margin (3)
Exporter sanction	−0.12***	0.01	−0.24**
	(0.05)	(0.02)	(0.10)
Importer sanction	0.06	−0.07**	−0.33
	(0.04)	(0.02)	(0.24)
N	978,237	978,237	978,237

Notes: The dependent variable is real exports in levels, and all estimates are obtained with the PPML estimator. Exporter-time, importer-time, and country-pair fixed effects are included. Robust standard errors, clustered by country pairs, are in parentheses.
***$p < 0.01$. **$p < 0.05$. *$p < 0.10$.

TABLE 5 | Economic sanctions and trade margins.

	Total exports (1)	Extensive margin (2)	Intensive margin (3)
Complete sanction	−1.20***	−0.56***	−0.50***
	(0.20)	(0.07)	(0.17)
Partial sanction	−0.06*	0.01	−0.29**
	(0.03)	(0.01)	(0.14)
N	978,237	978,237	978,237

Notes: The dependent variable is real exports in levels, and all estimates are obtained with the PPML estimator. Exporter-time, importer-time, and country-pair fixed effects are included. Robust standard errors, clustered by country pairs, are in parentheses.
***$p < 0.01$. **$p < 0.05$. *$p < 0.10$.

TABLE 6 | Economic sanctions and trade margins.

	Total exports (1)	Extensive margin (2)	Intensive margin (3)
Complete exporter sanction	−1.28***	−0.47***	−0.40***
	(0.29)	(0.10)	(0.18)
Complete importer sanction	−1.23***	−0.41***	−0.59**
	(0.31)	(0.08)	(0.25)
Partial exporter sanction	−0.10**	0.04**	−0.23**
	(0.05)	(0.02)	(0.10)
Partial importer sanction	−0.03	−0.04**	−0.30
	(0.04)	(0.02)	(0.26)
N	978,237	978,237	978,237

Notes: The dependent variable is real exports in levels, and all estimates are obtained with the PPML estimator. Exporter-time, importer-time, and country-pair fixed effects are included. Robust standard errors, clustered by country pairs, are in parentheses.
***$p < 0.01$. **$p < 0.05$. *$p < 0.10$.

Interestingly, importer sanctions do not appear to have a statistically significant effect on total trade volume, but they are negatively correlated with the extensive margin, showing approximately a 7% decline in the number of products exported to the sanctioning country. Remember that importer sanctions in our data are defined to equal 1 if country *i*'s (exporter) exports are sanctioned by country *j* (importer). One possible explanation is that certain products are banned entirely, leading to fewer products exported to the sanctioning country. Another possibility is that importer sanctions may involve more uncertainty than exporter sanctions. With exporter sanctions, a firm can negotiate directly with its own government for exceptions, and they may be able to better anticipate whether and to what extent future sanctions may occur. With importer sanctions, it may be harder to negotiate exceptions, and the foreign political environment may be volatile or, at a minimum, less transparent regarding future policy directions. As such, an importer sanction may function as an increase in uncertainty costs for the exporting country, which research suggests tends to impact the extensive margin more (Handley 2014).

In Table 5, we look at the effect of complete and partial sanctions. Our results show that complete sanctions of any type (import and/or export) are associated with approximately 70% lower exports, which is consistent with the findings from Felbermayr, Syropoulos, et al. (2020). The extensive and intensive margins are each affected similarly, showing decreases of 43% and 39%, respectively. In theory, complete sanctions should mean that exports are reduced to zero. However, this rarely happens in practice due to exceptions that may be granted for humanitarian reasons, potential corruption, legal means of sanction evasion, or simply the timing of when the sanction is imposed. For example, if the sanction is imposed near the end of the year, then our annual trade data will still show positive trade flows for that year.[5] As expected, partial sanctions have a smaller effect than complete sanctions. However, keep in mind that more than twice as many sanctions are partial in nature, and the vast majority of sanctions since 2000 are partial (Larch, Luckstead, and Yotov 2021). Partial sanctions appear to work entirely through the intensive margin, showing a reduction of 25%. However, as Table 6 shows, it also matters whether the complete or partial sanctions are imposed by the exporter or the importer. Column 1 shows that complete export sanctions are associated with 72% fewer exports which is quantitatively similar to the findings from Felbermayr, Syropoulos, et al. (2020). However, Felbermayr, Kirilakha, Syropoulos, et al. (2020) do not separately consider partial exporter sanctions and do not look at the export margins. We find a much smaller, but still economically meaningful, 9.5% reduction in exports when subject to partial exporter sanctions. We also see that partial exporter sanctions reduce the intensive margin by about 20%, while they lead to an increase in the extensive margin of about 4%. This suggests that firms may potentially be diversifying into other product categories when one of the currently exported products is subject to a sanction, but, as we explain in 4.3.2, this result is not robust to other specifications. Interestingly, the only statistically significant impact of a partial importer sanction is a decline in the extensive margin of about 4%. This is consistent with our earlier results that suggest a sanction on exports imposed by the importing country leads to increased uncertainty and acts as a sort of fixed cost. If firms are uncertain about whether future products may be sanctioned, then they may seek new markets for their products that are not yet sanctioned.

