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Abstract

Using established econometric techniques and disaggregated data that include intra-national trade flows, we estimate the direct and extraterritorial effects of complete trade sanctions on international trade. Across sectors, the direct effects of complete trade sanctions are negative, as expected. However, their extraterritorial effects are predominantly positive, working in the opposite direction of the direct effects. At the extreme, the extraterritorial effects of complete trade sanctions may fully offset their direct effects and lead to a perverse scenario in which the target's overall trade rises in the aftermath of sanctions.

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Highlights

- We estimate the direct and extraterritorial effects of complete trade sanctions.
- The direct effects of the sanctions are almost exclusively negative across sectors.
- The extraterritorial effects of sanctions are predominantly positive across sectors.
- The positive extraterritorial effects may lead to a net increase in the target's trade.
- Not accounting for the extraterritorial sanction effects may bias their direct effects.

1 Introduction

Recognizing that the direct effects of trade sanctions may not impose very large costs on the sanctioned states, some senders of sanctions have attempted to pressure third countries to cease or reduce their trade with targets. A prominent example of such policy initiatives is the Cuban Democracy Act (CDA) of 1992, a U.S. bill which *"[d]eclares that the President should encourage countries that conduct trade with Cuba to restrict their trade and credit relations with Cuba"*.[1] At the same time, Early (2015) and Scheckenhofer et al. (2025) have argued that often such efforts are doomed to failure because third parties engage in "sanctions busting". Thus, the evidence on whether sanctions promote or decrease trade with third countries is mixed.

We contribute to this debate by providing systematic evidence for the extraterritorial effects of complete trade sanctions on sectoral trade between targets and third countries. Specifically, we estimate a structural gravity model with established econometric techniques, which fully account for the conventional trade-creation and trade-diversion effects, and we apply the model to disaggregated trade data from the *International Trade and Production Database for Estimation* (ITPD-E). Crucially for our purposes and consistent with trade theory, the ITPD-E includes domestic trade flows, which enable us to estimate simultaneously both the direct and extraterritorial effects of sanctions for each sector in our sample within the same econometric specification and in the presence of a complete set of exporter-industry-time and importer-industry-time fixed effects.[2]

Our analysis generates five main findings. First, consistent with the existing literature, we find that the effects of complete trade sanctions on sectoral trade between senders and targets are negative, large, and statistically significant. Second, our estimates of the extraterritorial effects of complete trade sanctions on trade between targets and third countries are predominantly positive across the sectors in our sample. Third, several of the sectoral estimates of the direct effects of sanctions are smaller in absolute value than the corresponding estimates of the extraterritorial

[1] Consistent with the CDA and focusing on the U.S. sanctions on Cuba, Kwon et al. (2024) find that the average impact of trade sanctions on manufacturing trade between targets (and Cuba in particular) and third countries is negative.

[2] In addition to Scheckenhofer et al. (2025), who focus on military goods, and Kwon et al. (2024), who focus on Cuba and obtain negative extraterritorial sanction estimates, our paper is related to several other papers. Using a gravity model, Caruso (2003) finds that the extraterritorial effects of unilateral U.S. sanctions on trade between targets and G-7 countries are negative. Gammadigbe (2025) and Yalcin et al. (2025) also use an empirical gravity model to study the effects of sanctions on third countries and find positive effects. In addition to providing systematic evidence for positive extraterritorial sanction effects at the sectoral level, our contribution in relation to Caruso (2003), Gammadigbe (2025) and Yalcin et al. (2025) is that these papers do not rely on domestic trade flows, while, as we argue below, domestic sales are crucial for the identification of the extraterritorial sanction effects.

effects of sanctions. Fourth, in several sectors, the direct sanction effects are not statistically different from zero, while the extraterritorial sanction effects are large and positive. In combination, these findings imply that it is possible for a target's trade to increase in the aftermath of complete trade sanctions, and we demonstrate that the effects of complete trade sanctions are indeed perverse in the case of the 2006 sanctions of Russia on Georgia. Finally, the fact that the extraterritorial estimates of the complete trade sanctions are statistically significant implies that if they are not explicitly accounted for in the econometric model, then the estimates of the direct sanction effects would be biased.

The rest of the paper is organized as follows. Section 2 describes our econometric methods and data. Section 3 presents and discusses our main findings.

