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Abstract

We study the impact of financial sanctions on international trade. To pursue this objective, we assemble new data that distinguish between six types of financial sanctions across all countries in the world over the period 1950–2025. Combining these data with aggregate and disaggregated trade data in a structural gravity framework, we find that financial sanctions can exert substantial adverse effects on trade. However, these effects are highly heterogeneous across sectors, across sanction cases, and, most importantly, across the different types of financial sanctions in our data. Payment restrictions are most effective in eliminating trade between senders and targets. Unlike sanctions on goods, they also significantly reduce trade between targets and third countries.

Keywords: Financial sanctions; Payment restrictions; International trade; The Global Sanctions Data Base (GSDB).

JEL Classification: F13; F14; F51; F52.

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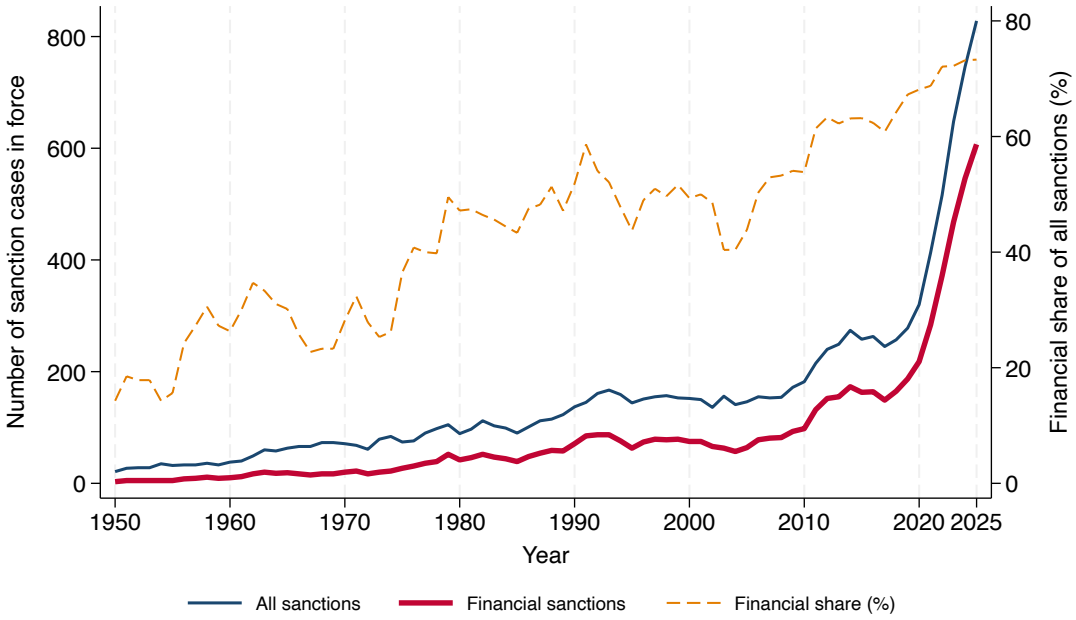
1 Introduction

Economic sanctions have become one of the most widely used instruments of foreign economic policy, and their use has risen sharply over the past several decades (The Economist, 2021; Morgan et al., 2023; Felbermayr et al., 2025). Within this expanding toolkit, *financial* sanctions have emerged as the single most important type of sanctions employed by sanctioning states. As shown in Figure 1, financial sanctions account for the largest and fastest-growing share of all sanction cases in the world, and that share has risen from 14% in 1950 to 73% in 2025. The appeal of financial sanctions lies in their flex-

Figure 1: The Evolution of Financial Sanctions, 1950–2025



Note: This figure illustrates the evolution of the number of sanction cases, financial sanction cases, and the share of financial cases in all sanction cases over the period 1950–2025. The underlying data is from the Global Sanctions Data Base – Release 5 (GSDB-R5) and the Global Sanctions Data Base – Financial Sanctions (GSDB-FS).

ibility: a financial sanction can be aimed narrowly at individual persons or institutions, or at the payment and settlement infrastructure that underpins virtually all cross-border transactions. In the latter case it reaches every field of economic activity, from trade in goods and services to financial flows and foreign direct investment.

Despite the large and growing prominence of financial sanctions and increasing academic and policy interest in quantifying their effects,[1] rigorous assessments of their impact remain hampered by a lack of comprehensive, disaggregated data. This data gap has led to some puzzling findings about the effects of financial sanctions. For example, using an aggregate financial-sanctions indicator, Felbermayr et al. (2020) find that financial sanctions have little or no impact on international trade flows. A similar conclusion emerges from Besedeš et al. (2017, 2021), who exploit detailed German firm- and transaction-level data and likewise find relatively small effects of financial sanctions on cross-border activity, including trade in goods and services. Taken together, these findings appear difficult to reconcile with the central and rapidly growing role that financial sanctions play in modern economic statecraft.