Overall, we generally see the expected negative relationship between sanctions and exports. This is strongest for complete sanctions and is similar for each margin. However, over the last 20 years, sanctions have become increasingly partial in nature. For partial sanctions, we see the export margins behave quite differently. Partial exporter sanctions have a much stronger negative effect on the intensive margin, while partial importer sanctions only appear to negatively affect the extensive margin.

4.3 | Extensions

Our results demonstrate that trade sanctions mostly have a large negative impact on exports. However, this effect seems to be more pronounced for the intensive margin relative to the extensive margin. We also see that sanctions imposed by an importing country may be creating uncertainty, thereby leading to seeking out other markets. To develop a more complete picture of how sanctions affect exports, we consider that sanctions may be anticipated and that their impact may persist even once sanctions are lifted. We also explore the possibility of trade diversion, whereby countries seek out new partners when their exports are sanctioned.

4.3.1 | Anticipation and Persistence

In Table 7, we investigate whether there are anticipatory or persistence effects related to sanctions for both aggregate exports and the export margins, as some studies suggest may occur. Dai et al. (2021) find anticipatory effects of sanctions, meaning that trade volume changes leading up to the date that sanctions officially take place as firms react to the increasing probability that sanctions take effect. Dai et al. (2021) recommend accounting for these anticipatory and lingering effects by including leads and lags in the empirical model. They also recommend looking at 1-year, 3-year, and 5-year time intervals to allow sufficient time for sanctions to take effect. Gutmann, Neuenkirch, and Neumeier (2021) explore this issue by creating dummy variables equal to one for the three years prior to the beginning of a sanction (Pre) and the three years after a sanction has ended (Post). While they focus primarily on the impact on economic growth, for which they find sanctions harm growth, they also investigate the relationship with trade. They find that trade declines in the first couple of years sanctions are in place, but these negative effects do not seem to persist once sanctions have ended. We extend this work by using bilateral export data rather than the country aggregates used in Gutmann, Neuenkirch, and Neumeier (2021). We follow their lead and create a "pre-sanction" variable equal to one in the three years prior to the sanction taking place. If exporters anticipate they may need to find new outlets for their products, then they may begin that process sooner rather than later. We also create a dummy variable equal to one for the five years once a sanction has ended. While Gutmann, Neuenkirch, and Neumeier (2021) use a three-year post-period, we include a couple of additional years to get a better gauge at how long effects may persist.[6] Column 1 of Table 7 shows the impact for aggregate exports, and we see that complete

TABLE 7 | Anticipation and persistence of sanctions.

	Total exports (1)	Extensive margin (2)	Intensive margin (3)
Complete sanctions			
Pre-complete sanction	−0.10	−0.04	−0.23**
	(0.09)	(0.04)	(0.11)
Complete sanction	−1.24***	−0.58***	−0.55***
	(0.21)	(0.06)	(0.19)
Post-complete sanction	−0.35***	−0.09***	0.06
	(0.12)	(0.02)	(0.16)
Partial sanctions			
Pre-partial sanction	−0.05	−0.02	−0.16
	(0.03)	(0.01)	(0.10)
Partial sanction	−0.07**	−0.01	−0.31**
	(0.03)	(0.01)	(0.14)
Post-partial sanction	−0.04	−0.04***	−0.03
	(0.03)	(0.01)	(0.12)
Observations	978,237		

Notes: The dependent variables are in levels, and all estimates are obtained with the PPML estimator with exporter-time, importer-time fixed effects, and country-pair fixed effects. The pre-sanction variable is equal to one in the three years prior to the sanction taking place, and the post-sanction variable is equal to one in the five years after a sanction has ended. Dummy variables for WTO, EIA, and EU are also included but not reported. Robust standard errors, clustered by country pairs, are in parentheses.
***$p < 0.01$. **$p < 0.05$. *$p < 0.10$.

sanctions dramatically reduce exports during a sanction period, as expected and as we have already shown in our previous results. Additionally, we show that exports decline an additional 30% during the five-year post-period once sanctions are lifted. That strong persistence appears to be driven by the extensive margin, which decreases a further 8.6% in the post-period, whereas the intensive margin which sees no statistically meaningful change. This is consistent with sanctions introducing uncertainty, which then acts as a fixed cost; firms are unable to adequately decipher whether future sanctions could occur, so they export less of all products to a sanctioned country. We see an equally large contemporaneous impact on the intensive margin under complete exporter sanctions, but these effects do not appear to persist once sanctions have ended. Rather, there are strong anticipatory effects along the intensive margin of exports, with it decreasing around 20% in the three years leading up to a sanction being imposed.