2 Econometric Methods and Data

To obtain our estimates, we rely on the workhorse model of trade – the gravity equation – and follow the recommendations for estimating the gravity model of Larch et al. (2025*b*). Specifically, we set up the following econometric model:

$$\begin{aligned} X_{ij,t}^{k} \;=\; & \exp[\beta^{k} TRADE\_SANCT_{ij,t} + \gamma^{k} EXTRA\_TRADE\_SANCT_{ij,t} + \sigma^{k} PARTL\_SANCT_{ij,t}] \times \\ & \exp[OTHER\_SANCT_{ij,t} \times \delta^{k} + POLICY_{ij,t} \times \alpha^{k} + GLOB_{ij,t}^{k} + \overrightarrow{\mu}_{ij}^{k} + \pi_{i,t}^{k} + \chi_{j,t}^{k}] \times \epsilon_{ij,t}^{k}. \end{aligned} \tag{1}$$

The dependent variable, $X_{ij,t}^{k}$, is nominal bilateral trade for consecutive years t between exporter i and importer j in industry k. Consistent with theory, the dependent variable includes domestic trade (Yotov 2022). The consideration of these flows is essential to our analysis because they help identify simultaneously both the direct and the extraterritorial effects of trade sanctions.[3][4]

We use Poisson Pseudo Maximum Likelihood (PPML) as our preferred estimator because it enables us to (i) account for heteroskedasticity in the trade flows data, and (ii) retain the zero trade flows in our estimating sample (Santos Silva & Tenreyro 2006). Following the standard

[3]Without domestic trade flows, the combination of $TRADE\_SANCT_{ij,t}$ and $EXTRA\_TRADE\_SANCT_{ij,t}$ is perfectly collinear with the country-time fixed effects in our model thus rendering impossible the identification of the two effects simultaneously with international trade only.

[4]The bilateral trade flows data come from the *International Trade and Production Database for Estimation* (ITPD-E), which is developed and maintained by the USITC (Borchert et al. 2020, Larch et al. 2025*a*), and it can be accessed freely at https://www.usitc.gov/data/gravity/itpde.htm. The ITPD-E covers a large number of countries (more than 200), a large number of industries (170), and a long period of time (1986-2022). Importantly, the ITPD-E is based on raw data, which makes it suitable for estimations, and it includes domestic trade flows, which is key for our identification. See Larch et al. (2025*a*) for further details on the construction and features of the ITPD-E.

approach in the gravity literature, we cluster the standard errors by pair-industry (Egger & Tarlea 2015), and we estimate our model in Stata with the *ppmlhdfe* command (Correia et al. 2020).

The first two terms on the right-hand side of (1) capture the direct and the extraterritorial effects of trade sanctions. $TRADE\_SANCT_{ij,t}$ is an indicator variable that takes a value of one if there is a complete trade sanction between exporter i and importer j at time t.[5] In addition, our key covariate $EXTRA\_TRADE\_SANCT_{ij,t}$ is an indicator variable that is equal to one for trade between the targets of complete trade sanctions and all other countries except the senders.[6] Thus, *ceteris paribus*, a positive and statistically significant estimate of γ^k would suggest that trade between targets and third countries increased after the imposition of complete trade sanctions.

The remaining terms in (1) are as follows. $PARTL\_SANCT_{ij,t}$ is an indicator for partial trade sanctions, $OTHER\_SANCT_{ij,t}$ is a vector of indicator variables for different types of sanctions, e.g., including arms sanctions, military sanctions, travel sanctions, financial sanctions, and other sanctions.[7] $POLICY_{ij,t}$ is a vector of time-varying bilateral policy variables, including joint membership in Regional Trade Agreements (RTA), Economic Integration Agreements (EIA), customs unions (CU), the European Union (EU), and the World Trade Organization (WTO).[8]

Specification (1) includes four sets of fixed effects. $GLOB^k_{ij,t}$ is a vector of time-varying border indicators, one for each year in our sample, which take a value of one for international flows and are equal to zero for domestic trade for each year and industry in our sample. These fixed effects capture any common-across-countries (de-)globalization trends that have affected international relative to domestic trade, e.g., improvements in communication, transportation, etc. $\overrightarrow{\mu}^k_{ij}$ are directional industry-pair fixed effects, which account for all possible time-invariant bilateral trade costs and mitigate potential endogeneity concerns (Baier & Bergstrand 2007).

