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Back to Sender: Sanctions' Effects on Bilateral Trade with Third-party Countries

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BACK TO SENDER: SANCTIONS' EFFECTS ON BILATERAL TRADE WITH THIRD-PARTY COUNTRIES

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Abstract

What are the effects of sanctions on trade with third countries in a context of globalization and increasingly interconnected economies? This paper addresses this issue, using the new Global Sanctions Database (GSDB) and a gravity model estimated on a global sample of 191 countries, from 1960 to 2021. First, it emerges that the imposition of sanctions initially favors trade between the sanctioning country and third countries. However, a decrease in exports with third countries (back to sender effect) occurs when the number of countries sanctioned by the sender exceeds a threshold. Second, sanctions disrupt the targeted country's exports to third countries. However, there is evidence of a non-linear relationship with an increase in exports to third countries as the number of countries imposing sanctions on the target exceeds a threshold (back to equilibrium effect). These effects are made possible on the one hand by the implicit sanctions imposed by consumers and companies in third countries, and on the other by their involvement in evading sanctions. The results suggest that sanctioning countries need to be transparent, credible and honest about their objectives, to win the support of third countries in international organizations, or face significant costs in terms of export losses as the number of sanctioned countries increases. The back to equilibrium effect in the sanctioned country suggests the exploration of alternative avenues such as diplomacy in the resolution of international conflicts to avoid huge economic losses for both sanctioned and sanctioning countries.

Keywords: *Economic sanctions, bilateral trade, gravity model*

JEL Classification: *F13, F14*

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1. Introduction

International relations between countries are deeply shaped by financial, economic and trade cooperation agreements, as well as by bilateral and multilateral sanctions. The latter have received renewed attention in the literature, in terms of their effects and effectiveness, with the Russian-Ukrainian crisis, the resurgence of armed conflict in the Middle East and the rise in geopolitical tensions worldwide. Sanctions represent the set of actions generally undertaken by countries and international organizations, with the aim of reprimanding, coercing, or influencing the behavior and policies of targeted states, private entities, and elites (Afesorgbor and Mahadevan, 2016; Alhassan et al. 2023). As genuine instruments of foreign policy, sanctions are flexible and preferable to the use of military power in settling international disputes. They are also deployed as coercive measures with a view to establishing and preserving international peace and security, fighting terrorism, destabilizing autocratic regimes, limiting human rights violations, promoting democracy, addressing the impunity of certain states, and responding to their illegal actions regarding international law. They cover a wide range of instruments such as asset freezes, embargoes, partial or total export and import restrictions, travel bans, suspension of economic agreements, blocking of financial transactions and halting of foreign aid (Alhassan et al. 2023; Felbermayr et al., 2020; Felbermayr et al., 2021).

Despite the noble objectives pursued by sanctions, the literature seems to show that their success rate, i.e. their ability to shift the behavior of sanctioned countries in the direction desired by the sanctioning country, is relatively low (Bapat and Morgan, 2009; Oechslin, 2014; Pape, 1997; van Bergeijk, 1989). However, even if sanctions are preferable to military intervention, they can nevertheless cause significant economic damage to targeted states. In this respect, a vast literature has focused on analyzing their effects on the value of the national currency, economic growth, poverty, inequality in the targeted country (Afesorgbor and Mahadevan, 2016; Alhassan et al. 2023; Peksen and Son, 2015; Neuenkirch and Neumeier, 2015; Dizaji and van Bergeijk, 2013). Some empirical work also reports that sanctions deteriorate food security and the availability of clean water, reduce access to healthcare and medical services (Garfield, 2002; Gibbons and Garfield, 1991), increase infant mortality and lower life expectancy in targeted countries (Ali and Shah, 2000; Solt, 2015). Regarding the sanctioning country, theoretical and empirical works, using gravity model, has highlighted that sanctions entail significant costs that reduce exports to the sanctioned country (Hufbauer et al., 2007; Morgan et al., 2014; Hufbauer and Oegg, 2003; Caruso, 2003; Yang et al., 2004; Afesorgbor, 2018; Felbermayr et al., 2020; Felbermayr et al., 2021). While existing empirical work has focused on the effects of sanctions on trade with the target-country, very little attention has been paid to the reaction of third-party countries regarding imports from the sanctioning country.

As economies become increasingly interconnected in a globalized world, the imposition of sanctions could have spillover effects or network effects on trade with third-party countries (Van Bergeijk, 1995; Bove et al, 2023; Kwon et al, 2024). Regarding the interdependence of economies and the positions and international trade profiles of sanctioned and sanctioning countries in the world trade network, the direction of this spillover effects can be quite ambiguous. On the one hand, the imposition of a sanction can be an instrument for substituting the

sanctioned country's exports to third countries with those of the sanctioning country. Indeed, sanctioning countries can take advantage of the disruption of trade routes and relations of sanctioned countries to facilitate access for their products to third country markets. This substitution may to some extent be a result of implicit support from consumers and businesses in third countries for the sanctions imposed on targeted countries. This trade creating effect in favor of the sanctioning country helps to reduce the costs associated with its trade restrictions. On the other hand, the signal sent by sanctions may be perceived negatively by third countries, which would reduce demand for the sanctioning country's products. Third countries may consider sanctions to be unfair, and boycott products exported by the sanctioning country, because of the damaging effects on the target economies. Moreover, the possibility of being the next victims of sanctions in the future may prompt third countries to reduce their trade and investment with the sanctioning country. This effect may be more plausible and more significant when third countries consider sanctions to be abusive and used for the economic or geopolitical interests of dominant countries. The negative effect can also be triggered when the reputation of the sanctioning country is tarnished by the ever-increasing number of countries it sanctions (Dimitrova et al, 2017). With these two opposing forces at work, the ultimate effect of sanctions on trade with third countries turns out to be an empirical issue.

This paper adds to the literature on the effects of sanction on trade. The existing literature provides some empirical evidence of the effect of sanctions on trade with third countries (Caruso, 2003; Bose et al, 2023; Kwon et al, 2024; Kwon et al, 2022). Caruso's paper (2003) analyzed the effect of unilateral U.S. sanctions on bilateral trade between target countries and potential U.S. competitors, notably the other six G-7 countries. Two main effects emerge from their analyses. On the one hand, moderate unilateral US sanctions stimulate trade between competitors and sanctioned countries. On the other hand, the opposite effect is observed in the case of major sanctions. More recently, Bose et al (2023) examined the case of trade between sanctioned countries and third countries that share the same border. The results highlighted the heterogeneity of responses. Indeed, the imposition of sanctions generally disrupted trade with neighboring third countries, although some cases of increased trade flows were reported. Similar results relating to the negative effects of sanctions on the cost of trade between sanctioned and third countries were confirmed by Kwon et al, (2024) on a large sample and based on the case of sanctions imposed by the USA on Cuba.

Regarding the effects of sanctions on trade between the sanctioning country and third countries, a gravity model was applied by Kwon et al (2022), showing that sanctioning countries improve their trade with third countries following the imposition of sanctions on target countries. Moreover, for sanctioning countries, the gains resulting from increased trade with third countries may offset the losses resulting from reduced trade with target countries. The positive effect highlighted in Kwon et al (2022) paper is a diversion of exports from the sender country to third countries, captured by a dummy variable. On the one hand, this approach does not reveal the cumulative effect of all the sanctions imposed by a country on its exports to third countries. For example, it does not allow assessing the effect of an additional sanction imposed conditional to those already in place. On the other hand, the dummy nature of the variables used to capture the effects of sanctions overlooks potential

non-linear effects linking the imposition of a sanction by a sanctioning country to its exports with a third country. Moreover, the positive effects highlighted by Kwon et al (2022) would suggest that sanctioning countries could continue to impose sanctions at no real cost to their trade with third countries, which may not be the case.

Yalcin et al (2025) revealed that the number of sanction cases has increased significantly in recent years, reaching a total of 1547 in 2023, compared to less than a dozen in 1950. Furthermore, the number of countries affected by sanctions increased significantly over the period from 1950 to 2023, rising from less than 20 countries in 1950 to over 140 countries in the 2000s before falling back to over 60 countries in 2016 (Felbermayr et al., 2020). With the current geopolitical crises and tensions, these figures are likely to rise further. The most targeted countries are generally developing nations (Felbermayr et al., 2020, 2021). However, these countries are characterized by low average per capita income levels and high poverty rates on the one hand, and a sizable proportion of the population forced to migrate to neighboring countries with high economic potential. These factors lead some authors to regard sanctions as unjust (Kaempfer and Lowenberg, 2007), as they adversely affect businesses and often impose hardship on innocent households. In addition, the work of Afesorgbor and Mahadevan (2016) has shown that sanctions foster inequality to the benefit of ruling elites. Estimates by Hufbauer et al, (2007) revealed that economic sanctions in the form of reduced foreign aid to target states could result in a welfare loss of 100% of the value of the aid. In view of these damaging effects on populations, it is interesting to analyze the dynamics of trade between third countries and the sanctioning country, especially when the number of sanctioned countries increases. This analysis could provide sanctioning countries with a clearer picture of the benefits and costs of imposing sanctions, and the need to use diplomatic levers when the costs outweigh the expected gains. The aim of this paper is to investigate the effects of sanctions on trade between the sending country and third countries. Using the new global sanction database (GSDB) compiled by Felbermayr et al, (2020), this study extends that of Kwon et al (2022) by exploring the dynamics of trade with third countries as the number of countries sanctioned by the exporting country increases. Symmetrically, the study analyzes the effects of sanctions imposed on the target country on its trade with third countries.

The paper contributes to literature in many ways. First, based on a global sample of 191 countries from 1960 to 2021, the paper shows, using a gravity model, and dummy variables capturing trade deflection, we show that imposing sanctions implies a trade creation effect with third countries to the benefit of the sanctioning country, whereas it significantly reduces trade of the target with third countries. Second, we deepen the analysis by looking at how these effects behave as the number of countries involved in sanctions increases. We find that sanctions have non-linear effects on trade with third countries. We show that the third-party trade creation effect increases as the number of countries sanctioned by the exporting country rises, up to a threshold of 87 countries. This effect could be explained by the substitution of exports from sanctioned countries by those of the sanctioning country. However, beyond the threshold of 87 sanctioned countries, imposing an additional sanction on a new country significantly reduces the sanctioning country's exports to third countries. This effect, which we refer to as "*back to sender (BTS) effect*," could be explained by several factors, including the bad

reputation and boycott of the sanctioning country's products by companies and consumers in third countries and the reduction of economic ties (financial flows, trade, and investment) by third countries out of fear of being the next target. The paper shows that the "*back to sender effect*" is observed in both total trade and manufactured products.

Third, the paper showed that as the number of countries sanctioning an exporter increases, its exports initially decrease with third countries due to additional trade costs and disruption of the productive apparatus. However, beyond a threshold of 97 countries, exports to third countries increase significantly. This effect, which we describe as a "*back to equilibrium (BTE) effect*," can be explained by the evasion of sanctions with the assistance of third countries, the development of export substitution capacity from sanctioning countries, and the diversification of trading partners. Fourth, the paper carries out a heterogeneity analysis depending on the type of sanction and the income level of the exporting country and the third country. Regarding sanctions, it emerges that the "*back to sender effect*" is more premature in the case of trade and financial sanctions, with optimal thresholds of 28 and 51 countries respectively. In addition, exports of manufactured goods are particularly vulnerable to sanctions, with a "*back to sender effect*" that is triggered with the first sanctioned country, with no gain in trade with third countries.