In the bottom half of Table 7, we separately examine the influence of partial sanctions. For aggregate exports in column 1, we see that there is a small negative relationship between partial sanctions and exports during a sanction period, but no meaningful anticipatory or lingering effects. However, we see more of an impact when looking separately at the export margins, which affirms heterogeneity in the response of exports. The post-sanction impacts for the extensive margin are statistically significant, yet economically small. This further supports the idea that sanctions imposed higher fixed costs in the form of uncertainty. There is a much larger contemporaneous effect on the intensive margin, with a reduction of nearly 27% during a sanction period. However, this effect does not appear to persist. Thus, persistence appears to be a much more significant concern in the case of complete sanctions, particularly for the extensive margin of exports, for which the effect is three times larger. Partial exporter sanctions appear to influence the intensive margin more, but the magnitudes are smaller and less persistent over time.

Next, in Table 8, we look separately at the persistence of exporter and importer sanctions. The pattern here is similar, but there are important differences. First, complete sanctions no longer show persistence along the extensive margin, with the coefficient estimate for complete importer sanctions in the post-period coming closest to statistical significance. However, complete sanctions are the least common in our data and even less common since 2000, so it is important to also consider partial sanctions of each type. We also see that the persistence of partial sanctions along the extensive margin is driven specifically by partial exporter sanctions, with a decline of nearly 5% (nearly 4 products, on average), after a sanction ends. To the extent that sanctions introduce uncertainty about the future, we would expect to see a decline in the extensive margin as firms hesitate to export new products in such an environment. This is exactly what we see; also, note that partial exporter sanctions are the most common type of trade sanction in our data. Interestingly, we also see significant effects for both margins in anticipation of partial exporter sanctions. This suggests that firms may be aware that sanctions will take place before they are officially imposed and preemptively reduce their exports to a potentially sanctioned market. For partial importer sanctions, we see large persistence along the intensive margin but none on the extensive margin.

4.3.2 | Heterogeneity of Sanctions: A MMQR Approach

4.3.2.1 | Heterogeneity in Trade Costs. We further extend the sanctions-trade literature by examining whether economic sanctions affect exports differently for country pairs that have a low existing level of exports compared to those with a high level of exports. Economic sanctions are essentially a non-tariff barrier, meaning they represent an additional trade cost that must be incurred to participate in trade, either with the sanctioned country or with alternative trading partners instead of the sanctioned country. We posit that the negative impact of sanctions should be larger for country pairs that trade at the lower end of the export distribution because sanctions increase the already-high fixed costs to entering new export markets or maintaining a foothold in markets where a firm has a small footprint. Our hypothesis is driven by studies that find substantial differences in country pair specific trade cost elasticities. For example, Novy (2013) finds trade cost elasticities are much higher between countries for whom the volume of trade is lower. As Novy (2013) notes, this implies that a reduction in trade costs, such as a decrease or removal in economic sanctions, would be most beneficial for country pairs with low bilateral trade volumes. Analogously, an

TABLE 8 | Anticipation and persistence of sanctions: Exporter and importer.

	Total exports (1)	Extensive margin (2)	Intensive margin (3)
Complete export sanctions			
Pre-complete exp. sanction	−0.18	0.04	−0.60**
	(0.18)	(0.05)	(0.15)
Complete exp. sanction	−1.32***	−0.47***	−0.44**
	(0.30)	(0.09)	(0.21)
Post-complete exp. sanction	−0.33**	0.00	0.01
	(0.14)	(0.03)	(0.21)
Complete import sanctions			
Pre-complete imp. sanction	−0.05	−0.06	0.14
	(0.12)	(0.04)	(0.14)
Complete imp. sanction	−1.26***	−0.42***	−0.58*
	(0.33)	(0.08)	(0.31)
Post-complete imp. sanction	−0.36*	−0.05	0.21
	(0.19)	(0.03)	(0.21)
Partial export sanctions			
Pre-partial exp. sanction	−0.04	−0.03*	−0.24**
	(0.04)	(0.02)	(0.12)
Partial exp. sanction	−0.11**	0.03	−0.24**
	(0.05)	(0.02)	(0.12)
Post-partial exp. sanction	−0.03	−0.05***	0.09
	(0.05)	(0.01)	(0.15)
Partial import sanctions			
Pre-partial imp. Sanction	−0.04	0.01	−0.09
	(0.04)	(0.02)	(0.12)
Partial imp. sanction	−0.05	−0.04*	−0.37
	(0.04)	(0.02)	(0.27)
Post-partial imp. sanction	−0.03	0.02	−0.35**
	(0.04)	(0.02)	(0.18)
Observations	978,237		

Notes: The dependent variables are in levels, and all estimates are obtained with the PPML estimator with exporter-time, importer-time fixed effects, and country-pair fixed effects. The pre-sanction variable is equal to one in the three years prior to the sanction taking place, and the post-sanction variable is equal to one in the five years after a sanction has ended. Dummy variables for WTO, EIA, and EU are also included but not reported. Robust standard errors, clustered by country pairs, are in parentheses.