[5] We focus on complete trade sanctions for two reasons: (i) because they have been shown to be more effective in decreasing trade between senders and targets (Felbermayr et al. 2020); and (ii) because the sanctions data from the GSDB does not allow us to identify the sectors that are targeted by partial trade sanctions. This said, we do control for the impact of partial trade sanctions.

[6] We recognize that both the direct and extraterritorial sanction effects can be very heterogeneous across trade partners. However, our objective is to obtain average direct and extraterritorial estimates, which are more easily comparable with each other and also sufficient to generate and highlight the possibility of 'perverse' trade sanctions.

[7] The data on all sanction variables in our model come from the Global Sanctions Database (Felbermayr et al. 2020, Yalcin et al. 2025). The GSDB is available at https://www.globalsanctionsdatabase.com/.

[8] The data on membership in the European Union (EU) and membership in the World Trade Organization (WTO) are from the *Dynamic Gravity Dataset* (DGD) of the USITC (Gurevich & Herman 2018), which can be accessed at https://www.usitc.gov/data/gravity/dgd.htm. The data on membership in Regional Trade Agreements (RTAs), customs unions (CUs), and economic integration agreements (EIAs) are from Egger & Larch (2008), https://www.ewf.uni-bayreuth.de/en/research/RTA-data/index.html.

Finally, $\pi_{i,t}^k$ and $\chi_{j,t}^k$ are exporter-industry-time and importer-industry-time fixed effects, which account for the structural multilateral resistance terms of Anderson & van Wincoop (2003) and any other country-time-specific determinants of trade flows on the source and the destination side. Importantly, these fixed effects control for any general equilibrium (GE) trade-creation effects; e.g., that, after the 2022 sanctions on Russia, trade will be diverted from Russia to India and vice versa to fill the 'vacuum' from Russia's lost trade with the sanctioning states. Thus, extending the India-Russia example, a positive estimate on γ^k would capture an increase in trade between these two countries that is in addition to the GE trade-creation effects, i.e., as if India and Russia have signed a free trade agreement. We provide evidence for that next.

3 Estimation Results and Analysis

In combination with the separability property of the gravity equation, i.e., that the model can be estimated at any level of aggregation (Anderson & van Wincoop 2004), the ITPD-E data can deliver 170 industry-level estimates of the extraterritorial effects of trade sanctions. For sharper clarity and to improve estimating efficiency, we obtain estimates sector by sector for 22 broad sectors instead of for each of the 170 ITPD-E industries. To take full advantage of the data, rather than *aggregating* the industry observations, we *pool* individual industries into 22 sectors, and we use the full set of fixed effects from specification (1). The only difference is that the estimates on the policy variables in (1), including the key estimate on $EXTRA\_TRADE\_SANCT_{ij,t}$, are constrained to be common across the industries within each broad sector.

Our results appear in Table 1. For benchmark comparisons, the estimates in panel A are based on specification (1) but without controlling for the extraterritorial effects of complete trade sanctions. For brevity, we only include the estimate of the effects of complete trade sanctions on trade between the senders and targets. Consistent with the existing literature, our estimates of the direct effects of complete trade sanctions on trade between targets and senders are negative, sizable, and statistically significant. Specifically, all 22 sectoral estimates on $TRADE\_SANCT_{ij,t}$ in panel A of Table 1 are negative and 20 of them are also statistically significant. The implication is that complete trade sanctions are effective in eliminating trade between targets and senders. This supports our decision to focus on complete trade sanctions.

Our main results, which are obtained from specification (1) including the covariate for extraterritorial effects of sanctions, appear in panel B Table 1 and can be visualized in Figure 1. Once again, for brevity, in panel B of Table 1 and Figure 1 we only report the estimates of the direct effects ($TRADE\_SANCT_{ij,t}$) and the extraterritorial effects ($EXTRA\_TRADE\_SANCT_{ij,t}$) of complete trade sanctions. Based on these results, we draw five conclusions.