Further analysis shows that the "*back to sender effect*" is observed regardless of the level of development of the sanctioning exporting country. However, developing countries have little room for leverage, with a threshold of 17 countries compared with developed countries, which can sanction up to 92 countries before expecting a negative effect on their exports to third countries. Moreover, "*back to equilibrium effect,*" is only experienced when the exporting country is a developed country with diversified exports and partners. Regarding importing third countries, the paper reveals that both advanced and developing third party countries participate in "*back to sender*" and "*back to equilibrium*" effects. Overall, the results show that the use of sanctions can prove very costly for the sanctioning country in terms of a drastic drop in trade with third countries as the number of sanctioned countries increases. Sanctioned countries also adapt to sanctions when the number of countries reaches a certain threshold, even if this last effect is more significant when they have a more robust production sector. The results of the paper underline the need to rely on diplomatic means to resolve international disputes.

The rest of the paper is structured as follows. The next section presents some stylized facts on the evolution of sanctions and their connection to trade with third countries. The empirical strategy of the paper is outlined in section 3. The results and their discussion are the focus of section 4. Section 5 discusses the economic policy implications of the findings, before concluding.

2. Data and stylized facts

Our empirical analysis relies essentially on three databases. The paper covers 191 countries (Appendix A, Table A) from 1960 to 2021. The database for the gravity model comes from the Centre d'Etudes Prospectives et d'Informations Internationales (CEPII). In addition to the gravity variables (distance, official language,

contiguity, etc.), the CEPII database also contains GDP data from the World Bank's World Development Indicators (WDI) database, bilateral trade data from the International Monetary Fund's (IMF) Direction of Trade Statistics (DOTS), and variables relating to countries' participation in regional trade agreements and the World Trade Organization. Trade data are extended to include bilateral exports of manufactured goods from the Structural Gravity Database (SGD) of the World Trade Organization (WTO). The SGD covers 186 countries from 1980 to 2016. The third database relates to the variables of interest in the study, particularly sanctions. They are taken from the Global Sanctions Data Base (GSDB, 2023). This is a new database compiled by Felbermayr et al (2020) by extending existing databases identified in the literature[2]. It is a detailed base covering sanction types (trade, financial, travel restrictions, arms sanctions, military assistance, other types of sanctions), their objectives (policy change, regime destabilization, prevention of territorial conflicts and wars, terrorism, respect for human rights, promotion of democracy, and other objectives) and their success rates (partial or total success, settlement by negotiation, total failure). It covers the period from 1950 to 2022.

Felbermayr et al (2020) have defined sanctions as "*binding restrictive measures applied by individual nations, country groups, the United Nations (UN), and other international organizations, to address different types of violations of international norms by inducing target countries to change their behavior or to constrain their actions.*" Trade sanctions are designed to restrict economic interaction with a target country by limiting international trade. They may affect exports or imports of one or more specific products, or all traded products. Financial sanctions involve the freezing of financial assets and investments between the sanctioning country and the target (Yalcin et al, 2025; Felbermayr et al, 2021). Financial sanctions also extend to limiting the availability of credit for payments in connection with the trade of goods, including aid payments, and prohibiting all financial transactions linked to a sanctioned economy, as well as the target country's participation in the SWIFT network (Society for Worldwide Interbank Financial Telecommunication). The GSDB also distinguishes between military and arms-related sanctions. While military sanctions include prohibitions on monetary or personal assistance, arms sanctions temporarily restrict the export or import of weapons. Another type of sanction frequently used by states concerns travel sanctions. They restrict the freedom of geographic movement of elites, business leaders and political figures close to the regime in place in the target country. Other less frequent types of sanctions are classified under "other sanctions." Sanctions cases listed in the GSDB may be a combination of the different types, and may be imposed unilaterally or multilaterally[3].

From 1960 to 2022, the stock of active sanctions cases worldwide has grown steadily, with new inflows every year (Panel (a) of Figure 1). Over this period, the number of active sanctions cases has increased by a factor of around 11, rising from 38 to 411 in 2022. The period from 2019 to 2021 was particularly marked by an increase in sanction cases, with 217 new ones added. Panel (b) of Figure 1 reveals that this dynamic is also observed

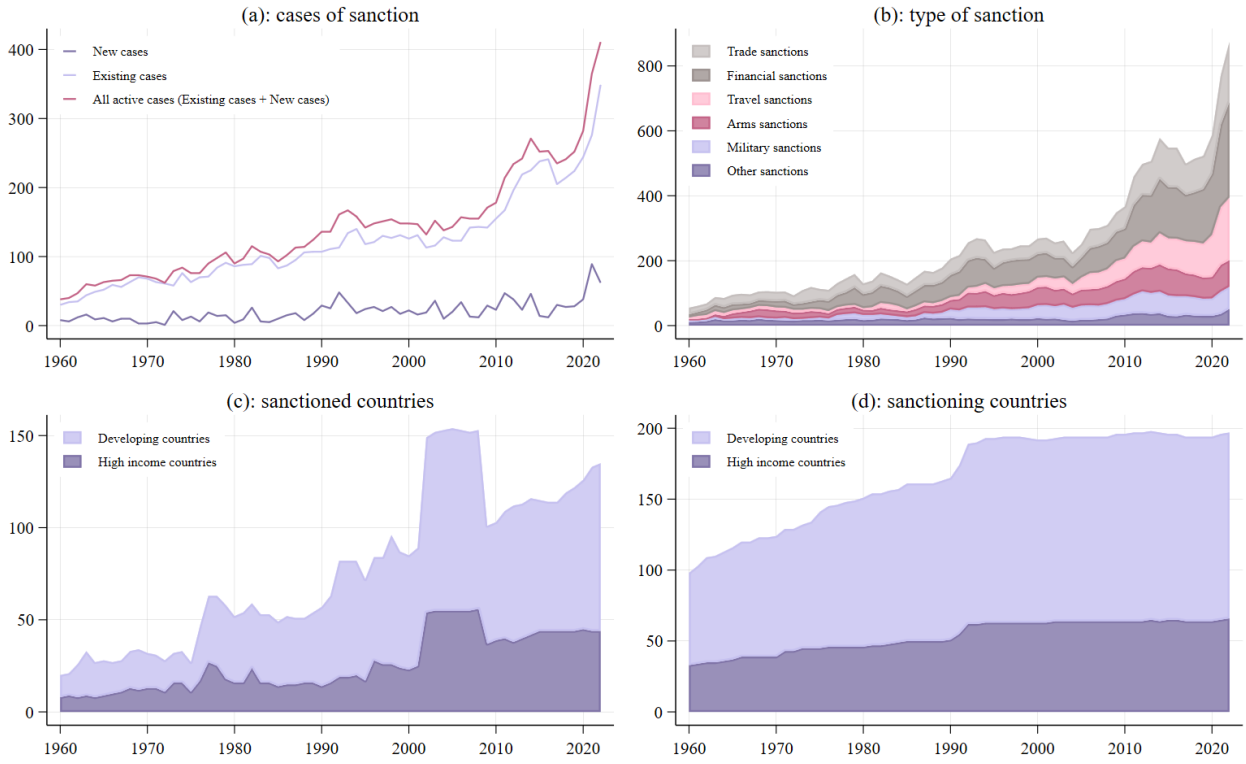
[2] See the database by Hufbauer et al, (2007) also known as HSE or HSEO database, the Threat and Imposition of Sanctions (TIES) database by Morgan et al, (2014), the Targeted Sanctions Consortium (TSC) database by Biersteker et al, (2018) and the EUSANCT database by Schneider and Weber (2018).

[3] For more information on the GSDB, see related work on the various releases (Felbermayr et al, 2020; Syropoulos et al, 2024; Kirilakha et al, 2021; Yalcin et al, 2025).

when the different types of sanction are considered. This evolution shows that all types of sanctions have gained in popularity over time as an instrument of coercion rather than the use of military force. Panel (c) shows that over the same period, the number of countries sanctioned has increased alongside the trend in sanctions cases, with a peak observed from 2002 to 2008 due to the sanctions imposed by the United States on signatories to the Rome Statute of the International Criminal Court (ICC) in 2002. Most sanctions are targeted at developing countries. These countries are increasingly among those imposing sanctions (panel (d) of Figure 1), particularly within the multilateral frameworks of the UN and other international organizations.

Figures 2 and 3 show the evolution of sanctions from a different perspective. These are snapshots of sanctions networks in 1960 and 2020. The size of the nodes is proportional to the number of sanctioned countries. Figure 2 shows that high-income countries are those with the largest number of sanctioned countries. In particular, the United States appears as the country imposing the most sanctions in 1960. Figure 3 calls for several comments.

Figure 1: Evolution of sanctions cases and the number of countries involved from 1960 to 2022

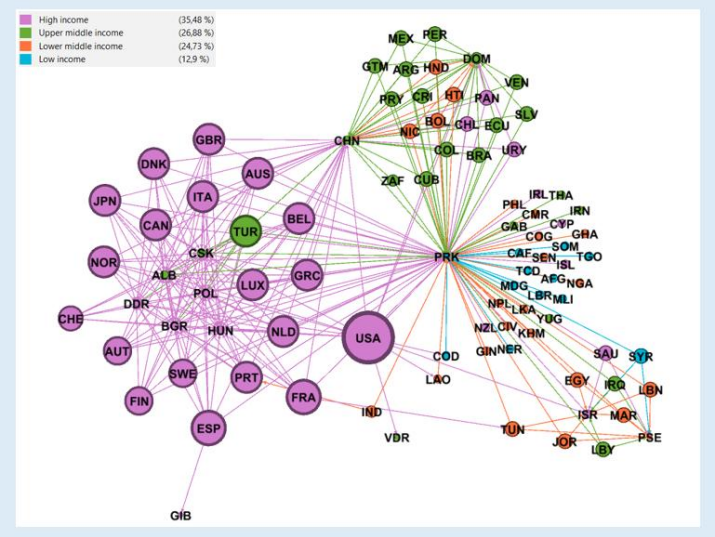


Source: Author based on GSDB data.

First, it emerges that, in 2020, high-income countries are still the biggest sanctioning nations. Russia ranks second after the USA in terms of sanctioned countries. Second, the increase in the number of sanction cases from 1960 to 2020 has translated into an increase in the number of nodes and a more complex network in 2020. In a globalized world with more interconnected economies, this structure of the sanctions network has repercussions on the dynamics of trade between targeted countries and senders on the one hand, and between the latter and third countries on the other. Figure 3 illustrates the theory proposed by Van Bergeijk (1995), who points out that following the imposition of sanctions, substantial changes occur in the structure of international

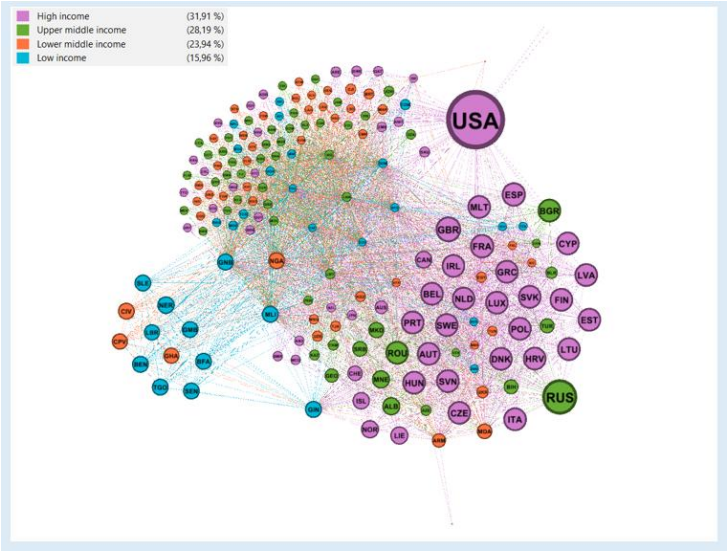
trade. These changes also affect the economic opportunities of countries not involved in the conflict, through value chains. Known in the literature as network effects, these effects are passed on to trading partners in the first round, and to trading partners of trading partners in a second round. The complexity of the network in 2020 also demonstrates the relevance of the sanctions-busting hypothesis outlined by Drezner (2000), particularly for countries occupying a strategic position in the network. The combination of these effects makes it difficult to theoretically predict the direction of change in trade between the sanctioning country and third countries after the imposition of sanctions on a target country. This is particularly relevant when, on the one hand, new sanctions are imposed while existing sanctions are still in force and, on the other, sanctioned countries can retaliate with new sanctions.