To address these challenges, we make three related contributions. First, we create the *Global Sanctions Data Base – Financial Sanctions* (*GSDB-FS*), an extension of the GSDB that provides the most comprehensive coverage of financial sanctions to date, spanning the period 1950–2025, and disaggregates them into six constituent types, namely asset freezes, restrictions on payment-service infrastructure ('payment restrictions'), restrictions on aid, restrictions on investment, restrictions on financial services, and other financial sanctions.[2] Second, along with the new GSDB-FS, we update and extend the original Global Sanctions Data Base (Felbermayr et al., 2020) to provide the most comprehensive coverage of sanctions to date, through 2025. The resulting fifth release (GSDB-R5), which we also introduce with this paper, is therefore fully compatible with the GSDB-FS. Furthermore, we introduce a new monthly time dimension in the GSDB-R5, which may be

[1] Recent contributions study the impact of financial sanctions on international trade (Felbermayr et al., 2020), on the performance of German firms (Besedeš et al., 2021), on financial flows between Germany and sanctioned countries (Goldbach and Nitsch, 2023), on global banking flows (Ha and Thang, 2023), on bank lending (Efing et al., 2023), and on the composition of central-bank reserves (Arslanalp et al., 2023). Clayton et al. (2026) provide a theoretical framework for the geoeconomic use of financial relationships. For a recent survey of the impact of financial sanctions, we refer the reader to Cipriani et al. (2023). For surveys of the broader impact of sanctions, including financial sanctions, please see Morgan et al. (2023), and Felbermayr et al. (2025).

[2] The GSDB-FS data is free for public use and can be requested at https://www.globalsanctionsdatabase.com/.

useful for event studies with high-frequency data.

Third, to highlight the importance of distinguishing between the different types of financial sanctions, we exploit the new data to re-evaluate the relationship between financial sanctions and international trade within a theory-consistent empirical gravity framework. In doing so, we resolve the 'missing trade effects of financial sanctions' puzzle by demonstrating that the near-zero average effect documented in the literature masks pronounced heterogeneity across the types of financial sanctions, and that payment restrictions, in particular, exert large, negative, and highly statistically significant effects on trade, comparable in magnitude to the effects of complete trade sanctions. Moreover, by combining the GSDB-FS with trade data that include domestic flows, we provide the first estimates of the *third-country* effects of payment restrictions, showing that, consistent with the multilateral design of instruments such as expulsion from the Society for Worldwide Interbank Financial Telecommunication (SWIFT), they hamper the targets' trade not only with the senders but also with third countries.

To perform the empirical analysis, we combine the new financial sanctions measures from the GSDB-FS with two complementary sources of trade data. For the main aggregate analysis, we use bilateral international trade flows from the International Monetary Fund's Direction of Trade Statistics (DOTS) database. The main advantage of the aggregate trade data is that it covers the same 1950–2025 period as the GSDB-FS. For the disaggregated analysis, we rely on the third edition of the International Trade and Production Database for Estimation (ITPD-E, Larch et al., 2025c). The main advantages of the ITPD-E are that (i) it covers 170 industries, which enables us to obtain disaggregated estimates of the effects of financial sanctions, and (ii) it includes consistently constructed domestic trade flows, which allows us to estimate the third-country effects of financial sanctions. Throughout the analysis, we control for a rich set of time-varying trade policy variables, including membership in the European Union, other regional trade agreements, customs unions, economic integration agreements, and the World Trade Organization. These vari-

ables are drawn from the *Dynamic Gravity Dataset* (Gurevich and Herman, 2018) and from Egger and Larch (2008).

We obtain our estimates from a theory-consistent structural gravity equation, following the estimation guidelines of Larch et al. (2025b). Specifically, we rely on the Poisson Pseudo Maximum Likelihood (PPML) estimator, which addresses heteroskedasticity concerns and uses the information in the zero trade flows. In addition to the time-varying bilateral policy variables, we employ a rich set of three-dimensional fixed effects (exporter-time, importer-time, and country-pair), which fully control for all country-specific and time-invariant bilateral determinants of trade flows. In the disaggregated analysis, these fixed effects are also industry-specific. Moreover, since the ITPD-E includes domestic trade flows, our disaggregated specifications also include a set of time-varying border variables and we can separately identify the *direct* effects of sanctions on trade between senders and targets and their effects on trade between targets and third countries.

The following results stand out from the analysis with the aggregate trade data. First, consistent with the existing literature, we find that sanctions in general reduce trade only modestly on average, and that this average effect is driven by trade sanctions, especially complete trade sanctions. Second, and in line with earlier puzzling findings in the literature (like the ones noted above), the average effect of financial sanctions on trade is economically small and not statistically significant. Third, this null result conceals substantial heterogeneity. Once we allow the effects to differ by type of financial sanction, we find that several categories, such as restrictions on aid and on investment, reduce trade, whereas asset freezes and restrictions on financial services do not.

The highlight from our aggregate analysis is that payment restrictions exert the largest negative and highly statistically significant effects on international trade, comparable to the impact of complete trade sanctions.[3] This finding is important for several reasons.

[3]We also explore the effects of the payment restrictions by sanction case and find that they are pervasive but heterogeneous: the U.S. sanctions are among the most effective in decreasing trade, while the Swiss sanctions are ineffective or even counterproductive.

First, perhaps due to the lack of data, the impact of payment restrictions has not been documented in the existing literature.[4] Second, payment restrictions are a recent and fast-growing instrument. SWIFT expulsion went from a rarely used measure, applied to Iran in 2012,[5] to a front-line tool against Russia in 2022, so its trade impact is a first-order and timely policy question with essentially no clean causal evidence yet. Third, the large trade effects we estimate demonstrate that international payment infrastructure constitutes a binding constraint on real trade. In other words, the medium of exchange matters for trade alongside tariffs and trade sanctions. Finally, our results challenge the 'smart sanctions' narrative. Although financial sanctions are often portrayed as more targeted and less harmful to civilians than comprehensive embargoes, we show that payment restrictions have large negative effects on trade, raising questions about the extent to which financial sanctions can be considered 'smart.'