***$p < 0.01$. **$p < 0.05$. *$p < 0.10$.

imposition of sanctions would be most harmful for these countries. Similarly, in the context of trade liberalization, Bas, Mayer, and Thoenig (2017) also find trade cost elasticities are larger for country pairs with a low volume of bilateral trade flows. Several studies (Baltagi and Egger 2016; Bista et al. 2019; Sheridan, Bista, and Figueiredo 2020) also show that trade costs differ in statistically and economically meaningful ways across the quantiles of the conditional distribution of exports. Moreover, there is theoretical support for such heterogeneity. For example, Melitz (2003) shows that only the most productive firms will export, which of course depends partly on country pair specific trade costs. Head, Mayer, and Thoenig (2014) and Melitz and Redding (2015) argue that empirical estimates of the gains from trade are more accurate when allowing for heterogeneous trade costs. As economic sanctions represent an increase in trade costs, it is therefore reasonable to expect the impact of sanctions on exports to be more pronounced at the lower end of the export distribution, where even a minor increase in trade costs could make exporting less profitable. To examine this potential heterogeneity across the distribution of trade flows, we use quantile regression estimation in a panel data context with fixed effects, a novel method using the method of moments proposed by Machado and Santos Silva (2019).

4.3.2.2 | Empirical Approach. A key advantage of the PPML estimation approach is its robustness to heteroskedasticity. The log-linear model is also robust to heteroskedasticity issues when estimated by quantile regression (QR) (Baltagi and Egger 2016; Koenker and Bassett Jr 1978). Moreover, QR is robust to outliers (Koenker 2004) and can allow for heterogeneity along the distribution of the dependent variable, which is our focus in this section. We use the method of moments quantile regression (MMQR) approach by Machado and Santos Silva (2019) so we can account for time-invariant, country-fixed effects, which are critical in the gravity literature. Unlike other QR models with fixed effects, MMQR does not suffer from the incidental parameters problem, as it allows the individual effects to affect the entire distribution instead of solely being location shifters (Machado and Santos Silva 2019).[7] Therefore, we follow Machado and Santos Silva (2019) and estimate the impact of sanctions on exports, T, evaluated at each quantile τ for a given set of controls:

$$lnT_{ijt} = \alpha_i + X_{ijt}\beta + \left(\delta_i + Z_{ijt}\gamma\right)\eta_{ijt} \tag{5}$$

where $Pr\left(\delta_i + Z_{ijt}\gamma > 0\right) = 1$. The parameters $\left(\alpha_i, \delta_i\right)$ capture exporter-year fixed effects, and Z_{ijt} is a k-vector of known differentiable transformations of the components of X, including our sanction variables. X_{ijt} is assumed to be $i.i.d.$ for country i. η_{ijt} are i.i.d., statistically independent of X_{ijt}, and normalized to satisfy the moment conditions ($E\left(\eta_{ijt}\right) = 0$; $E\left(|\eta_{ijt}|\right) = 1$). Consequently, the panel quantile function for quantile τ is:

$$Q_{lnT_{ijt}}\left(\tau|X_{ij}\right) = \alpha_i + \delta_i q(\tau) + X_{ij}\beta + Z_{ijt}\gamma q(\tau) \tag{6}$$

where the scalar coefficient $\alpha_i(\tau) \equiv \alpha_i + \delta_i q(\tau)$ is the quantile-τ fixed effect for exporter (i), or the distributional effect at τ. This allows all variables, including those that are time-invariant, to have a heterogeneous impact on export flows. We apply this model using our primary variable of interest, economic sanctions. Rios-Avila (2020) extended the work of Machado and Santos Silva (2019) by creating a Stata command—mmqreg—to

TABLE 9 | Distribution of trade flows: Total exports.