Figure 2: visualization of the network of sanctioning and sanctioned countries in 1960



Source: Author based on GSDB data. Links represent sanctions, while nodes refer to countries. The size of the nodes is proportional to the number of sanctioned countries.

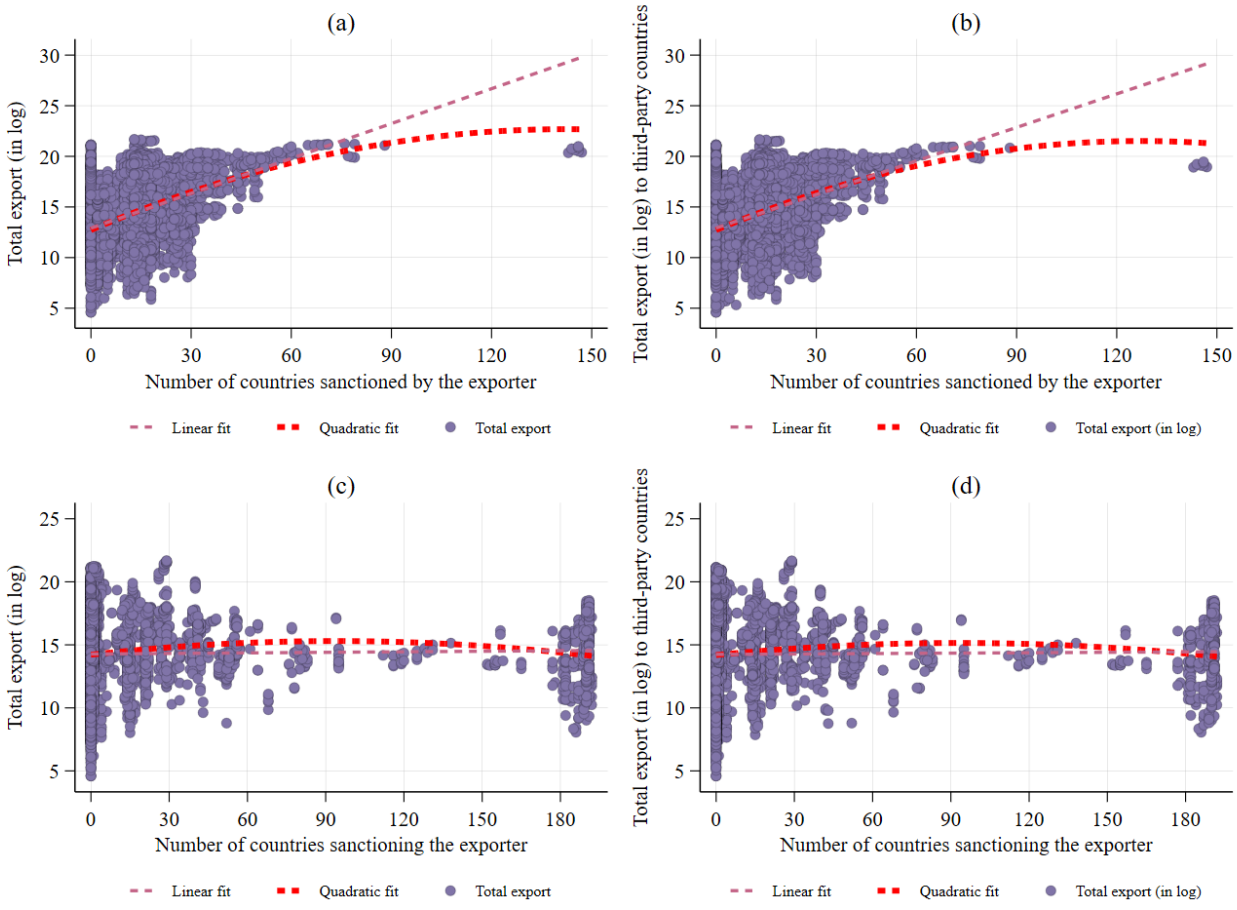
Figure 3: visualization of the network of sanctioning and sanctioned countries in 2020



Source: Author based on GSDB data. Links represent sanctions, while nodes refer to countries. The size of the nodes is proportional to the number of sanctioned countries.

Despite this complexity, stylized facts seem to point to some important correlations between a country's exports and the number of countries sanctioned (Figure 4). In fact, the scatterplot linking total exports and the number of countries sanctioned in panel (a) of Figure 4 shows a non-linear rather than linear relationship, with a positive slope up to a threshold beyond which the number of sanctioned countries would negatively affect exports. The quadratic fit also seems more appropriate when it comes to exports to non-sanctioned third countries (Panel (b) in Figure 4). This relationship seems to show that, as the number of sanctioned countries increases, the sanctioning country bears an ever-increasing cost regarding market losses for its products. The number of third countries with which the sanctioning country trades freely decreases, significantly increasing the costs of its sanctions. Regarding the relationship between total exports and the number of countries that have imposed sanctions on the exporter, no clear relationship appears to emerge when either linear or quadratic adjustments are made (Panels (c) and (d), Figure 4). However, this correlation does not take into account the other control variables.

Figure 4: Correlation between exports and the number of sanctioned and sanctioning countries



Source: Author based on GSDB and CEPII data.

The analysis of stylized facts revealed significant correlations between trade between sanctioning countries and their non- sanctioned partners. These relationships are explored more systematically in the next section, using econometric methods.

3. Empirical strategy

Our analysis of the effects of sanctions on trade between the sender and third countries is based on a gravity model. This well-known model in the international trade literature suggests a normal level of bilateral trade, and so by introducing dummy variables relating to free trade agreements (FTA), it is possible to identify their effects (Anderson and van Wincoop, 2003; Baier and Bergstrand, 2007; Santos Silva and Tenreyro, 2011). In a similar way, the introduction of dummy variables relating to sanctions makes it possible to highlight the effects of the costs associated with the imposition of sanctions on bilateral trade. The gravity model specification used in this study is linked to the PPML estimation approach. The choice of the PPML method for estimating equation (1) below is motivated by the need to overcome econometric issues. Recent literature has shown that this method is more efficient in dealing with zero trade problem than other approaches, such as removing zero trade from the sample, using OLS and Tobit regressions after adding an arbitrary value (Felbermayr et al., 2020; Felbermayr et al., 2021; Kwon et al, 2022; Kwon et al, 2024). The PPML method is robust to heteroscedasticity and proves suitable when the proportion of zero trade is high, which is the case in this study (Santos and Tenreyro, 2006; Martinez-Zarzoso and Marquez-Ramos, 2019). Our baseline augmented gravity model is as follows:

$$\begin{aligned} TRADE_{ijt} = {} & Exp\left(\alpha_1 GDP_{it} + \alpha_2 GDP_{jt} + \alpha_3 DIST_{ij} + \alpha_4 FTA_{ijt} + \alpha_5 WTO_{ijt}\right) \\ & \times Exp\left(\alpha_6 REM_{it} + \alpha_7 REM_{jt} + \sum_k \beta_k SANCT_{ijt}^k\right) \\ & \times Exp\left(\gamma_i + \lambda_j + \vartheta_t\right) \times \varepsilon_{ijt} \end{aligned} \qquad (1)$$

Where $TRADE_{ijt}$ represents exports from country i to country j over period t. GDP_{it} and GDP_{jt} are the Gross Domestic Product (thousands USD) of the exporter and importer, expressed in logarithm. They are indicative of each country's potential market size and supply capacity. The variable $DIST_{ij}$ measures the geodesic distance (km) between countries i and j, and is used to approximate transport costs, which are assumed to have a negative impact on bilateral trade. The FTA_{ijt} and WTO_{ijt} variables respectively capture participation in regional and international free-trade agreements. Accordingly, FTA_{ijt} is a dummy variable taking the value 1 when i and j are participating in a free trade agreement at a given time t and zero otherwise, while the WTO_{ijt} variable is equivalent to 1 when both countries are members of the World Trade Organization and zero otherwise. REM_{it} and REM_{jt} variables represent multilateral resistance terms (MRT) or remoteness variables. They help reduce omitted variable bias where the temporal dimension of the sample is high, and are preferable to the inclusion of time-varying country fixed effects (WTO, 2012; Head and Mayer, 2014). They are calculated as follows:

$$REM_{it} = \sum_j \frac{DIST_{ij}}{GDP_{jt}/GDP_{wt}} \qquad (2)$$

The MRT variables, therefore, calculates the average weighted distance of a country from its trading partners (Head and Mayer, 2014; Baier and Bergstrand, 2009), where the weights are the partner countries' shares of global GDP (denoted by GDP_w). The term ε_{ijt} captures the standard error, while γ_i and λ_j are country-specific effects. The ϑ_t term accounts for the temporal effects common to all country pairs. The other gravity model variables, such as border sharing, common official language and landlockedness, as well as those relating to countries' colonial past, were not included due to their collinearity with the country's fixed effects. Since several gravity model specifications will be explored as well as various sanction types, the k variables of interest of the study ($SANCT_{ijt}^{k}$) will be presented in the next section.

4. Results

This section presents the main results of our econometric analysis of the effect of sanctions on trade with third countries. The paper distinguishes between the effects on total exports and those of manufactured goods from the SGD database. Extending the analysis to trade in manufactured goods serves two purposes. First, it allows us to highlight the particularity of manufactured products in world trade and to test the robustness of the results. Second, the SGD database includes domestic trade in manufactured goods. As pointed out by Yoto (2022), the use of domestic trade flows in gravity model estimation allows for identification of the country-specific effects of trade policies, trade-diversion effects, and country-specific characteristics on bilateral trade flows. It is also consistent with the theory of both extensive and intensive margin of trade.

Bilateral trade data in the CEPII database are "*squared*" by design. The paper covers 191 countries from 1960 to 2021, after removing countries that no longer exist, giving a maximum of 2,249,980 ($191 \times 190 \times 62$) possible observations, largely high enough to include many sanctions cases. However, the panel is unbalanced due to missing observations on the GDP of some developing countries over several periods. All estimates were made using the PPML method, with standard errors clustered at country pairs.