Motivated by the large and significant estimates of the impact of payment restrictions on aggregate trade, we focus the disaggregated analysis specifically on this type of financial sanction. Our findings are the following. Consistent with our aggregate findings, payment restrictions have very strong but also heterogeneous negative effects on industry-level and sectoral trade. More importantly, the domestic-trade dimension of the ITPD-E enables us to estimate the effects of payment restrictions on third countries, and we find that these *third-country* effects are sizable. SWIFT is a global network, and cutting a country off impairs its trade with all partners, not just the sanctioning state(s). Thus, our findings underscore the multilateral nature of payment restrictions and stand in sharp contrast to the case of complete trade sanctions, whose third-country effects are

[4] As discussed earlier, several papers have studied the impact of financial sanctions on international flows, e.g., Besedeš et al. (2017); Draca et al. (2018); Ahn and Ludema (2020); Felbermayr et al. (2020); Besedeš et al. (2021); Efing et al. (2023); Arslanalp et al. (2023); Besedeš et al. (2024). Nevertheless, none of these studies examines how the effects vary across different types of financial sanctions.

[5] The 2012 measure was terminated upon Iran's reconnection to SWIFT following the Joint Comprehensive Plan of Action (JCPOA) implementation day in January 2016, and the GSDB-FS codes the case accordingly (2012–2016). The renewed disconnection of Iranian banks in November 2018, after the U.S. withdrawal from the JCPOA, reflected U.S. pressure on SWIFT rather than a formal multilateral payment-infrastructure measure and is therefore not coded as a separate payment-restriction case. Iranian banks were formally disconnected again in 2025.

predominantly positive (Felbermayr et al., 2026). Because targets typically trade more with third countries than with senders themselves, the multilateral reach of payment restrictions implies substantially larger trade and welfare costs for the targeted economies than the direct sender-target effects alone would suggest. Seen from the sender's side, this multilateral reach is precisely what makes payment restrictions attractive: they shift part of the enforcement burden onto third countries. That shift improves the sender's cost–benefit calculus relative to trade sanctions.

The rest of the paper is organized as follows. Section 2 introduces the GSDB-FS (along with the GSDB-R5) and describes the construction methods, the sources, and the dimensions. Section 3 presents our econometric specification and describes our findings. Finally, Section 4 concludes with a summary and directions for future work. Additional information on the data, along with more estimates, is included in an Online Appendix, which is not intended for publication.

2 The Global Sanctions Data Base

The main data contribution of this paper is the *Global Sanctions Data Base – Financial Sanctions (GSDB-FS)*. Along with the new GSDB-FS, we also update the original Global Sanctions Data Base to its fifth release (GSDB-R5), extending its temporal coverage through 2025 and enriching it with a monthly time dimension.[6] Since the methods we employ to create the GSDB-FS are based on those used to create the GSDB-R5, we start this section with a description of the GSDB-R5, in Subsection 2.1. Then, in Subsection 2.2, we introduce the GSDB-FS. Finally, in Subsection 2.3, we briefly discuss the new monthly time dimension of the GSDB-R5.

[6]The GSDB-FS and the GSDB-R5 are free for public use and can be requested at https://www.globalsanctionsdatabase.com/.

2.1 The Global Sanctions Data Base – Release 5 (GSDB-R5)

The GSDB-R5 was compiled under the same protocol as the original GSDB, which was developed by Felbermayr et al. (2020) in response to rising geoeconomic tensions and the proliferation of sanctions.[7] Its unit of observation is the sanction case, defined as a set of measures imposed by one or more senders on one or more targets. Both senders and targets can be either states or international organizations, such as the United Nations or the European Union. Distinguished by its comprehensive dimensionality and coverage, the database categorizes sanction cases into six distinct types (trade, financial, travel, arms, military assistance, and other) and classifies them according to nine political objectives and five outcome categories ranging from total success to failure.[8]

The GSDB-R5 is compiled from primary legal sources and validated against the secondary literature. The primary sources are the instruments through which sanctions are enacted. They include United Nations Security Council resolutions, U.S. Federal Executive Orders together with the departmental records implementing them, in particular the designations of the Office of Foreign Assets Control, common positions, decisions and regulations of the Council of the European Union, and the corresponding national instruments of the remaining senders. Because many cases leave no consolidated legal trace, above all the earlier ones and those imposed by smaller senders, these records are supplemented by systematic keyword searches of national archives, news outlets and historical accounts.[9] To ensure accuracy and consistency, every case is cross-referenced with major sanctions datasets, including the HSE/HSEO database (Hufbauer et al., 2007) and the Threat and Imposition of Economic Sanctions (TIES) project (Morgan et al., 2009).

The GSDB-R5 comprises 1,794 sanction cases recorded since 1950, of which 786 were still in force on December 31, 2025 and 1,008 had been terminated. Relative to the GSDB-

[7] The other three releases include Kirilakha et al. (2021); Syropoulos et al. (2024); Yalcin et al. (2025).

[8] See Felbermayr et al. (2020) for a detailed description of the data structure.

[9] For the R5 update, large language model tools were used to assist with the retrieval and cross-referencing of sources; every case was subsequently verified, coded, and registered by the authors, who take full responsibility for the data.

R4, the updated release expands coverage by adding 283 cases, removes 36 cases following review, and introduces information on the calendar month of both imposition and termination wherever these dates can be identified.