	$\tau = 0.10$	$\tau = 0.25$	$\tau = 0.5$	$\tau = 0.75$	$\tau = 0.90$	$H_0: \tau_{10} = \tau_{90}$
Complete exporter sanction	−1.46***	−1.33***	−1.19***	−1.07***	−0.99***	0.15
	(0.32)	(0.25)	(0.18)	(0.15)	(0.16)	
Complete importer sanction	−1.73***	−1.40***	−1.02***	−0.70***	−0.46***	0.00
	(0.27)	(0.22)	(0.18)	(0.17)	(0.18)	
Partial exporter sanction	−0.33***	−0.37***	−0.41***	−0.44***	−0.47***	0.06
	(0.08)	(0.07)	(0.06)	(0.05)	(0.06)	
Partial importer sanction	−0.04	−0.05	−0.07	−0.08	−0.09	0.65
	(0.10)	(0.08)	(0.06)	(0.05)	(0.06)	
N	863,617					

Notes: The dependent variable is the log of real exports, and all estimates are obtained with the "mmqreg" estimator with exporter-time, importer-time, and country-pair fixed effects. Dummy variables for WTO, EIA, and EU are also included but not reported. Robust standard errors, clustered by country pairs, are in parentheses.
***$p < 0.01$. **$p < 0.05$. *$p < 0.10$.

TABLE 10 | Distribution of trade flows: Extensive margin.

	$\tau = 0.10$	$\tau = 0.25$	$\tau = 0.5$	$\tau = 0.75$	$\tau = 0.90$	$H_0: \tau_{10} = \tau_{90}$
Complete exporter sanction	−0.90***	−0.78***	−0.64***	−0.52***	−0.43***	0.00
	(0.16)	(0.14)	(0.11)	(0.09)	(0.09)	
Complete importer sanction	−0.83***	−0.68***	−0.50***	−0.34***	−0.23***	0.00
	(0.12)	(0.10)	(0.08)	(0.08)	(0.08)	
Partial exporter sanction	−0.05	−0.07**	−0.10**	−0.12***	−0.14***	0.00
	(0.04)	(0.03)	(0.03)	(0.03)	(0.03)	
Partial importer sanction	−0.15***	−0.14***	−0.12***	−0.10**	−0.09***	0.12
	(0.05)	(0.03)	(0.03)	(0.03)	(0.03)	
N	863,617					

Notes: The dependent variable is the log of the number of products exported (the extensive margin), and all estimates are obtained with the "mmqreg" estimator with exporter-time, importer-time, and country-pair fixed effects. Dummy variables for WTO, EIA, and EU are also included but not reported. Robust standard errors, clustered by country pairs, are in parentheses.
***$p < 0.01$. **$p < 0.05$. *$p < 0.10$.

allow for quantile estimation with the fixed effects that are crucial to the gravity model framework: exporter-year, importer-year, and country-pair. This command also allows us to cluster our standard errors by country pairs. We present these results in Tables 9–11.

4.3.2.3 | Results. We begin in Table 9 by looking at how complete and partial exporter sanctions impact aggregate export flows depending on the existing level of exports from country *i* to *j*. The coefficient estimates on complete exporter sanctions are not statistically different from each other. For example, the coefficient estimates at the 10^{th} and 90^{th} percentiles are not statistically different. The same is true of the coefficient estimates of the partial importer sanctions. The middle two rows of coefficients are statistically significant and statistically different from each other. In particular, we focus on the estimates for partial exporter sanctions. It appears that countries with higher levels of trade are more negatively impacted by sanctions relative to countries with low levels of trade. For example, our coefficient estimates imply that a country with a low initial level of exports can expect to see 28% lower exports after imposing a partial sanction on a trading partner, while those with a high initial level of exports may see a 37% decrease in exports with a sanctioned partner. This is consistent with partial exporter sanctions being the most common type of sanction in our data. It also makes sense that countries imposing sanctions would choose products that are important to the destination countries.

We next explore the impacts on the extensive and intensive margins of exports. Table 10 shows that, for the extensive margin, countries that initially have the lowest level of exports are much more negatively affected by imposing a complete sanction on a trading partner relative to countries that initially have a higher level of exports. We show that complete export sanctions reduce trade by around 60% for countries in the 10^{th} percentile of trade volume, while countries in the 90^{th} percentile see reductions of nearly half as much. The magnitudes for complete import sanctions are smaller, but they are proportionally similar in comparison. The pattern appears to reverse in the third row when we consider partial export sanctions. Countries at the low end of the export distribution see essentially no impact, while those with high export volumes see a reduction of about 13%.[8] Table 11 shows that the intensive margin is affected in a similar manner. Countries that trade the least are the most harmed when they are subject to complete sanctions. The primary difference here is

TABLE 11 | Distribution of trade flows: Intensive margin.