4.1. Effects of sanctions on trade with sanctioned and third countries

We start the empirical analysis by assessing the effect of sanctions on exports between the sanctioning country, the target country and third countries. Three variables relating to sanctions are included in model (1). The first variable ($SANCTION_{ijt}^{Target}$) is a dummy variable equal to 1 when any sanction is imposed and zero otherwise. The second variable captures the creation or diversion of trade between the sender and third countries. This variable ($DIVERT_{ijt}^{Sender}$) is a dummy which takes the value of 1 at period t when the pair of countries is made up of the sanctioning country and a third country not subject to any sanctions and zero otherwise. The diversion or creation of trade between the target and a third country is captured by the third dummy variable ($DIVERT_{ijt}^{Target}$), which is evaluated at 1 at a time t when the pair is made up of a sanctioned country and a third country not subject to any sanctions.

The results are presented in Table 1. Columns (1) and (2) respectively report the gravity model estimates using data for total exports and manufactured goods. The results show the significance of several variables of interest with the expected signs. On the one hand, the imposition of sanctions significantly (with 1% error risk) reduces trade between the sanctioning country and the target country, both for total exports and for manufactured goods. These findings are in line with the existing literature (Caruso, 2003; Hufbauer et al., 2007; Afesorgbor, 2018; Felbermayr et al., 2020), which has already shown that sanctions imply additional bilateral trade costs. Based on our estimates, sanctions induce a decline of 16.41% ($(\exp(-0.17928)-1)\times 100$) and 14.65% ($(\exp(-0.15845)-1)\times 100$) respectively in total exports and manufactured goods between the sanctioning country and the target country. These are referred to as direct or primary effects (Kwon et al, 2022 and 2024).

Table 1: Direct effects of sanction on bilateral trade (total and manufactured export)

Variables	(1) Total Export	(2) Manufactured Export
Distance	0.01945	-0.88111***
	(0.48743)	(0.27812)
Exporter's GDP	0.68056***	0.85383***
	(0.03261)	(0.03990)
Importer's GDP	0.56492***	0.66944***
	(0.03118)	(0.04403)
Free trade area membership	0.11548***	0.19989***
	(0.03439)	(0.04630)
WTO membership	0.10790***	-0.05239
	(0.02672)	(0.05532)
Exporter remoteness	-0.00034*	-0.00013
	(0.00019)	(0.00024)
Importer remoteness	-0.00016	0.00005
	(0.00016)	(0.00017)
Sanction	-0.17928***	-0.15845***
	(0.03086)	(0.03094)
Sender diversion	0.03575	0.07926***
	(0.02622)	(0.02877)
Target diversion	-0.12416***	-0.39792***
	(0.04780)	(0.15082)
Constant	-5.90595	-1.15125
	(3.77019)	(3.04546)
Observations	1,469,334	924,279
Exporter fixed effects	Yes	Yes
Importer fixed effects	Yes	Yes
Year fixed effects	Yes	Yes
Pseudo R square	0.981	0.979
F-Stat	970.1	1186
Prob > F	0.0000	0.0000

Source: author's estimates based on data from CEPII, SGD and GSDB databases. The study period is 1960 to 2021 for total exports, while observations of manufactured exports only cover the period 1980 to 2016. Estimates were performed using the PPML method. Standard deviations are in brackets. They are clustered by country pairs. (***), (**) and (*) denote statistical significance at 1%, 5% and 10% respectively.

The indirect effects of sanctions concern the creation or diversion of exports to third countries. Regarding the diversion of exports of the sanctioning country to third countries, the effect is positive but insignificant when total trade is considered. However, for manufactured exports, our results show a significantly positive

coefficient for the sender country's trade diversion variable. The sanctioning country seems to benefit from sanctions to increase its exports of manufactured goods to third countries. A similar effect was highlighted by Kwon et al, (2022) using trade in manufactured goods and a structural gravity model. Regarding the diversion of exports from the sanctioned country to third countries, the results support the hypothesis of significant trade disruption. Indeed, for both total and manufactured exports, the coefficients for trade creation are negative and significant at 1%. The coefficient for the effect on trade in manufactured goods is three times higher than that for total trade. This result also confirms those of Kwon et al (2022, 2024).

The main control variables of the gravity model are significant with the expected signs. Estimations in Table 1 showed that bilateral trade increases as partner size increases, with significant coefficients on their GDPs in both estimated models. Distance has a negative effect on trade in manufactured goods. Furthermore, participation in a free trade agreement (FTA) encourages trade in both manufactured goods and total exports. WTO membership also positively affects total exports (Felbermayr et al., 2020).

4.2. Non-linear effects of sanctions on trade with third countries

The results in Table 1 confirming the extraterritorial or spillover effects of sanctions on trade with third countries are very interesting and in line with recent work by Kwon et al, (2022, 2024) who used SGD database with a structural gravity model. However, one question that emerges is whether the positive effects on the sanctioning country's exports to third countries can remain positive as the number of sanctioned countries increases. Symmetrically, we wonder how a target's exports to third countries evolve as the number of sanctioning countries increases. These effects cannot be captured by dummy variables used in the previous specification.

To address these questions major modifications have been made to the definition of the sanction's variables. First, we introduce into the model variables capturing the number of countries sanctioned by the exporting country ($NSANCTIONED_{it}$) and the number of countries that have imposed sanctions on the exporting country ($NSANCTIONING_{it}$). These two variables are included in the gravity model (1) to test their linear effects on trade with third countries. This approach is fundamentally different from the widespread use of dummy variables in the literature to capture sanctions' effects, whether unilateral or multilateral (Hufbauer et al., 2007; Morgan et al., 2014; Hufbauer and Oegg, 2003; Caruso, 2003; Yang et al., 2004; Afesorgbor, 2018; Felbermayr et al., 2020; Felbermayr et al., 2021). The rationale is that the use of dummy variables cannot capture the intensity of the effects of sanctions on the target as the number of sanctioning countries increases. Second, the stylized facts shown in Figure 4 lead us to test the hypothesis of non-linearity between these variables and trade with third countries. To this end, the squares of these two variables have also been included in a new specification. Third, from this subsection, we perform the new estimates on the subsample of country pairs not involved in a sanction. In other words, the new sample covers only country pairs that are not involved in a sanction to facilitate identification.

Table 2: Non-linear indirect effects of sanctions on trade with third-party countries

	Total exports		Manufactured exports	
Variables	(1)	(2)	(3)	(4)
Distance	0.15843	0.14741	-0.84692***	-0.87519***
	(0.51608)	(0.51740)	(0.31397)	(0.31843)
Exporter's GDP	0.68673***	0.68662***	0.86496***	0.85583***
	(0.03246)	(0.03190)	(0.04072)	(0.03930)
Importer's GDP	0.55109***	0.55893***	0.65488***	0.66420***
	(0.03382)	(0.03289)	(0.05280)	(0.05266)
Free trade area membership	0.10825***	0.10459***	0.19537***	0.18959***
	(0.03479)	(0.03383)	(0.04897)	(0.04749)
WTO membership	0.09955***	0.10666***	-0.07625	-0.06297
	(0.02903)	(0.02932)	(0.06223)	(0.06167)
Exporter remoteness	-0.00035*	-0.00029	-0.00011	0.00001
	(0.00020)	(0.00020)	(0.00026)	(0.00028)
Importer remoteness	-0.00014	-0.00012	0.00009	0.00010
	(0.00017)	(0.00017)	(0.00017)	(0.00017)
Number of countries sanctioned by the exporter	0.00066	0.01044***	0.00201	0.01535***
	(0.00102)	(0.00222)	(0.00143)	(0.00511)
Squared number of countries sanctioned by the exporter		-0.00006***		-0.00008***
		(0.00001)		(0.00002)
Number of countries sanctioning the exporter	-0.00105*	-0.00388***	-0.00067	-0.00211
	(0.00056)	(0.00128)	(0.00049)	(0.00183)
Squared number of countries sanctioning the exporter		0.00002*		0.00001
		(0.00001)		(0.00001)
Constant	-6.93262*	-7.73123*	-1.87613	-2.99592
	(3.97732)	(4.01861)	(3.35002)	(3.52075)
Observations	1,384,855	1,384,855	864,489	864,489
Exporter fixed effects	Yes	Yes	Yes	Yes
Importer fixed effects	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes
Pseudo R square	0.981	0.981	0.979	0.979
F-Stat	895.2	978.9	831.2	952.8
Prob > F	0.0000	0.0000	0.0000	0.0000

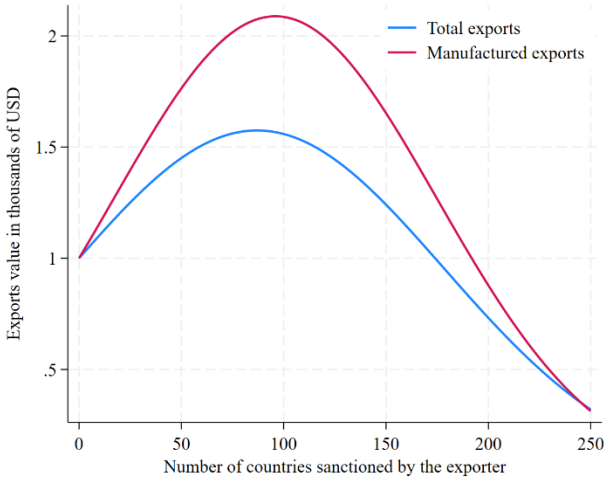
Source: author's estimates based on data from CEPII, SGD and GSDB databases. The study period is 1960 to 2021 for total exports, while observations of manufactured exports only cover the period 1980 to 2016. The sample is restricted to pairs of countries that have not imposed any sanctions on each other over a specific period ($SANCTION_{ijt}^{Target} = 0$). Estimates were performed using the PPML method. Standard deviations are in brackets. They are clustered by country pairs. (***), (**) and (*) denote statistical significance at 1%, 5% and 10% respectively.

The results are shown in Table 2. It emerges that non-linear specifications are more relevant. Indeed, whether for total exports or manufactured items, the coefficients of the linear and quadratic variables (the number of countries sanctioned by the exporting country and its square) are significant at 1%. The opposite signs of these coefficients suggest a threshold-effect relation between trade with third countries and the number of sanctioned countries. Based on the estimated parameters (Table 2, columns 2 and 4) and ignoring (or fixing) the other variables in the model, the relationship between a sanctioning country's exports to third countries and the number of sanctioned countries can be illustrated in Figure 5. It shows that the narrative revealed so far by the first regressions (Table 1) is incomplete. Indeed, the imposition of sanctions by an exporting country improves its bilateral exports with third countries when the number of sanctioned countries is below a given threshold. In other words, the trade-creating effect of sanctions on the sanctioning country is not unlimited. Based on the

estimates in Table 2, the thresholds are 87 and 96 respectively for total exports and manufactured goods[4]. Above these thresholds, sanctioning an additional country would reduce exports to third countries. This negative effect, which we call the "*back to sender effect*," could be explained by several factors, which will be elucidated in the following subsections.