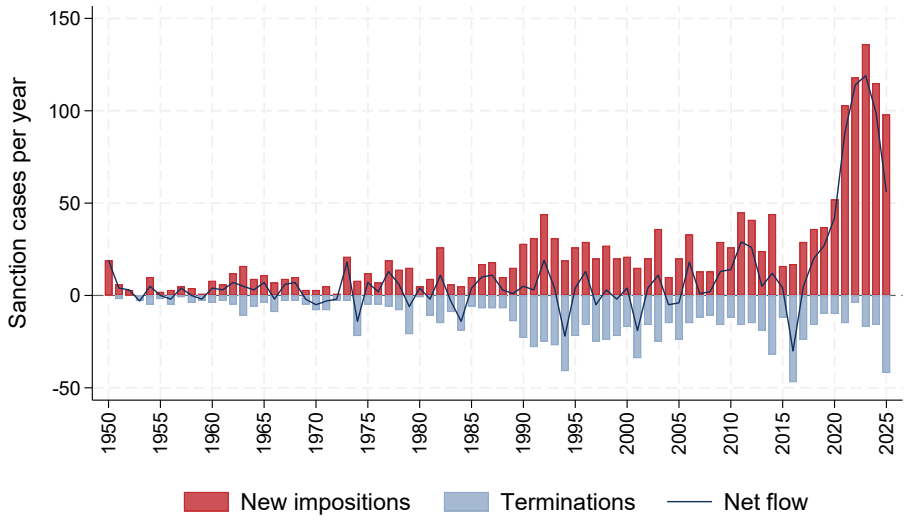
Panel (a) of Figure 2 reports the number of cases imposed and terminated in each year. Impositions remain close to their historical peak through the two additional years of coverage, at 115 cases in 2024 and 98 in 2025, and three broad clusters account for most of them. The war against Ukraine contributes 27 cases naming Russia or Belarus, eight of which also name third countries that absorbed the redirection of Russian trade or served as transshipment hubs along the new routes. The conflict in the Middle East after October 2023 contributes 33 cases naming at least one of Israel, Iran, Yemen, and Lebanon. A third cluster has no single geographic center and is instead organized around the democracy and human rights objectives, with Georgia alone named in 14 cases imposed by ten distinct senders.

On the other side, sanction terminations, whose incidence had been low and flat for most of the preceding decade, jump to 42 cases in 2025, the second-highest annual figure in the database. Two developments account for most of this jump. The unwinding of the sanctions against Syria after the collapse of the Assad government contributes 14 terminations,[10] and the United States, following its change of administration, lifted 21 of its own cases.

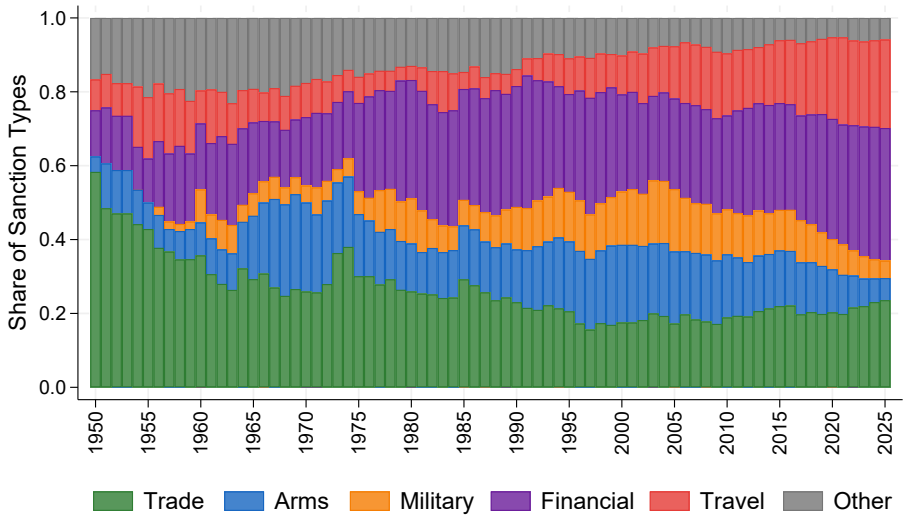
Panel (b) reports the composition of the types in force in each year. The share of trade measures falls from 58% of all instrument incidences in 1950 to 18% by the turn of the century, before recovering somewhat thereafter, while the share of financial measures

[10]The unwinding is only partial, since two cases against Syria remain in force. For comprehensive sanctions regimes built up over successive rounds of imposition, as in the Syrian case, the lifting of measures appears to proceed gradually rather than as a single act (Attia, 2026).

Figure 2: Sanction Flows and the Composition of Types, 1950–2025



(a) New impositions, terminations and net flow



(b) Share of sanction types in force

Notes: Panel (a) reports the number of sanction cases newly imposed in each year, the number terminated in each year, and the net flow between them, over the period 1950–2025. A case is counted as imposed in its year of imposition and as terminated in its year of termination; cases still in force at the end of the coverage period are treated as censored rather than terminated. Panel (b) reports the composition of the sanctions in force in each year across the six instrument types recorded in the GSDB-R5: trade, arms, military assistance, financial, travel, and other. The types are not mutually exclusive, since a single sanction case may combine several of them. The shares in panel (b) are therefore computed over instrument incidences, defined as the sum of the six type indicators across all active cases, rather than over cases, and the incidence denominator exceeds the number of active cases: 1,691 incidences across the 828 cases active at some point in 2025 (the 786 in force at year-end plus the 42 terminated during the year).

rises from 13% in 1950 to 36% in 2025, the largest single component of the stock.[11] The following subsection is motivated by the fact that financial sanctions constitute both the most prevalent type and the largest component of the active stock. The GSDB-R5 records whether a case contains any financial sanctions as a single binary variable, without specifying the exact measures applied. The GSDB-FS, which we describe next, supplies this missing content.