Table 1: The Direct & Extraterritorial Effects of Complete Trade Sanctions on Trade

Sector ID	Sector Description	A. No Extraterritorial Effects		B. With Extraterritorial Effects			
		Direct Effects		Direct Effects		Extraterritorial Effects	
1	Crops and Grains	-.627	(.295)*	-.626	(.305)*	.001	(.13)
2	Specialty and Horticulture	-1.003	(.168)****	-.79	(.172)****	.379	(.106)***
3	Processed Food and Bev.	-1.834	(.449)****	-1.978	(.466)****	-.176	(.197)
4	Animal Products	-1.369	(.306)****	-1.48	(.32)****	-.165	(.145)
5	Industrial and Resources	-.788	(.15)****	-.906	(.185)****	-.154	(.157)
6	Mining and Energy	-.516	(.202)*	.097	(.273)	.634	(.189)***
7	Food	-.479	(.2)*	-.308	(.201)	.246	(.04)****
8	Beverages and Tobacco	-1.061	(.277)***	-1.134	(.28)****	-.104	(.112)
9	Textiles	-.392	(.189)*	-.129	(.188)	.519	(.085)****
10	Apparel and Footwear	-.299	(.279)	.11	(.246)	.553	(.129)****
11	Wood	-.701	(.119)****	-.635	(.121)****	.17	(.076)*
12	Paper	-.579	(.119)****	-.542	(.116)****	.1	(.083)
13	Chemicals	-.783	(.144)****	-.167	(.157)	.827	(.097)****
14	Rubber and Plastic	-.533	(.127)****	-.469	(.128)***	.153	(.101)
15	Mineral Products	-.597	(.086)****	-.518	(.081)****	.268	(.057)****
16	Metal Products	-.632	(.106)****	-.28	(.096)**	.782	(.105)****
17	Machines General	-.829	(.14)****	-.573	(.155)***	.372	(.126)**
18	Machines Specific	-.792	(.235)***	-.495	(.221)*	.403	(.073)****
19	Electronics	-.26	(.128)*	-.132	(.132)	.275	(.049)****
20	Transportation	-.131	(.131)	-.025	(.137)	.28	(.101)**
21	Other Manufacturing	-.708	(.188)***	-.658	(.188)***	.074	(.069)
22	Services	-.574	(.234)*	-.608	(.238)*	-.038	(.05)