Based on the thresholds calculated, we identify the USA in our sample as the country that has imposed sanctions on more than 87 other countries over the entire period from 1960 to 2022. Figures 2 and 3 revealed that the USA occupies an important place in the global sanctions network. Figure B1 panel (a) of appendix B shows the evolution of the United States' market share (total exports and manufactured products) and the number of sanctioned countries. The graph seems to confirm the results of the estimates in Table 2. In fact, total US exports as a proportion of world trade continue to fall as the number of sanctioned countries increases. This dynamic is also observed when exports to third (non-sanctioned) countries are considered. Following the imposition of sanctions on signatories of the Rome Statute of the International Criminal Court (ICC) in 2002, the number of countries sanctioned by the USA has more than doubled between 2002 and 2008, rising from 60 to 148 countries in 2008. Over the same period, the share of exports in world trade fell from 12% to 8%. The market share of manufactured goods also fell from 16% to 12%. Trends in the opposite direction are also observed when it comes to manufactured exports. Admittedly, sanctions alone do not explain these trends in US exports. However, considering the econometric results in Table 2, it is difficult to consider that the number of sanctioned countries is neutral vis-à-vis this decrease in market share.

Figure 5: Relation between exports and the number of sanctioned countries ("*back to sender effect*")



Source: Author' estimates (Table 2) based on GSDB and CEPII data.

We extend this analysis to three other countries in the sample that have sanctioned more than 50 countries: the UK, Canada, and Russia. Panels (b), (c) and (d) in Figure B1 (Appendix B) show the same trends in these three other countries. Whether the share of total exports or that of manufactured goods in world trade, the figures

[4] Optimal thresholds are obtained by solving the equation: $\frac{\partial TRADE}{\partial NSANCTIONED} = 0 \Longrightarrow \widehat{NSANCTIONED} = -\frac{\beta_1}{2\beta_2}$ where β_1 and β_2 are respectively the coefficients of variable $NSANCTIONED$ and its square. In other words, $87 = -\frac{0.01044}{-0.00006\times2}$ and $96 = -\frac{0.01535}{-0.00008\times2}$

show a downward trend as the number of sanctioned countries increases. Moreover, the same conclusion can be drawn for both total exports and exports to third countries. In the case of Russia, market shares increased from 1990 to 2014, when the number of sanctioned countries was relatively low. However, the sanctions imposed on the country following the annexation of Crimea, as well as the sanctions imposed by Russia in retaliation, have had adverse effects on its total and manufacturing exports to third countries.

Table 2 also confirms the negative effect of sanctions on exports from sanctioned countries to third countries (Table 1). It goes further, pointing out that this effect seems to increase as the number of countries imposing the sanction expands. This result is in line with existing literature (Caruso, 2003; Syropoulos et al, 2024) which has shown that sanctions are more effective when they are imposed multilaterally, or when they are applied by several countries. However, column 2 shows that above a certain threshold ($97 = (0.00388/(0.00002 \times 2))$ countries) the effect becomes positive. This effect is illustrated in Figure B2 panel (a), Appendix B. This effect, which we refer to as the "*back to equilibrium (BTE) effect*," will be interpreted economically in the following sections. However, when exports of manufactured goods are considered, the coefficients of the variables relating to the number of sanctioning countries are not statistically significant (columns 3 and 4 of table 2). A potential reason for this insignificant relationship may be the combination of several types of sanction in the construction of the variables of interest. Indeed, as shown by Felbermayr et al, (2020), the effects of sanctions can be heterogeneous. These results lead us to further refine the analysis by taking a closer look at the effects of some widely used sanctions.

4.3. Heterogeneity analysis of sanction's effects

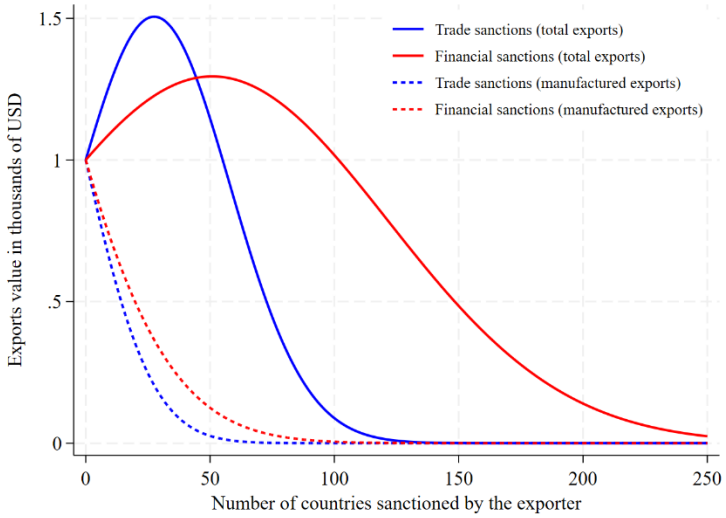
In this section, we test the hypothesis of the differentiated effects of two types of sanction most widely used in international relations. These are trade sanctions and financial sanctions. While we do not underestimate the effects of other sanctions, we believe that the effects of trade and financial sanctions are more likely to affect trade with third countries, due to their impact on value chains and the disruption of trade routes. We modify the definition of our variables of interest. We introduce into the model variables capturing the number of countries sanctioned by the exporting country ($NSANCTIONED_{it}^{Type}$) using trade (financial) sanctions and the number of countries that have imposed trade (financial) sanctions on the exporting country ($NSANCTIONING_{it}^{Type}$). These two variables are included in the gravity model (1) to test their linear and non-linear effects on trade with third countries. We perform the new estimates on the subsample of country pairs not involved in a sanction using the PPML method.

The results are reported in Table C1 in Appendix C. Non-linear specifications of the gravity model (columns 2, 4, 6 and 8) are more appropriate than linear ones, due to the significance of the coefficients of the quadratic variables. This result confirms those obtained when all types of sanctions are considered (Table 2). However, there are significant differences. Figure 6 clearly shows these differences by presenting the estimated relationship between exports (total and manufactured) and the number of countries sanctioned by the exporting country. In terms of total exports, the estimates show that the exporting country increases its trade with third

countries as the number of countries on which it imposes trade and financial sanctions increases, up to a certain threshold. Above this threshold, the "*back to sender effect*" is significant, and has a negative impact on trade with third countries. However, as opposed to the previous case of all types of sanctions, the thresholds are relatively low, estimated at 28 $(-0.02974/(-0.00054 \times 2))$ countries in the case of trade sanctions and 51 $(-0.01017/(-0.00010 \times 2))$ countries for financial sanctions. First, these results show heterogeneity in the effects of sanctions on trade with third countries. The high thresholds of 87 and 96 countries previously estimated with all types of sanctions (Table 2) could be linked to the positive effects of other sanctions (military and arms sanctions, travel sanctions and other sanctions). Second, the "*back to sender effect*" appears earlier when it comes to trade sanctions, with a threshold of 28 countries beyond which it becomes significant. In addition, the "*back to sender effect*" is more delayed in the case of all types of sanctions (87 countries) than when financial sanctions are concerned (51 countries).

When it comes to exports of manufactured goods, the differences are greater than those obtained using all types of sanctions (Table 2). Indeed, although the estimates (columns 6 and 8 of Table C1 in Appendix C) support the hypothesis of a non-linear relationship, the parameters of the variables relating to the number of sanctioned countries reveal a total absence of gains linked to trade with third countries. Indeed, Figure 6 reveals a significant drop in exports of manufactured goods to third countries when a country is sanctioned. In other words, the threshold beyond which the "*back to sender effect*" comes into play is zero. The non-linear relationship suggests that the rate of decline in manufactured exports to third countries increases with the number of countries sanctioned. Figure 6 also shows that the "*back to sender effect*" in the case of manufactured goods is more severe for trade sanctions than for financial sanctions. However, compared to all types of sanctions, financial sanctions entail a higher cost for the sanctioning country, in terms of lost trade with third countries.

Figure 6: "*Back to sender effects*" depending on the type of sanction imposed



Source: Author' estimates (Table C1, Appendix C) based on GSDB and CEPII data.

Furthermore, columns 2 and 6 of Table C1 in Appendix C highlight the "*back to equilibrium effect*" as the number of countries imposing trade sanctions increases. The effect is positive when a threshold of 100 $(0.01201/(0.00006 \times 2))$ and 93 $(0.01673/(0.00009 \times 2))$ countries are reached, for total exports and manufactured goods respectively. However, when it comes to financial sanctions, the "*back to equilibrium effect*" is only significant for manufactured exports (column 8) with a threshold of 90 $(0.00358/(0.00002 \times 2))$ countries. Figure B2 panel (a) in Appendix B illustrates the dynamics of exports to third countries as the number of countries imposing sanctions on the exporting country increases. The results also show that the "*back to equilibrium effect*" is relatively less sensitive to sanction types than the "*back to sender effect.*"

Before going any further with our analysis, we need to look at the economic mechanisms that might explain the "*back to sender*" and "*back to equilibrium*" effects highlighted in the various regressions. Concerning the "*back to sender effect*," it should be stressed that two economic forces are at work in opposite directions. First, sanctions imposed by an exporting country may enable it to substitute exports from sanctioned countries to third countries (Kwon, et al, 2022; Kwon et al., 2024). The sanctioning country can in fact take advantage of the disruption of trade routes and the additional trade costs inflicted on sanctioned countries to grab their market share in third countries (Slavov, 2007). Exporting firms can also avoid the costs of economic sanctions by exporting indirectly to the target via neighboring countries (Crozet et al., 2021). Sanctions modify competitiveness in favor of companies in the sanctioning country, which cannot fail to seize this opportunity to replace the sanctioned competitor's products in third countries, thus resulting in a trade creating effect.

Trade creation effect in favor of the sanctioning country may be reinforced by an implicit sanction by companies and consumers. Indeed, the imposition of a sanction sends a signal to third countries and their businesses and consumers. This signal could be perceived favorably or negatively by the latter, depending on the explicit or implicit objectives pursued by the sanctioning country. There is no guarantee that all third countries will adhere to these explicit or implicit objectives. Thus, when the objectives pursued are deemed noble and justified by the majority of third countries, the latter can contribute to the substitution of the products of the sanctioning country by boycotts in favor of those of the sanctioning country, even if they do not participate directly in the sanctions imposed. However, when the majority of third countries consider that these sanctions are unjustified, or that they are imposed solely to implicitly secure the political, economic, and geopolitical interests of the sanctioning country, they may adopt different behaviors which will tend to impede exports from the sanctioning country (Hufbauer et al., 1997; Hufbauer et al., 2003). These can include massive boycotts of the sanctioning country's products, and the reduction of economic ties (financial flows, trade, and investment) out of fear of being the sanctioning country's next target. Dimitrova et al. (2017) have shown that a poor reputation can lead to a significant drop in exports. Hufbauer et al. (1997) reported that the effects of sanctions can extend far beyond the targeted sectors and can damage the reputation of the sanctioning country's companies, which are now seen as unreliable suppliers. Moreover, even after sanctions have been lifted, trade between sanctioning and target countries can take time to return to initial levels (Hufbauer et al., 2003). These elements form the second force contributing to the reduction of the sanctioning country's exports to third countries.

When the negative effect outweighs the trade-creating effect, the "*back to sender effect*" appears. Indeed, as the number of sanctioned countries increases, so does the likelihood that third countries will indirectly suffer the implicit costs of sanctions through the disruption of value chains and trade routes. Furthermore, as the number of sanctioned countries increases, so does the sanctioning country's reputation for imposing sanctions, which increases the risk of a third country seeing itself as a potential target (Hufbauer et al., 2003). The reasons for imposing sanctions can be difficult to justify as the number of sanctioned countries increases, leading third countries to question the real, unofficial reasons for imposing them. Also, as the number of sanctioned countries increases, cases of severe economic and social damage to populations become more frequent, which may lead some third countries to revise their perceptions of the sanctioning country. Some third countries may prefer diplomatic channels to resolve conflicts between trading partners, rather than resorting to sanctions whose success rates are highly questionable (Pape, 1997; Hufbauer et al., 2007). In view of these factors, the negative factors end up outweighing the trade-creating effect when the estimated thresholds are exceeded. The fact that the estimated thresholds are lower for trade and financial sanctions, and zero when it comes to trade of manufactured goods, reinforces these analyses. Indeed, these types of sanctions affect target and third countries and their populations more rapidly and severely than other sanctions such as travel bans and military sanctions.