2.2 The Global Sanctions Data Base – Financial Sanctions (GSDB-FS)

Of the 1,794 cases in the GSDB-R5, 1,072 (59.8%) carry a financial component, and the GSDB-FS classifies each of them into a taxonomy of six financial subtypes. Rather than assembling a new set of cases, the GSDB-FS inherits its cases from the GSDB-R5, so a case enters the GSDB-FS exactly when the parent release records it as financial. Thus the GSDB-FS and the GSDB-R5 are perfectly compatible with each other and the two datasets can be merged one-to-one on the `case_id` variable, so that every dimension recorded in the GSDB-R5, including senders, targets, objectives, outcomes, and the timing of imposition and termination, can be used directly alongside the new classification.[12]

The taxonomy distinguishes six financial instruments, namely aid sanctions, asset freezes, suspensions of financial services, investment restrictions, restrictions on payment-service infrastructure, and a residual other category. Aid sanctions restrict the transfer of public funds from the sender to the target, usually within particular programs or for particular recipients. Asset freezes block the stock of assets held within the sender's jurisdiction. Suspensions of financial services withdraw the intermediation, like banking,

[11] These shares are not comparable to the case-level incidence rate reported in Figure 1, which rises from 14% in 1950 to 73% in 2025. That rate is a share of cases, and the six such shares sum to well above 100% because a single case may combine several types, whereas the shares in panel (b) are computed over instrument incidences and therefore sum to unity by construction. The two series happen to be close in 1950, at 14% of cases against 13% of incidences, because sanction cases in that year rarely combined more than one instrument. They diverge as bundling becomes common.

[12] For the complete variable definitions and the coding conventions underlying both releases, see the GSDB Codebook, which can be found at https://www.globalsanctionsdatabase.com/.

insurance, and reinsurance, through which transactions are arranged. Investment restrictions stop the flow of new capital, whether into designated sectors or into the target as a whole. Restrictions on payment-service infrastructure close off the messaging and settlement layer and therefore operate at the level of the banking system itself. Table 1 sets out the definitions in full and gives two examples of each. The categories are not mutually exclusive. A case may combine several subtypes, and the more comprehensive sanction regimes typically do.

Panel (a) of Figure 3 reports the number of GSDB-FS cases in force in each year. The case count remains below 100 until 2011 and then climbs steeply, to 218 cases in 2020 and 607 in 2025. Panels (b) and (c) decompose the stock of measures in force into the six subtypes, in levels and in shares. The stacked total in panel (b) exceeds the case count in panel (a) because a single case may combine several subtypes. The dominant development in both panels is the rise of asset freezes and suspensions of financial services. The two subtypes together account for 88.7% of all instrument incidences in force in 2025, against 31.3% in 2000, and 77.9% of the cases imposed since 2020 carry both of them.

Payment restrictions appear in 18 cases between 1950 and 2025, 16 of which were in force in 2025, accounting for 1.4% of instrument incidences in that year. Their distribution is narrow in two respects. First, they name only seven targets, namely Russia, Belarus, Iran, North Korea, Afghanistan, Iraq, and Georgia. Second, they are almost never imposed alone. The average case carrying a payment restriction carries 3.44 financial subtypes, against 1.55 for the average financial case in the database, and 10 of the 18 carry four or more. In particular, 83.3% of the cases with a payment restriction also suspend financial services and 61.1% also freeze assets. Payment restrictions are therefore imposed as part of the most comprehensive sanction regimes observed in the data. Within the financial toolkit, payment restrictions thus play a role analogous to that of complete embargoes among trade sanctions: rarely imposed, but the most sweeping instrument available.

Table 1: Definitions and Examples of Financial Sanctions

Aid Sanctions

Restrictions or suspensions of foreign aid, grants, or concessional loans to a target government or entity.[†]

Examples: 1. France's suspension of aid to Mali (2022) in response to the democratic backsliding under the Malian junta. 2. EU suspension of direct financial support to the Burundian government (2016).

Asset Freeze

The blocking of financial assets and property owned or controlled by targeted individuals or entities, preventing their transfer or use.

Examples: 1. Freezing of Libyan state assets by the UN Security Council (2011). 2. EU and U.S. asset freezes on Russian elites following the invasion of Ukraine (2022).

Financial Services Suspensions

Prohibitions on providing financial services such as banking, insurance, or reinsurance to targeted sectors or individuals.

Examples: 1. Ban on providing insurance for ships carrying Iranian oil (EU, 2012). 2. Restrictions on correspondent banking relationships with North Korean banks (UN, 2013).

Investment Restrictions

Bans on new investment in specific sectors (e.g., energy, defense) or general investment bans in a target country.

Examples: 1. U.S. ban on new investment in the Russian energy sector (2022). 2. EU restrictions on investment in the Crimean peninsula (2014).

Payment Service Infrastructure

Exclusion of target country banks from international payment messaging systems, effectively cutting them off from cross-border transactions.

Examples: 1. Removal of Iranian banks from SWIFT (2012). 2. Exclusion of select Russian banks from SWIFT (2022).