	$\tau = 0.10$	$\tau = 0.25$	$\tau = 0.5$	$\tau = 0.75$	$\tau = 0.90$	$H_0: \tau_{10} = \tau_{90}$
Complete exporter sanction	−0.71***	−0.64***	−0.55***	−0.47***	−0.40***	0.16
	(0.19)	(0.15)	(0.12)	(0.11)	(0.13)	
Complete importer sanction	−0.90***	−0.73***	−0.54***	−0.34***	−0.19***	0.00
	(0.16)	(0.14)	(0.12)	(0.12)	(0.14)	
Partial exporter sanction	−0.23***	−0.26***	−0.31***	−0.36***	−0.40***	0.00
	(0.06)	(0.05)	(0.05)	(0.05)	(0.06)	
Partial importer sanction	0.02	0.04	0.06	0.08	0.10	0.36
	(0.08)	(0.06)	(0.05)	(0.05)	(0.06)	
N	863,617					

Notes: The dependent variable is the log of the average number of products exported (the intensive margin), and all estimates are obtained with the "mmqreg" estimator with exporter-time, importer-time, and country-pair fixed effects. Dummy variables for WTO, EIA, and EU are also included but not reported. Robust standard errors, clustered by country pairs, are in parentheses.
***$p < 0.01$. **$p < 0.05$. *$p < 0.10$.

that partial exporter sanctions exhibit a substantially larger negative effect compared to the extensive margin, which is consistent with our earlier results. However, we now show that this effect is nearly twice as large for countries at the high end of the export volume distribution relative to countries at the low end. Overall, our results remain consistent. Most of the adjustment from a sanction takes place via the intensive margin, and this is robust to both the PPML specification and the log-linear MMQR approach.

5 | Conclusion

We add to the rapidly growing literature on economic sanctions and international trade in several ways. First, we look at the impact of exporter and importer sanctions separately on the aggregate exports of a sanctioning country, whereas much of the literature focuses on the sanctioned country and/or combined sanctions (i.e., trade sanctions). We find a decline in exports that is driven primarily by complete exporter sanctions, in which the sender country prohibits exports to the targeted country. Second, we go beyond aggregate exports and show the decline in exports occurs along both the extensive and intensive margins of exports. Partial exporter sanctions, which are much more common in our data, especially in recent time periods, have less of an impact on aggregate exports but a large negative effect on the intensive margin of exports. Third, we look at anticipation and persistence along the export margins. Aggregate exports see a large and persistent decline during a given sanction period, and once sanctions have ended, driven largely by complete sanctions. For the extensive and intensive margins, we find contemporaneous negative effects that are similar in magnitude, statistically significant, and economically large, but the persistence of the negative effects only occurs for the extensive margin. We find some anticipation along the intensive margin and persistence along the extensive margin for partial exporter sanctions. Fourth, we take a cursory look to see if there is evidence of trade diversion in response to sanctions. Our results suggest this is likely occurring, but further research on the mechanism and path of these diverted exports is warranted. Finally, and importantly, we use modern quantile methods to see if the export response varies based on the current level of exports from the sender to the target country. Complete sanctions again have the largest negative impact, but we show that this effect is strongest for countries that trade the least; this is also true for the extensive and intensive margins. Partial exporter sanctions also negatively impact exports, but this effect is stronger for the intensive margin and is more harmful for countries that initially have the highest volume of exports. Overall, our results confirm intuition and existing studies that show trade sanctions lower exports from sender to target countries. However, we show that this impact differs along the export margins, the type of sanction, and the initial volume of trade between country pairs.

Conflicts of Interest

The authors declare no conflicts of interest.

Data Availability Statement

The dataset used in our manuscript is from three main sources: (1) The Global Sanction Database (https://www.globalsanctionsdatabase.com/); (2) World Integrated Trade Solution (https://wits.worldbank.org/); (3) The Dynamic Gravity Dataset (https://www.usitc.gov/data/gravity/dgd.htm).

Endnotes

[1] As of this writing, the DGD database is updated through 2019 and includes important bilateral data for variables in our gravity model. Therefore, our time period stops in 2019, even though sanctions data are currently available through 2022.

[2] We retrieved trade data for 1962–2017 from Simoes and Hidalgo and since that time the data has fallen behind a paywall; we updated our data through 2019 using the World Integrated Trade Solutions Database (2013), which is also the original data source for Simoes and Hidalgo.

[3] See Section 2, pages 11–12, and Figure 3 in Felbermayr, Kirilakha, Syropoulos, et al. (2020), Felbermayr, Syropoulos, et al. (2020) for more details.

[4] The calculation to interpret this PPML coefficient is $[\exp(-0.13) - 1] \times 100\% = -12.2\%$. Other PPML coefficients are interpreted analogously.

[5] This suggests we should also consider the persistence of sanctions, which we do in Tables 7 and 8.

[6] We also used a 3-year window, and the results were virtually the same; therefore, we show that any effects persist even longer.

[7] Other QR models, like the seminal Koenker (2004) model, along with others (Canay 2011), consider a model where the individual effects only cause parallel shifts of the distribution of the response variable to mitigate the effects of the incidental parameters problem.