The economic mechanisms underlying the "*back to equilibrium effect*" are also linked to the reaction of third countries and sanctioned countries to the imposition of sanctions. Like the "*back to sender effect*," "*back to equilibrium effect*" is the result of factors working in opposite directions. On the one hand, a negative effect on exports from the sanctioned country to third countries could be explained by additional trade costs (Bove et al., 2023; Slavov, 2007; Kwon et al., 2024). In the same way that the misuse of sanctions can destroy the reputation of the sanctioning country, sanctions can also deal a severe blow to the reputation of the sanctioned country. The latter can be seen as a rogue state that violates human rights and international law. This bad reputation can lead to boycotts by consumers and businesses in non-allied third countries. Fear of an unstable economic environment and a lack of protection for investors' rights can also lead to a drop in foreign direct investment (FDI) from third countries. Besides these costs, sanctions can damage the long-term productive capacity of the target economy by disrupting the innovation process (Wen et al., 2024). These effects seem to grow stronger as the number of countries involved in the sanction increases. However, sanctioned countries cannot remain inactive in the face of sanctions. In this context, Hufbauer et al., (2007) point out that sanctions create their own antidotes by uniting the sanctioned country through support for the government and the search for commercial alternatives. First, they can strengthen their trade with remaining third countries not involved in sanctions. Target countries can diversify their trading partners, even at higher transaction costs, by offering a variety of discounts (Dizaji and Farzanegan, 2023). For example, Ioannou et al. (2023) explain the case of Russia, which under the effect of sanctions has modified its global trade strategy since its invasion of Ukraine by discounting its commodity exports to attract new customers to replace its eurozone partners. Similarly, in the case of Iran after sanctions were imposed in 2008, Haidar's (2017) paper shows that exporters of non-oil products (From

2006 to 2011) have been diverted to other destinations such that total exports have increased as Iranian companies have reduced their prices and increased their quantities when exporting to new destinations.

Second, third countries may deem sanctions unjust and help the sanctioned country. This assistance can take the form of strengthening economic relations and evading sanctions to avoid a collapse of the target's economy. Such support is particularly plausible when the sanctioned country is a member of regional trade agreements (RTA) in which several third countries participate. These third countries can play a major role in re-exporting hard-to-substitute products (e.g. energy products and raw materials) from sanctioned countries to sanctioning countries. For example, Bove et al. (2023) report on oil trade between China and North Korea, and coal exports from North Korea to China despite international sanctions. Crozet et al. (2021) find that exporting companies avoid the costs of economic sanctions by exporting indirectly to the target via neighboring countries. Furthermore, the increase in the number of sanctioning countries is not always associated with an increase in the severity of the effects of sanctions on the sanctioned country. Significant gaps can exist between the imposition of sanctions and their actual application. A striking recent example is the large number of countries that have sanctioned Russia in connection with the Russian-Ukrainian conflict. However, Russia's trade with a number of these sanctioning countries has not been affected (Dizaji and Farzanegan, 2023).

Third, sanctions force sanctioned countries to develop capacities to replace products from sanctioning countries, and even to export them to third countries (Hufbauer et al., 2007). Indeed, the incentive to develop the capacities needed to substitute imports from sanctioning countries increases as their numbers rise. These factors would explain the growth in sanctioned country exports to third countries as the number of sanctioning countries crosses a certain threshold.

4.4. Does the level of development matter?

Stylized facts have shown that both advanced and developing countries use sanctions in their relations with other countries. Having analyzed the mechanisms underlying the "*back to sender*" and "*back to equilibrium*" effects, we move on to consider sanctions effects variability depending on the level of development of the sanctioning and third countries. To do this, we consider the case where the sanctioning country is an advanced country and the case where it is a developing country based on the World Bank classification. The results are presented in Table 3. Looking at total exports, it appears that the "*back to sender*" effect is significant whatever the level of development of the sanctioning country (columns 1 and 2). However, Figure 7 shows that the optimal threshold for the number of sanctioned countries not to be exceeded is relatively lower for developing countries (17 countries) than for developed countries (92 countries). The cost of imposing sanctions on developing countries would be relatively high, in terms of significant losses of exports to third countries as the number of sanctioned countries increases. This result could be explained by the limited diversification of exports and trading partners in developing countries, and their relatively low share of world trade. In addition, these countries lack advanced means of enforcing the sanctions they impose. Moreover, their capacity to substitute exports from sanctioned countries on third-country markets is relatively weak, due to the

concentration of their exports on a few commodities. These factors could explain the lack of significance of the effects of sanctions on trade with third countries when it comes to manufactured products (column 4). These results show that developing countries should be cautious when imposing sanctions, to avoid significant losses of exports to third countries.

Table 4: Level of development of sanctioning country and effect on trade with third-party countries

Variables	**Exporting countries**		**Exporting countries**	
	High income countries	Developing countries	High income countries	Developing countries
	Total export		Manufactured exports	
Distance	1.86816**	-0.75291***		-0.34219
	(0.94180)	(0.23861)		(0.32638)
Exporter's GDP	0.60486***	0.61843***	0.59729***	0.65861***
	(0.03983)	(0.04489)	(0.05075)	(0.07236)
Importer's GDP	0.53120***	0.66250***	0.72426***	0.66767***
	(0.03361)	(0.03920)	(0.06067)	(0.04664)
Free trade area membership	0.10615***	0.10802**	0.17415***	0.09069
	(0.03934)	(0.04766)	(0.05452)	(0.06609)
WTO membership	0.13112***	0.17907***	-0.19633**	0.16198**
	(0.03708)	(0.04374)	(0.07932)	(0.06716)
Exporter remoteness	-0.00027*	-0.00065**	0.00003	-0.00090***
	(0.00015)	(0.00033)	(0.00020)	(0.00035)
Importer remoteness	-0.00030	0.00036	-0.00005	0.00074**
	(0.00019)	(0.00029)	(0.00017)	(0.00032)
Number of countries sanctioned by the exporter	0.01645***	0.02593**	0.02417***	-0.02062
	(0.00262)	(0.01250)	(0.00499)	(0.02850)
Squared number of countries sanctioned by the exporter	-0.00009***	-0.00076*	-0.00012***	0.00037
	(0.00001)	(0.00040)	(0.00002)	(0.00049)
Number of countries sanctioning the exporter	-0.01283***	-0.00242	-0.02370***	-0.00061
	(0.00220)	(0.00160)	(0.00285)	(0.00214)
Squared number of countries sanctioning the exporter	0.00008***	0.00001	0.00013***	0.00000
	(0.00001)	(0.00001)	(0.00002)	(0.00001)
Constant	-17.70049**	-2.06180	-4.92360*	0.40776
	(6.94192)	(3.76175)	(2.62726)	(3.91890)
Observations	461,686	923,169	291,774	572,715
Exporter fixed effects	Yes	Yes	Yes	Yes
Importer fixed effects	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes
Pseudo R square	0.980	0.982	0.977	0.984
F-Stat	602.3	816.5	533	467.7
Prob > F	0.0000	0.0000	0.0000	0.0000

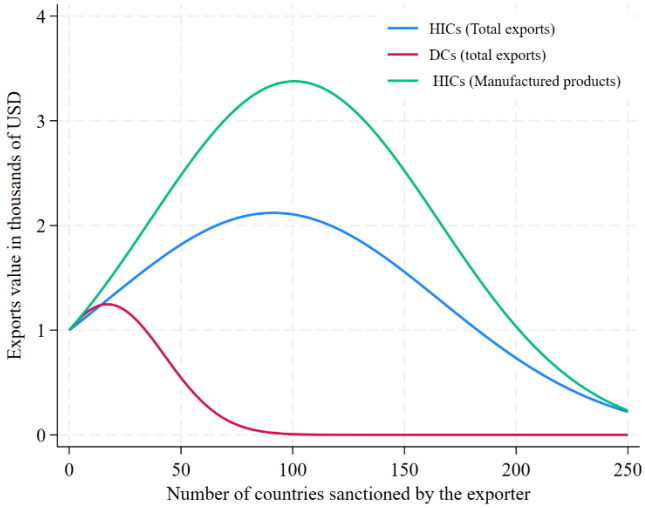
Source: author's estimates based on data from CEPII, SGD and GSDB databases. The study period is 1960 to 2021 for total exports, while observations of manufactured exports only cover the period 1980 to 2016. The sample is restricted to pairs of countries that have not imposed any sanctions on each other over a specific period ($SANCTION_{ijt}^{Target} = 0$). Estimates were performed using the PPML method. Standard deviations are in brackets. They are clustered by country pairs. (***), (**) and (*) denote statistical significance at 1%, 5% and 10% respectively.

Exports of manufactured items to third countries are only sensitive to sanctions if they are imposed by developed countries (columns 3 and 4). This result reflects the significant share of developed countries in world trade in manufactured goods. The optimal threshold of countries beyond which sanctions have a negative impact on trade with third countries is 101 countries, compared to 97 countries when all countries are

considered (table 2, column 4). However, marginal gains of exports to third countries are greater in the trade creation phase when the sender is a developed country (Figures 5 and 7).

Columns 1 and 3 of table 4 also show that "*back to equilibrium effect*" is only significant when the exporter is a developed country. We illustrate the dynamics of exports with third countries in Figure B2 panel (b). The coefficients of the variables relating to the number of countries sanctioning the exporter are not significant in the case of developing countries (columns 2 and 4), whereas they are significant at 1% for developed countries. Developing countries' trade with third countries is not significantly affected by the number of countries sanctioning them. On the other hand, high income countries are likely to be able to improve their trade with third countries as the number of sanctioning countries increases. It would be relatively easier for a developed country to evade sanctions and boost its exports to third countries despite sanctions, due to the diversity of its trading partners.

Figure 7: "*Back to sender effects*" depending on the income level of the sanctioning country



Source: Author' estimates (Table 4) based on GSDB and CEPII data. HICs = High Income Countries. DCs = Developing Countries.

We also consider the income level of third countries, distinguishing between high-income and developing countries. This allows us to distinguish four cases for each type of export analyzed: (i) the case where both countries (exporting and third) are high-income countries, (ii) the case where the exporting country is a high-income country and the third country is a developing country, (iii) the case where the exporting country is a developing country and the third country is a developed country and (iv) the case where both exporting and third countries are developing countries. Table C2 in Appendix C shows the estimation results for both total exports and manufactured goods. The results reveal in general that both advanced and developing third party countries participate in "*back to sender*" and "*back to equilibrium*" effects. In the case where both countries (exporter and importer) are developing countries, the effects of sanctions on total exports to third countries are not significant (columns 4). However, in the case of manufactured exports, the "*back to sender effect*" is significant (column 8). Column 7 further shows that exports of manufactured goods from developing countries

to developed third countries are not as sensitive to sanctions. This result could be linked to the relatively low share of developing countries in global manufactured exports.