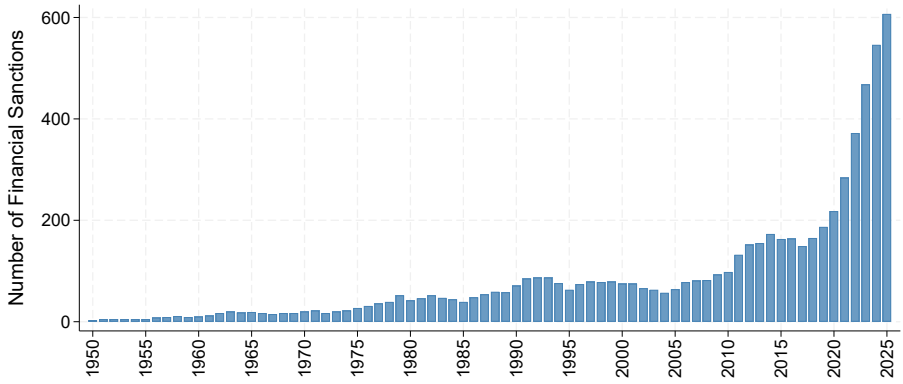
Other

Miscellaneous financial restrictions, such as prohibitions on supplying banknotes, price caps on target-country exports, or caps on sovereign debt trading, as well as any other form of financial sanction not covered by the previous categories.

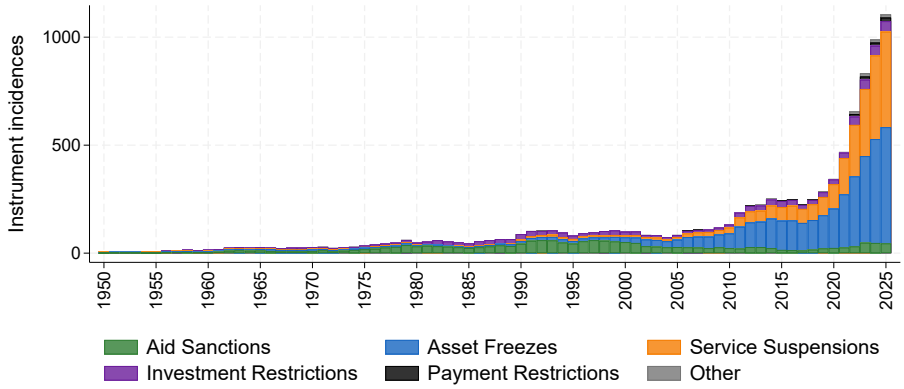
Examples: 1. Prohibition on the export of Euro banknotes to Russia (EU, 2022). 2. G7 and EU price cap on Russian seaborne crude oil (2022).

[†] Importantly, this category includes only suspensions that are explicitly motivated by the sanctioning country's objectives vis-à-vis the target country. Reductions in aid resulting from general budget cuts or unrelated policy changes in the sanctioning country do not constitute aid sanctions.

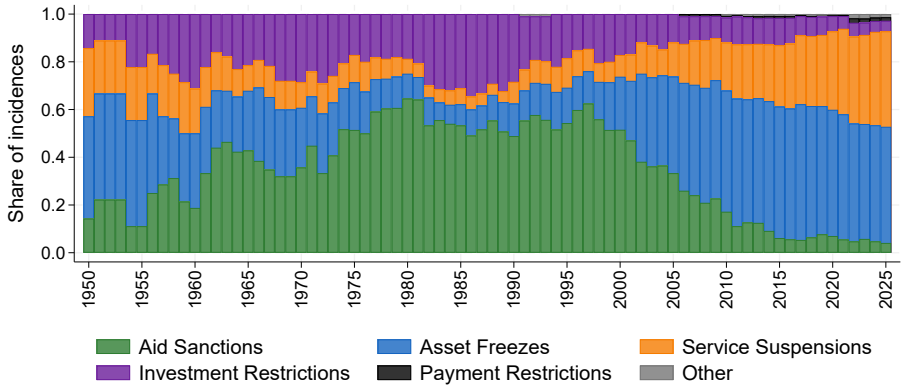
Figure 3: The Composition of Financial Sanctions, 1950–2025



(a) Cases in force



(b) Instrument incidences, by subtype



(c) Share of subtypes in total incidences

Notes: Panel (a) reports the number of cases in the GSDB-FS in force in each year, where the GSDB-FS comprises the sanction cases in the GSDB-R5 that carry a financial component. A case is counted as in force in every year from its year of imposition to its year of termination inclusive, so the figure for 2025 includes the cases terminated during that year. Panels (b) and (c) decompose those cases into the six financial subtypes recorded in the GSDB-FS: aid sanctions, asset freezes, financial services suspensions, investment restrictions, payment restrictions, and other. The subtypes are not mutually exclusive, since a single case may combine several of them. Panels (b) and (c) are therefore computed over instrument incidences, defined as the sum of the six subtype indicators across all cases in force, rather than over cases, and the stacked total in panel (b) exceeds the case count in panel (a): 1,105 incidences across the 607 cases in force in 2025. Panel (b) reports incidences in levels and panel (c) their shares, which sum to unity by construction.

2.3 The Monthly Time Dimension of the GSDB

To allow for a more accurate analysis of the time dimension of sanctions and to make matching with monthly variables possible, the GSDB-R5 introduces the calendar month of imposition in addition to the calendar year of imposition, which was the only time dimension in the previous releases of the GSDB. The month of imposition is available for 96.6% of all cases recorded in the GSDB-R5, and the month of termination is recorded for 87.1% of the terminated cases. While not utilized in the current analysis, we believe that the monthly dimension is a useful addition to the GSDB because annual data treat every case as though it were in force for the whole of its first and last calendar years, and short cases are common rather than marginal.