[8] In the case of partial exporter sanctions, these results are different from what we find in Table 6 This is due to the fact that our earlier results include zero trade flows, while the log specification of MMQR means it cannot include zero trade flows. All other results are quantitatively and qualitatively similar across specifications. The only results that are not robust are the coefficient estimates for partial exporter sanctions along the extensive margin.

References

Anderson, J. E., and E. van Wincoop. 2003. "Gravity With Gravitas: A Solution to the Border Puzzle." *American Economic Review* 93, no. 1: 170–192.

Baier, S. L., and J. H. Bergstrand. 2007. "Do Free Trade Agreements Actually Increase Members' International Trade?" *Journal of International Economics* 71, no. 1: 72–95.

Baier, S. L., J. H. Bergstrand, and M. Feng. 2014. "Economic Integration Agreements and the Margins of International Trade." *Journal of International Economics* 93, no. 2: 339–350.

Baltagi, B. H., and P. Egger. 2016. "Estimation of Structural Gravity Quantile Regression Models." *Empirical Economics* 50, no. 1: 5–15.

Bas, M., T. Mayer, and M. Thoenig. 2017. "From Micro to Macro: Demand, Supply, and Heterogeneity in the Trade Elasticity." *Journal of International Economics* 108: 1–19.

Beck, T. 2002. "Financial Development and International Trade: Is There a Link?" *Journal of International Economics* 57, no. 1: 107–131.

Bělín, M., and J. Hanousek. 2021. "Which Sanctions Matter? Analysis of the Eu/Russian Sanctions of 2014." *Journal of Comparative Economics* 49, no. 1: 244–257.

Bernard, A., B. Jensen, S. Redding, and P. Schott. 2007. "Firms in International Trade." *Journal of Economic Perspectives* 21, no. 3: 105–130.

Besedeš, T., S. Goldbach, and V. Nitsch. 2021. "Cheap Talk? Financial Sanctions and Non-Financial Firms." *European Economic Review* 134: 103688.

Besedeš, T., and T. J. Prusa. 2011. "The Role of Extensive and Intensive Margins and Export Growth." *Journal of Development Economics* 96, no. 2: 371–379.

Bista, R., E. Figueiredo, B. Sheridan, et al. 2019. "Heterogeneous Time Zone Effects and Exports." *Economics Bulletin* 39, no. 2: 1039–1046.

Buch, C. M., J. Döpke, and H. Strotmann. 2009. "Does Export Openness Increase Firm-Level Output Volatility?" *World Economy* 32, no. 4: 531–551.

Canay, I. A. 2011. "A Simple Approach to Quantile Regression for Panel Data." *Econometrics Journal* 14, no. 3: 368–386.

Chaney, T. 2008. "Distorted Gravity: The Intensive and Extensive Margins of International Trade." *American Economic Review* 98, no. 4: 1707–1721.

Crozet, M., J. Hinz, A. Stammann, and J. Wanner. 2021. "Worth the Pain? Firms' Exporting Behaviour to Countries Under Sanctions." *European Economic Review* 134: 103683.

Dai, M., G. J. Felbermayr, A. Kirilakha, C. Syropoulos, E. Yalcin, and Y. V. Yotov. 2021. "Timing the Impact of Sanctions on Trade." In *Research Handbook on Economic Sanctions*, Chapter 22, 411–437. Cheltenham, UK: Edward Elgar Publishing.

Dutt, P., I. Mihov, and T. V. Zandt. 2013. "The Effect of WTO on the Extensive and the Intensive Margins of Trade." *Journal of International Economics* 91, no. 2: 204–219.

Eaton, J., S. Kortum, and F. Kramarz. 2004. "Dissecting Trade: Firms, Industries, and Export Destinations." *American Economic Review* 94, no. 2: 150–154.

Egger, P. H., M. Larch, and Y. V. Yotov. 2022. "Gravity Estimations With Interval Data: Revisiting the Impact of Free Trade Agreements." *Economica* 89, no. 353: 44–61.

Felbermayr, G., A. Kirilakha, C. Syropoulos, E. Yalcin, and Y. V. Yotov. 2020. "The Global Sanctions Data Base." *European Economic Review* 129, no. C: 103561.

Felbermayr, G., C. Syropoulos, E. Yalcin, and Y. Yotov. 2020. *On the Heterogeneous Effects of Sanctions on Trade and Welfare: Evidence From the Sanctions on Iran and a New Database*. Technical Report. Philadelphia, PA: LeBow College of Business, Drexel University.

Felbermayr, G. J., C. Syropoulos, E. Yalcin, and Y. V. Yotov. 2019. "On the Effects of Sanctions on Trade and Welfare: New Evidence Based on Structural Gravity and a New Database."