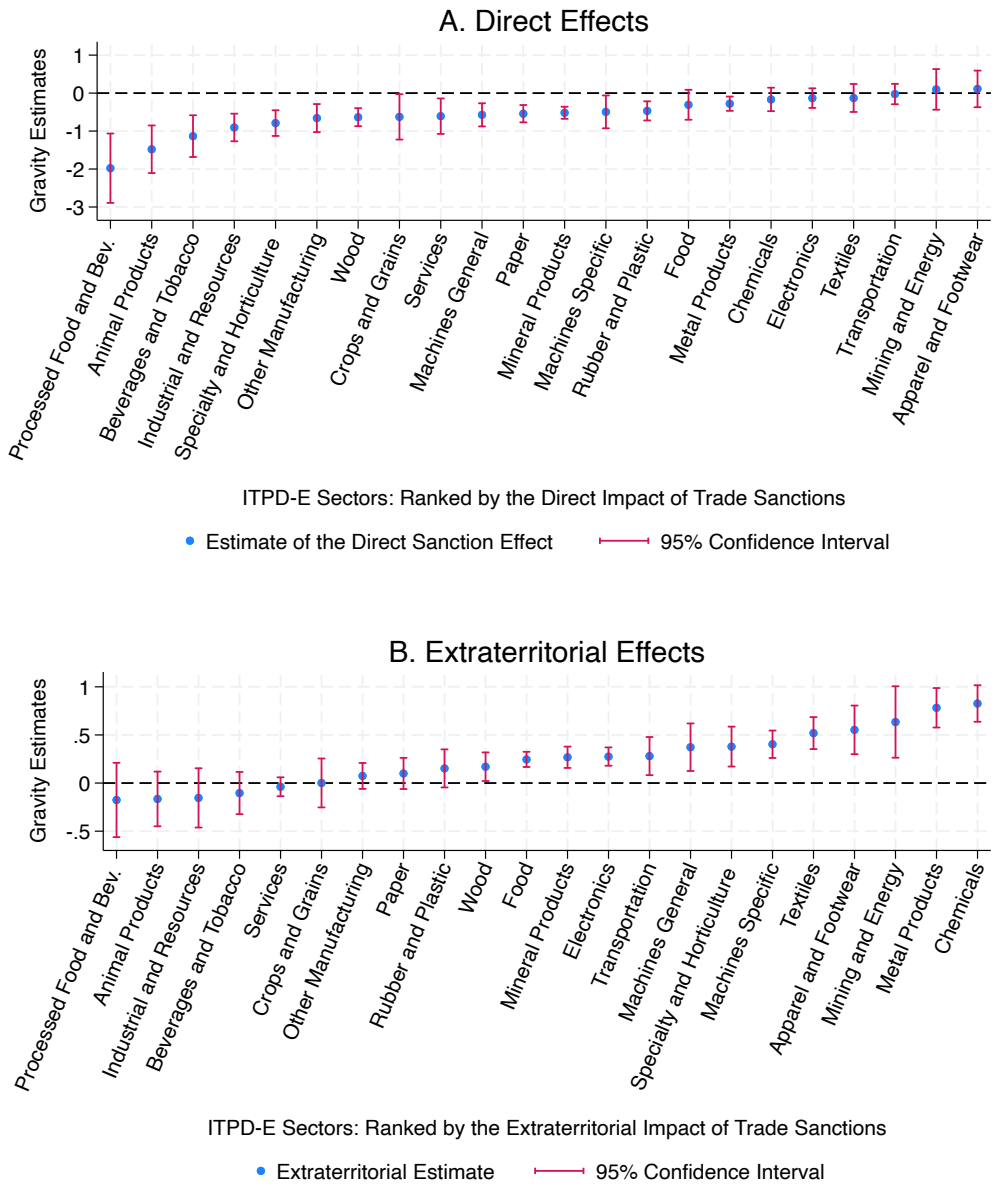
Notes: This table reports sectoral estimates of the direct and extraterritorial impact of complete trade sanctions. The only difference between panels A and B is that panel A does not control for the extraterritorial effects of sanctions, while panel B does. The estimates for each sector are obtained from a single specification after estimating a pooled version of equation (1) across the industries that comprise each of the sectors in this table. The dependent variable is trade in levels, including domestic sales, and the Poisson Pseudo Maximum Likelihood (PPML) estimates for each sector are obtained with exporter-industry-time fixed effects, importer-industry-time fixed effects, directional pair-industry fixed effects, time-industry-varying border indicators, and a series of policy controls, whose estimates are omitted for brevity. Panel A reports the direct effects of complete trade sanctions on trade between senders and targets from a specification that does not control for the extraterritorial sanction effects. Panel B reports estimates of both the direct and the extraterritorial effects of complete trade sanctions on trade between the targets and third countries, which are obtained simultaneously for each sector. The standard errors are clustered by pair-industry. * p<0.05, ** p<0.01, *** p<0.001, **** p<0.0001. See text for further details.

First, we see from panel B that the extraterritorial effects of complete trade sanctions on trade between targets and third countries are predominantly positive.[9] This is our main finding. Specifically, 17 of the 22 possible estimates on $EXTRA\_TRADE\_SANCT_{ij,t}$ are positive and 13 of them are also sizable and statistically significant. While a full general equilibrium comparison of

[9]This result is consistent with existing evidence on "sanctions busting" from the academic literature (Early 2015, Scheckenhofer et al. 2025), as well as with policy reports on individual sanction cases, e.g., the 2006 trade embargo from Russia on Georgia (Jugheli 2015), which we will focus on as a specific example below.

the impact of the complete trade sanctions on trade and welfare is beyond the scope of this paper, our estimates are sufficient to draw several implications and conclusions, which we discuss next.[10]

Figure 1: The Direct & Extraterritorial Effects of Complete Trade Sanctions on Trade



Note: This figure visualizes the sectoral direct and extraterritorial estimates of the impact of complete trade sanctions from Table 1. The estimates for each sector are obtained from a single specification after estimating a pooled version of equation (1) across the industries that comprise each of the sectors in this table. The dependent variable is trade in levels, including domestic sales, and the Poisson Pseudo Maximum Likelihood (PPML) estimates for each sector are obtained with exporter-industry-time fixed effects, importer-industry-time fixed effects, directional pair-industry fixed effects, time-industry-varying border indicators, and a series of policy controls, whose estimates are omitted for brevity. Panel A reports the direct effects of complete trade sanctions on trade between senders and targets. Panel B reports estimates of the extraterritorial effects of complete trade sanctions on trade between the targets and third countries. The standard errors are clustered by pair-industry. See text for further details.