Panel (a) of Figure A-1 in the Online Appendix reports the distribution of durations for cases that ended within three years, both as the number of cases and as a share of all terminated cases with known months. The median duration of a completed case is 32 months, and 52.7% of the terminated cases with known months end within three years. Moreover, 141 cases begin and end in the same calendar year, so annual data would assign them a duration of zero.

The monthly records also reveal a stylized fact that has been overlooked so far, namely the pronounced reversal in the duration of sanctions over time. Panel (b) of Figure A-1 reports Kaplan–Meier survival estimates by decade of imposition. Median survival falls from 86 months for cases imposed in the 1950s to 33 months for cases imposed in the 1990s, and rises again thereafter, to 53 months in the 2000s and 156 months in the 2010s. Among the cases imposed in the 2020s, 91.6% are still in force and already show a tendency to last longer.

3 Empirical Analysis: Financial Sanctions and Trade

We examine the effects of financial sanctions on international trade rather than on financial flows. Bilateral data on financial flows are sparse and uneven relative to trade data, particularly over the long period covered by our sanctions measures, and it is in trade that the real-economy costs of financial sanctions ultimately materialize. To highlight the key features of our new measures of financial sanctions and their heterogeneous effects on trade, we develop the empirical analysis sequentially. We begin in Subsection 3.1 with a benchmark specification that describes our econometric approach and, for comparison, replicates some stylized results from the existing literature. In Subsection 3.2, we add to the benchmark specification the new variables for financial sanctions by type from the GSDB-FS, and we explore the heterogeneity of their effects on trade with a focus on payment restrictions. In Subsection 3.3, we present our disaggregated estimates of the effects of payment restrictions by sector and industry. Finally, in Subsection 3.4, we quantify the third-country effects of payment restrictions on trade between targets and third countries.

3.1 Sanctions and Trade: Benchmark Estimates

To set our benchmark econometric model, we follow the recommendations for estimating trade gravity equations from Larch et al. (2025b):[13]

$$X_{ij,t} = \exp[\overrightarrow{\mu}_{ij} + \pi_{i,t} + \chi_{j,t} + POLICY_{ij,t} \times \alpha + SANCTION_{ij,t} \times \beta] \times \epsilon_{ij,t}. \quad (1)$$

The dependent variable, $X_{ij,t}$, denotes nominal trade flows from exporter i to importer j at time t, i.e., the dependent variable includes directional trade (exports and imports). To obtain our benchmark results, we use aggregate trade data for international trade flows

[13] As demonstrated by Larch et al. (2025b), equation (1) is based on the structural gravity model of trade. In turn, Arkolakis et al. (2012) show that, subject to parameter interpretation and standard assumptions, many alternative theoretical microfoundations lead to isomorphic structural gravity models.

only.[14] The reason is that the aggregate trade data on international trade flows have the longest time coverage (1950–2025), thus fitting perfectly the time coverage of the GSDB-FS, which is also 1950–2025. Finally, based on the recommendations of Egger et al. (2022), we use data for consecutive years (instead of data with intervals as advocated by Cheng and Wall (2005)).

Turning to the covariates in our model, the first term, $\overrightarrow{\mu}_{ij}$, on the right-hand side of equation (1) denotes a set of directional (asymmetric) country-pair fixed effects. Motivated by Baier and Bergstrand (2007), and consistent with the average treatment effects methods of Wooldridge (2010), country-pair fixed effects are commonly used in trade gravity models to mitigate potential endogeneity concerns.[15] Crucially, the country-pair fixed effects absorb and control for all (observable and unobservable) time-invariant bilateral trade costs.[16] They similarly absorb the impact of any policies enacted before the investigation period that remained unchanged throughout the entire sample period. Consequently, our estimates isolate the specific effects of the sanctions imposed or lifted during the period of investigation. Finally, following Baier et al. (2019), in order to avoid attributing asymmetries in the underlying time-invariant trade costs to the policy variables, we explicitly allow for the country-pair fixed effects to vary depending on the direction of trade flows, i.e., from "i" to "j" vs. from "j" to "i". This directional nature motivates the

[14] Following Baldwin and Taglioni (2006), we use nominal trade flows. We construct our dependent variable using trade flows data from the International Monetary Fund's Direction of Trade Statistics database. Specifically, in order to maximize the number of non-missing observations, we start with the theory-consistent c.i.f. imports. Then, where the importer does not report c.i.f. imports but the corresponding exporter reports f.o.b. exports to the same importer, we use the f.o.b. exports to replace the missing observations. This applies to 24,319 observations (1.9% of the full sample). Where neither c.i.f. imports nor f.o.b. exports are reported, we set the trade value to zero; this applies to 119,045 observations (9.2% of the full sample). In the robustness analysis, we extend the estimating sample further by filling additional missing values with data from Yalcin et al. (2025), who complement the IMF data with data from the United Nations COMTRADE database. Our main results and conclusions remain robust to using the extended dataset (results available by request).

[15] We are aware that the country-pair fixed effects in our model cannot fully eliminate all possible endogeneity concerns, e.g., reverse causality and self-selection bias. Such concerns are further mitigated in our disaggregated analysis below, because trade in a particular industry is less likely to motivate sanctions.

[16] Egger and Nigai (2015) and Agnosteva et al. (2019) demonstrate that the standard gravity variables (e.g., distance, common language, and colonial relationships) do well in predicting *relative* bilateral trade costs. However, these variables fail to capture the *level* of bilateral trade costs. For example, they underpredict the bilateral trade costs for poor countries and overpredict these costs for more developed countries.

arrow notation in $\overrightarrow{\mu}_{ij}$.