Foster, N., J. Poeschl, and R. Stehrer. 2011. "The Impact of Preferential Trade Agreements on the Margins of International Trade." *Economic Systems* 35, no. 1: 84–97. The Variety and Quality of Trade in Development and Transition.

Gurevich, T., P. Herman, N. Abbyad, et al. 2021. "The Dynamic Gravity Dataset: Technical Documentation."

Gutmann, J., M. Neuenkirch, and F. Neumeier. 2021. "The Economic Effects of International Sanctions: An Event Study." *Available at SSRN 3821520*.

Handley, K. 2014. "Exporting Under Trade Policy Uncertainty: Theory and Evidence." *Journal of International Economics* 94, no. 1: 50–66.

Head, K., T. Mayer, and M. Thoenig. 2014. "Welfare and Trade Without Pareto." *American Economic Review* 104, no. 5: 310–316.

Hufbauer, G. C., and E. Jung. 2020. "What's New in Economic Sanctions?" *European Economic Review* 130: 103572.

Hummels, D., and P. J. Klenow. 2005. "The Variety and Quality of a Nation's Exports." *American Economic Review* 95, no. 3: 704–723.

Kehoe, T. J., and K. J. Ruhl. 2013. "How Important Is the New Goods Margin in International Trade?" *Journal of Political Economy* 121, no. 2: 358–392.

Kirilakha, A., G. Felbermayr, C. Syropoulos, E. Yalcin, and Y. Yotov. 2021. "The Global Sanctions Data Base: An Update That Includes the Years of the Trump Presidency." In *School of Economics Working Paper Series 2021-10*, edited by A.G. van Peter. Bergeijk, Cheltenham, UK: Edward Elgar Publishing.

Koenker, R. 2004. "Quantile Regression for Longitudinal Data." *Journal of Multivariate Analysis* 91, no. 1: 74–89.

Koenker, R., and G. Bassett Jr. 1978. "Regression Quantiles." *Econometrica* 46, no. 1: 33–50.

Larch, M., J. Luckstead, and Y. V. Yotov. 2021. "Economic Sanctions and Agricultural Trade."

Larch, M., S. Shikher, C. Syropoulos, and Y. V. Yotov. 2022. "Quantifying the Impact of Economic Sanctions on International Trade in the Energy and Mining Sectors." *Economic Inquiry* 60, no. 3: 1038–1063.

Le, H. T. 2022. "Global Economic Sanctions and Export Survival: Evidence From Cross-Country Data." *Entrepreneurial Business and Economics Review* 10, no. 1: 7–22.

Machado, J. A., and J. Santos Silva. 2019. "Quantiles via Moments." *Journal of Econometrics* 213, no. 1: 145–173. Annals: In Honor of Roger Koenker.

Melitz, M. 2003. "The Impact of Trade on Intra-Industry Reallocations and Aggregate Industry Productivity." *Econometrica* 71, no. 6: 1695–1725.

Melitz, M. J., and S. J. Redding. 2015. "New Trade Models, New Welfare Implications." *American Economic Review* 105, no. 3: 1105–1146.

Neuenkirch, M., and F. Neumeier. 2015. "The Impact of Un and Us Economic Sanctions on GDP Growth." *European Journal of Political Economy* 40: 110–125.

Nguyen, T. T., and M. H. Do. 2021. "Impact of Economic Sanctions and Counter-Sanctions on the Russian Federation's Trade." *Economic Analysis and Policy* 71: 267–278.

Novy, D. 2013. "International Trade Without CES: Estimating Translog Gravity." *Journal of International Economics* 89, no. 2: 271–282.

Regis, P. J. 2018. "The Extensive and Intensive Margins of Exports of Firms in Developing and Emerging Countries." *International Review of Economics & Finance* 56: 39–49.

Rios-Avila, F. 2020. *MMQREG: Stata Module to Estimate Quantile Regressions via Method of Moments*. Chestnut Hill, MA: Statistical Software Components, Boston College Department of Economics.

Santos Silva, J., and S. Tenreyro. 2006. "The Log of Gravity." *Review of Economics and Statistics* 88, no. 4: 641–658.

Sheridan, B. J., R. Bista, and E. Figueiredo. 2020. "Growth Takeoffs and Trade Margins: A Quantile Regression Approach." *Empirical Economics* 59: 275–294.

Simoes, A. J. G., and C. A. Hidalgo. 2011. The Economic Complexity Observatory: An Analytical tool for Understanding the Dynamics of Economic Development.

Syropoulos, C., G. J. Felbermayr, A. Kirilakha, E. Yalcin, and Y. V. Yotov. 2022. The Global Sanctions Data Base–Release 3: Covid-19, Russia, and Multilateral Sanctions.

World Integrated Trade Solutions Database. 2013. Trade Analysis Branch: United Nations Conference on Trade and Development.