Second, the positive extraterritorial estimates we obtain suggest that, on average, trade between targets and third countries in most sectors increases after complete trade sanctions. Therefore, without any further qualifications, these positive effects mitigate the direct negative impact of complete trade sanctions. This result can be used to explain the low effectiveness of sanctions. We remind readers that, by construction, the increase in trade between targets and third countries due to the extraterritorial effects of sanctions is in addition to any general equilibrium trade-creation effects, which push in the same direction as the extraterritorial effects and are fully controlled for by the country-industry-time fixed effects in our model.

Third, we note that several of the sectoral estimates of the direct effects of sanctions are smaller in absolute value than the corresponding estimates of the extraterritorial effects of sanctions (e.g., for 'Metal Products'). The implication of this result is that, if the pre-sanction trade between a target and the sender(s) of a complete trade sanction is the same as the pre-sanction trade between this target and third countries, then, *ceteris paribus*, the combination of the direct and the extraterritorial effects will result in a net/overall increase in the trade of the target, i.e., the complete trade sanction effect is 'perverse' because it has led to more trade for the target.[11]

Fourth, on a related note, there are several sectors (e.g., 'Textiles', 'Chemicals', 'Electronics', and 'Transportation') where the direct sanction effects are not statistically different from zero, while the extraterritorial sanction effects are large and positive. Thus, *ceteris paribus*, the net impact of the partial-equilibrium effects of the complete trade sanctions on the targets' trade in these sectors would be an increase. 'Apparel and Footwear' is even a more extreme example, where the direct estimate is not statistically significant but positive as well.

To illustrate the possibility of real perverse sanction effects with a specific example, we examine the impact of the 2006 complete trade sanctions of Russia on Georgia. Based on Georgia's pre-sanction (i.e., in 2005) exports to Russia and to the rest of the world, we use our estimates from panel B of Table 1 to construct predicted post-sanction trade to Russia (based on the direct sanction estimates) and to the rest of the world (based on the extraterritorial sanction effects) for each of 22

[10] We purposefully refrain from claims about 'perverse' sanction effects on welfare. The reason is that we cannot measure the costs (e.g., negotiation, export promotion, etc.) that are associated with the additional 'trade liberalization' between the targets and third countries, which is reflected in our positive extraterritorial estimates.

[11] Most complete trade sanctions involve a relatively small number of senders. This means that the pre-sanction trade between a target and third countries can be significantly larger than the corresponding pre-sanction trade between the sender(s) and this target. As a result, even a relatively smaller positive extraterritorial sanction estimate may still generate the 'perverse' effect of a complete trade sanction on the target's trade in a given sector.

sectors in our sample. Then, we sum the sectoral data to construct aggregate pre- and post-sanction exports from Georgia (i) to Russia, (ii) to the rest of the world, and (iii) to all countries (i.e., total exports, including Russia and the rest of the world). Finally, we construct the percentage changes between the pre- and post-sanction exports from Georgia for each of the three groups.

Our main findings are as follows. After the complete trade sanctions, Georgia's exports to Russia fall by 56.9%, however Georgia's exports to the rest of the world increase by 79.5%. Moreover, because in 2005 Russia accounted for a smaller fraction of Georgia's baseline exports (i.e., about 14%) than the far larger rest-of-world, the net positive effect on Georgia's total exports is even larger, at 60.9%.[12] As noted earlier, this analysis is only partial equilibrium, ignoring possible costs of trade liberalization between Georgia and the rest of the world (which will mitigate the perverse sanction effects) as well as the general equilibrium trade diversion effects (which will make the perverse sanction effects even stronger). Nevertheless it provides a clear real-world example of perverse trade sanction effects in action.

Finally, from a methodological perspective, the fact that we obtain statistically significant estimates of the extraterritorial effects of complete trade sanctions implies that if these extraterritorial effects are not explicitly accounted for in our econometric model, then the estimates of the direct sanction effects would be biased. Specifically, when the extraterritorial estimates are positive, not accounting for them would lead to upward bias (in absolute value) in the estimates of the direct sanction effects, i.e., the negative estimates of the direct sanction effects would be larger in absolute value. This implication can be seen very clearly in Table 1 by comparing the direct sanction effects in panel A (i.e., without the extraterritorial covariate) vs. panel B (with the extraterritorial covariate) .

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[12] With 16 of 22 sectors registering net gains and the losses concentrated in a few sectors.

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