5. Conclusion and policy implications

The international trade architecture is largely shaped by free trade agreements (FTA) and sanctions. While the former aims to promote trade and shared prosperity, the latter hinders it through the additional costs it imposes on partners. Full knowledge of these costs compared to the gains and objectives of sanctions is crucial to the decision making of the sanctioning country. On this issue, the literature has largely focused on the impact of sanctions on trade between the sanctioning country and the target and very few studies have looked at the indirect effects on trade with third countries. Moreover, analyses carried out to date do not seem to address the effect of sanctions on the sanctioned country and targets as the number of sanctioned and sanctioning countries increases. In an increasingly globalized and interconnected world, the assumption that sanctions are neutral regarding trade with third countries is difficult to accept, given that the imposition of sanctions sends a signal to companies, consumers, and governments in both target and third countries. The latter may remain indifferent to this signal, or adopt positions favorable or unfavorable to trade with the sanctioned and sanctioning country, depending on their assessment of whether the sanctions imposed are justified and proportionate. Since perceptions of third countries may change over time as the number of sanctioned countries increases, it is interesting to analyze the complex relationship between sanctions and trade with third countries. To address this issue, this paper uses the new Global Sanction Database (GSDB) and a gravity model well known in the literature estimated using PPML approach. The study covers 191 countries from 1960 to 2021.

The results showed that the imposition of sanctions initially favors trade between the exporting country and the third country. However, the "*back to sender effect*" occurs when the number of sanctioned countries exceeds a threshold. The analysis has shown that this threshold is highly dependent on the type of sanction considered (all types of sanction, commercial or financial), the products traded (total exports and manufactured goods) and the level of development of the sanctioning countries and third countries. This shift in trade dynamics can be explained by the negative effects of bad reputations and boycotts, which dominate those of trade creation via eviction of products from the targeted country. In addition, econometric estimates have also shown that sanctions significantly disrupt the targeted country's exports to third countries. However, a significant non-linear relationship is also revealed with the increase in exports to third countries as the number of countries imposing sanctions on the exporter increases ("*back to equilibrium effect*"). These results could be explained by the positive effects of sanctions evasion, third countries or allied countries support, and export substitution, which counterbalance the negative effects of trade disruption.

The results of this research have important implications for the management of international relations through trade and foreign policy. First, the analysis revealed that the imposition of sanctions, if well managed, can lead to gains in terms of trade creation with third countries by crowding out exports from sanctioned countries. Paradoxically, sanctions have the same trade creation or trade diversion effect as membership of a free trade

agreement (FTA). When the gains outweigh the expected losses of a sanction on the target countries, it could appear attractive to use the instrument of sanctions for personal economic and geopolitical interests under the pretexts noble objectives such as fighting terrorism, preserving international peace and security, promoting democracy and human rights violations. In these conditions, the use of sanctions should be carefully justified by the sanctioning country to ensure its effectiveness and preserve its credibility vis-à-vis third countries. Failing such justification, the ambiguity of the objectives pursued by sanctioning country would be a factor which could precipitate the "*back to sender effect*". Sanctioning countries must therefore be transparent, credible and honest about their objectives, to win the support of third countries in international organizations such as the United Nations (UN).

Second, the existence of a threshold beyond which the imposition of a sanction on a new target leads to losses of exports to third countries means that sanctioning countries should not abuse the use of this trade weapon, which can turn out to be "*a double-edged sword*" or "*a slow poison*". Indeed, beyond this threshold, sanctions become counterproductive, whether justified or not, by creating an unexpected retaliation, an implicit counter-sanction by consumers, businesses and governments in third countries. Exceeding this threshold tarnishes a sanctioning country's reputation and puts its companies in jeopardy, as they may lose substantial markets in third countries, as well as investment opportunities. This is particularly true for developing countries, where the thresholds identified are relatively low due to the lack of diversification in terms of partners and products exported. In addition, the choice of the type of sanction (trade or financial) and the products targeted should be the subject of more in-depth analysis, to avoid sudden losses of manufactured exports in a world where product substitution is relatively easier with globalization and the intensification of competition on the world market.

Third, the evidence of a "*back to equilibrium effect*" in the sanctioned country suggests the exploration of alternative avenues such as diplomacy in the resolution of conflicts between countries. Indeed, the possibility of sanctioned countries adapting to sanctions despite periods of deterioration in their trade with third countries reduces the likelihood of achieving the objectives set. In such conditions, sanctions create significant economic losses for both the sanctioning countries and the targets, without any certainty that the objectives will be achieved. Far from aping impunity and the reprehensible actions of some governments, this analysis simply suggests the serious exploration of diplomatic avenues for conflict resolution, rather than the hasty recourse to sanctions, whose consequences can in some cases be as disastrous as military intervention through the internal conflicts they provoke.

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Appendix A

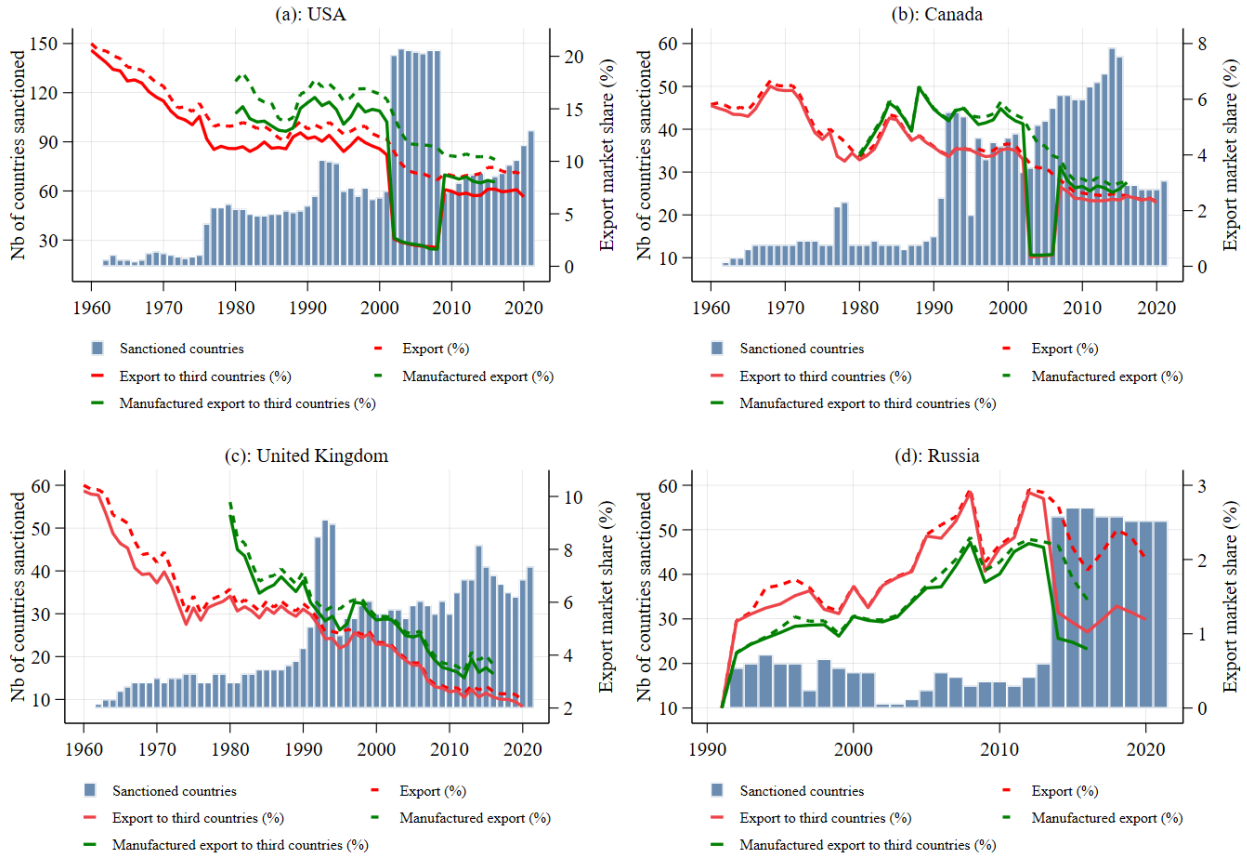
Table A: List of countries in the sample

Albania	Ecuador	Lithuania	Sierra Leone
Algeria	Egypt, Arab Rep.	Luxembourg	Singapore
Angola	El Salvador	Madagascar	Slovak Republic
Antigua and Barbuda	Equatorial Guinea	Malawi	Slovenia
Argentina	Eritrea	Malaysia	Solomon Islands
Armenia	Estonia	Maldives	Somalia
Australia	Eswatini	Mali	South Africa
Austria	Ethiopia	Malta	South Sudan
Azerbaijan	Fiji	Marshall Islands	Spain
Bahamas, The	Finland	Mauritania	Sri Lanka
Bahrain	France	Mauritius	St. Kitts and Nevis
Bangladesh	Gabon	Mexico	St. Lucia
Barbados	Gambia, The	Micronesia, Fed. Sts.	St. Vincent and the Grenadines
Belarus	Georgia	Moldova	Sudan
Belgium	Germany	Mongolia	Suriname
Belize	Ghana	Montenegro	Sweden
Benin	Greece	Morocco	Switzerland
Bhutan	Grenada	Mozambique	Syrian Arab Republic
Bolivia	Guatemala	Myanmar	Tajikistan
Bosnia and Herzegovina	Guinea	Namibia	Tanzania
Botswana	Guinea-Bissau	Nauru	Thailand
Brazil	Guyana	Nepal	Togo
Brunei Darussalam	Haiti	Netherlands	Tonga
Bulgaria	Honduras	New Zealand	Trinidad and Tobago
Burkina Faso	Hong Kong SAR, China	Nicaragua	Tunisia
Burundi	Hungary	Niger	Türkiye
Cabo Verde	Iceland	Nigeria	Turkmenistan
Cambodia	India	North Macedonia	Tuvalu
Cameroon	Indonesia	Norway	Uganda
Canada	Iran, Islamic Rep.	Oman	Ukraine
Central African Republic	Iraq	Pakistan	United Arab Emirates
Chad	Ireland	Palau	United Kingdom
Chile	Israel	Panama	United States
China	Italy	Papua New Guinea	Uruguay
Colombia	Jamaica	Paraguay	Uzbekistan
Comoros	Japan	Peru	Vanuatu
Congo, Dem. Rep.	Jordan	Philippines	Venezuela, RB
Congo, Rep.	Kazakhstan	Poland	Vietnam
Costa Rica	Kenya	Portugal	Yemen
Côte d'Ivoire	Kiribati	Qatar	Zambia
Croatia	Korea, Dem. People's Rep.	Romania	Zimbabwe
Cuba	Korea, Rep.	Russian Federation	
Cyprus	Kuwait	Rwanda	
Czechia	Kyrgyz Republic	Samoa	
Czechoslovakia	Lao PDR	San Marino	
Denmark	Latvia	São Tomé and Príncipe	
Djibouti	Lebanon	Saudi Arabia	
Dominica	Lesotho	Senegal	
Dominican Republic	Liberia	Serbia	
East Germany	Libya	Seychelles	

Source: author

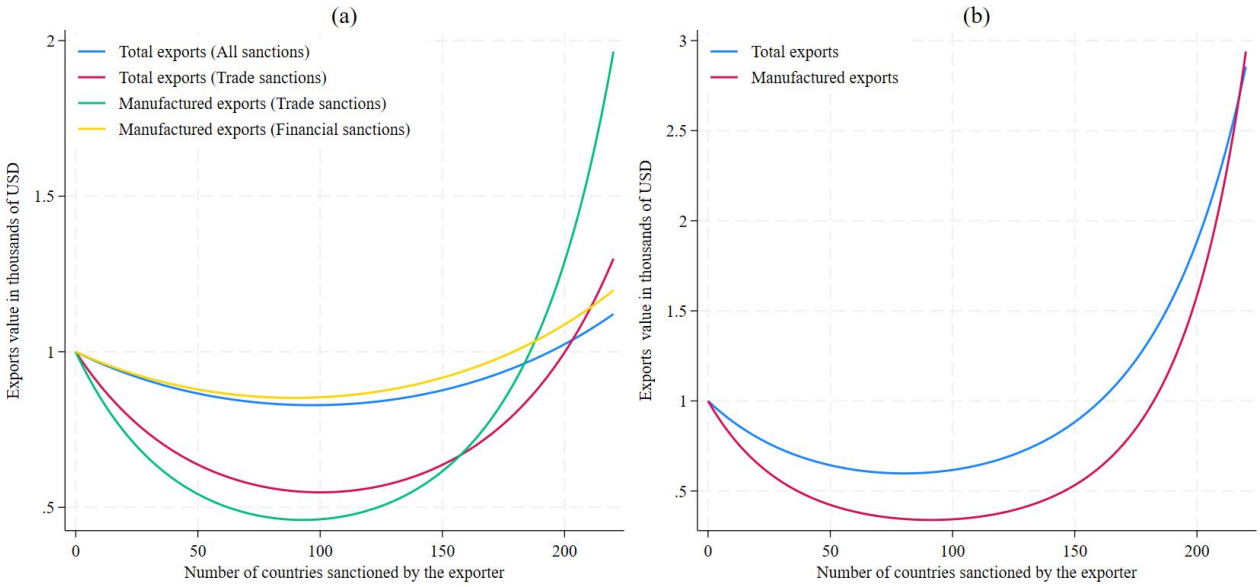
Appendix B

Figure B1: Trend in market share and the number of sanctioned countries for the top sanctioning countries.



Source: Author based on GSDB, SGD and CEPII data.

Figure B2: Relation between exports and the number of sanctioning countries ("*back to equilibrium effect*")



Source: Author' estimates (Table C1, Appendix C, Table 2, and Table 3) based on GSDB and CEPII data.

Appendix C:

Table C1: Non-linear indirect effects of sanctions on trade with third-party countries

	Total exports				Manufactured exports			
Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Distance	0.09944	0.17898	-0.02891	0.08933	-0.78406***	-0.83191***	-1.08951***	-1.04609***
	(0.50059)	(0.51413)	(0.49721)	(0.50738)	(0.29511)	(0.30714)	(0.32011)	(0.33906)
Exporter's GDP	0.68134***	0.67903***	0.68917***	0.68173***	0.84905***	0.83704***	0.89642***	0.87373***
	(0.03195)	(0.03206)	(0.03313)	(0.03286)	(0.04041)	(0.04069)	(0.04211)	(0.04476)
Importer's GDP	0.56023***	0.56401***	0.57247***	0.55781***	0.67048***	0.66999***	0.68678***	0.67505***
	(0.03190)	(0.03407)	(0.03185)	(0.03190)	(0.04759)	(0.05198)	(0.04515)	(0.04961)
Free trade area membership	0.10708***	0.10895***	0.11586***	0.10752***	0.19139***	0.19350***	0.20902***	0.19498***
	(0.03373)	(0.03335)	(0.03462)	(0.03424)	(0.04682)	(0.04676)	(0.04735)	(0.04704)
WTO membership	0.11156***	0.14006***	0.09586***	0.10364***	-0.04110	-0.04256	-0.05161	-0.07605
	(0.02894)	(0.03055)	(0.02797)	(0.02887)	(0.05952)	(0.06367)	(0.05394)	(0.05812)
Exporter remoteness	-0.00039*	-0.00031	-0.00032	-0.00024	-0.00017	-0.00007	0.00005	0.00032
	(0.00020)	(0.00020)	(0.00020)	(0.00022)	(0.00025)	(0.00024)	(0.00026)	(0.00032)
Importer remoteness	-0.00013	-0.00014	-0.00019	-0.00012	0.00009	0.00009	0.00012	0.00018
	(0.00016)	(0.00016)	(0.00017)	(0.00017)	(0.00017)	(0.00016)	(0.00016)	(0.00017)
Number of countries sanctioned by the exporter (trade sanction)	0.00578***	0.02974***			0.00828*	0.03868***		
	(0.00174)	(0.00401)			(0.00435)	(0.00621)		
Squared number of countries sanctioned by the exporter (trade sanction)		-0.00054***				-0.00069***		
		(0.00008)				(0.00013)		
Number of countries sanctioning the exporter (trade sanction)	-0.00156**	-0.01201***			-0.00235***	-0.01673***		
	(0.00074)	(0.00225)			(0.00072)	(0.00258)		
Squared Number of countries sanctioning the exporter (trade sanction)		0.00006***				0.00009***		
		(0.00001)				(0.00001)		
Number of countries sanctioned by the exporter (financial sanction)			0.00476**	0.01017***			0.01836***	0.03058***
			(0.00219)	(0.00340)			(0.00365)	(0.00577)
Squared number of countries sanctioned by the exporter (financial sanction)				-0.00010*				-0.00022**
				(0.00005)				(0.00009)
Number of countries sanctioning the exporter (financial sanction)			-0.00070	-0.00295*			-0.00011	-0.00358*
			(0.00057)	(0.00159)			(0.00051)	(0.00188)
Squared Number of countries sanctioning the exporter (financial sanction)				0.00001				0.00002*
				(0.00001)				(0.00001)
Constant	-6.33589	-7.70246*	-5.83374	-7.52988*	-1.90808	-2.28720	-3.04511	-5.51151
	(3.86441)	(3.95094)	(3.86300)	(3.99001)	(3.21630)	(3.20865)	(3.25995)	(3.55073)
Observations	1,437,954	1,384,855	1,431,828	1,384,855	901,486	864,489	895,315	864,489
Exporter fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Importer fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Pseudo R square	0.981	0.981	0.981	0.981	0.979	0.980	0.980	0.980
F-Stat	912.9	910.9	887.8	967	848.3	816.4	911.2	909.3
Prob > F	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Source: author's estimates based on data from CEPII, SGD and GSDB databases. The study period is 1960 to 2021 for total exports, while observations of manufactured exports only cover the period 1980 to 2016. The sample is restricted to pairs of countries that have not imposed any sanctions on each other over a specific period ($SANCTION_{ijt}^{Target} = 0$). Estimates were performed using the PPML method. Standard deviations are in brackets. They are clustered by country pairs. (***), (**) and (*) denote statistical significance at 1%, 5% and 10% respectively.

Table C2: Level of development of sanctioning country and indirect non-linear effect of sanctions on trade with third-party countries

Variables	Total exports				Manufactured exports			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	HICs vs HICs	HICs vs DCs	DCs vs HICs	DCs vs DCs	HICs vs HICs	HICs vs DCs	DCs vs HICs	DCs vs DCs
Distance	2.98593***	-0.45250	0.47443	-0.85723***				-0.23667
	(1.04806)	(0.74957)	(0.83907)	(0.20646)				(0.32554)
Exporter's GDP	0.60564***	0.63549***	0.58540***	0.72427***	0.58964***	0.69125***	0.64148***	0.78172***
	(0.04575)	(0.07133)	(0.05243)	(0.04631)	(0.05938)	(0.09331)	(0.08182)	(0.05615)
Importer's GDP	0.49802***	0.48871***	0.55606***	0.64660***	0.74905***	0.51754***	0.63708***	0.45426***
	(0.04182)	(0.05635)	(0.06694)	(0.05328)	(0.05261)	(0.09483)	(0.07276)	(0.05810)
Free trade area membership	0.09253*	0.10155	0.11923**	0.07757*	0.15903**	0.13250	0.08828	0.10067
	(0.04829)	(0.06191)	(0.05554)	(0.04698)	(0.06577)	(0.08689)	(0.06924)	(0.06568)
WTO membership	0.11552***	0.15993***	0.18511***	0.19852***	-0.31818***	0.06109	0.21079***	0.07607
	(0.03926)	(0.05825)	(0.05345)	(0.06751)	(0.07932)	(0.09161)	(0.07953)	(0.07132)
Exporter remoteness	-0.00041**	0.00059*	-0.00080**	-0.00053**	-0.00009	0.00086***	-0.00080**	-0.00156***
	(0.00016)	(0.00033)	(0.00040)	(0.00024)	(0.00021)	(0.00026)	(0.00040)	(0.00027)
Importer remoteness	-0.00044***	-0.00020	0.00081	-0.00027	-0.00028	0.00001	0.00099*	0.00029
	(0.00017)	(0.00022)	(0.00050)	(0.00025)	(0.00017)	(0.00017)	(0.00056)	(0.00027)
Number of countries sanctioned by the exporter	0.01779***	0.01297***	0.03420**	0.01404	0.02601***	0.02008***	-0.04874	0.08082***
	(0.00296)	(0.00361)	(0.01622)	(0.01025)	(0.00491)	(0.00691)	(0.03192)	(0.02343)
Squared number of countries sanctioned by the exporter	-0.00010***	-0.00007***	-0.00114**	-0.00001	-0.00013***	-0.00010***	0.00085	-0.00143***
	(0.00001)	(0.00002)	(0.00052)	(0.00027)	(0.00002)	(0.00004)	(0.00056)	(0.00048)
Number of countries sanctioning the exporter	-0.01713***	-0.00854**	-0.00385*	0.00084	-0.02804***	-0.01896***	-0.00126	0.00240
	(0.00396)	(0.00353)	(0.00222)	(0.00137)	(0.00504)	(0.00444)	(0.00263)	(0.00241)
Squared Number of countries sanctioning the exporter	0.00010***	0.00006***	0.00001	-0.00001	0.00015***	0.00011***	0.00001	-0.00001
	(0.00002)	(0.00002)	(0.00001)	(0.00001)	(0.00003)	(0.00003)	(0.00001)	(0.00001)
Constant	-23.49589***	-6.84960	-11.13898	0.89929	-2.41765	-10.46317***	-3.98856	8.89929**
	(7.68634)	(6.59431)	(7.88270)	(2.80255)	(2.27724)	(3.55326)	(6.04431)	(3.95075)
Observations	160,717	300,969	337,701	585,468	102,647	189,127	212,340	360,375
Exporter fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Importer fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Pseudo R square	0.975	0.985	0.983	0.978	0.976	0.970	0.986	0.975
F-Stat	467.7	302.1	491.2	591.6	517.3	164	285.6	544.9
Prob > F	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Source: author's estimates based on data from CEPII, SGD and GSDB databases. The study period is 1960 to 2021 for total exports, while observations of manufactured exports only cover the period 1980 to 2016. HICs means High Income Countries. DCs means Developing Countries. The sample is restricted to pairs of countries that have not imposed any sanctions on each other over a specific period ($SANCTION_{ijt}^{Target} = 0$). Estimates were performed using the PPML method. Standard deviations are in brackets. They are clustered by country pairs. (***), (**) and (*) denote statistical significance at 1%, 5% and 10% respectively.

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