The next two terms on the right-hand side of equation (1) are also fixed effects. Specifically, guided by theory, $\pi_{i,t}$ and $\chi_{j,t}$ are source-time and destination-time fixed effects, respectively. From a theoretical perspective, these fixed effects account for the structural multilateral resistance terms of Anderson and van Wincoop (2003) and, from an econometric perspective, they control for and absorb any country-time-specific determinants of trade flows on the exporter and the importer side.

Next, the vector $POLICY_{ij,t}$ in equation (1) includes a series of time-varying bilateral policy variables, such as membership in the European Union (EU), membership in other Regional Trade Agreements (RTA), Economic Integration Agreements (EIA), customs unions (CU), and membership in the World Trade Organization (WTO).[17] Finally, and most importantly for our purposes, the last term in equation (1), $SANCTION_{ij,t}$, is a vector that includes a series of sanctions variables. These variables will be introduced gradually to our econometric specification. The first sanction variable we employ in our benchmark analysis is $ANY\_SANCT_{ij,t}$, an indicator variable that takes a value of one if there is a sanction of any type between country i and country j in year t. All sanction variables in the analysis come from the new GSDB-R5 and GSDB-FS.

Motivated by Santos Silva and Tenreyro (2006), we use the Poisson Pseudo Maximum Likelihood (PPML) estimator. Due to its multiplicative form, the PPML estimator enables us to include and take advantage of the information contained in the zeros in our sample. In addition, and more importantly, the PPML estimator successfully handles heteroskedasticity in trade flows data, which, due to Jensen's inequality, renders the corre-

[17] The data on memberships in the European Union (EU) and the World Trade Organization (WTO) come from the *Dynamic Gravity Dataset* (DGD) of the USITC (Gurevich and Herman, 2018), https://www.usitc.gov/data/gravity/dgd.htm. The DGD data cover the years through 2019. To fill this gap, we extend the EU and WTO variables until 2025. Since no new countries entered the EU during 2019–2025, and the UK exited the EU, we excluded its membership in the EU from 2020 onward. Furthermore, we extend WTO membership during the 2019–2025 period by including Timor-Leste and Comoros, which joined it in 2024. The data on membership in Regional Trade Agreements (RTAs), customs unions (CUs), and economic integration agreements (EIAs) are from Egger and Larch (2008), which covers the full period of investigation (1950–2025), https://www.ewf.uni-bayreuth.de/en/research/RTA-data/index.html.

sponding OLS estimates inconsistent. We estimate our model in Stata with the `ppmlhdfe` command of Correia et al. (2020) and, following the standard approach in the gravity literature (e.g., Egger and Tarlea (2015), Pfaffermayr (2019), and Pfaffermayr (2022)), we cluster the standard errors by country pair.

The first set of estimates from equation (1) is reported in column (1) of Table 2. Without going into details, we note that the estimates of all policy variables in column (1) are comparable to results from the existing literature. As expected, we obtain positive and statistically significant estimates of the effects of the EU, CUs, EIAs, and RTAs on trade among their members. Our estimate of the effect of the WTO is not statistically significant (and, actually, negative), which is consistent with the findings of Rose (2004). Larch et al. (2025a) demonstrate that this puzzling result of missing WTO effects disappears when the impact of the WTO is estimated with data that include theory-consistent domestic trade flows. Consistent with Larch et al. (2025a), in results available by request, we confirm that the impact of the WTO on trade is indeed positive when our estimating sample includes domestic sales. The most important result from column (1) of Table 2 for our purposes is the negative and statistically significant (albeit quite small) estimate we obtain of the impact of sanctions of any type (ANY_SANCT) on trade.

The specification in column (2) of Table 2 distinguishes between the effects of trade sanctions ($TRADE\_SANCT$) vs. any other sanctions, which remain in the covariate ANY_SANCT.[18] The main findings from column (2) are that (i) the effects of trade sanctions are negative and statistically significant, as expected, and (ii) the average impact of all other sanctions is no longer statistically significant. We do note, however, that our estimate of the impact of trade sanctions remains relatively small. This changes in column (3) of Table 2, where we split the $TRADE\_SANCT$ indicator to distinguish between the effects of complete trade sanctions ($COMPL\_SANCT$) vs. partial trade sanctions ($PARTL\_SANCT$). Our estimates suggest that, on average, complete trade sanctions decrease international trade

[18] Specifically, to ease interpretation, we set the indicator for ANY_SANCT to be equal to zero when the indicator for trade sanctions is equal to one. Thus, both estimates should be interpreted as level effects.

Table 2: Financial Sanctions and International Trade, 1950–2025

	(1) ANY	(2) TRADE	(3) COMPLT	(4) TYPE	(5) PAYMNT	(6) FINNCL
EU	0.417	0.417	0.416	0.416	0.414	0.421
	(0.040)**	(0.040)**	(0.040)**	(0.040)**	(0.040)**	(0.040)**
CU	0.331	0.337	0.341	0.344	0.337	0.360
	(0.063)**	(0.061)**	(0.061)**	(0.062)**	(0.063)**	(0.059)**
EIA	0.150	0.154	0.154	0.156	0.139	0.145
	(0.034)**	(0.035)**	(0.035)**	(0.034)**	(0.033)**	(0.033)**
RTA	0.117	0.121	0.121	0.124	0.118	0.120
	(0.024)**	(0.024)**	(0.024)**	(0.024)**	(0.024)**	(0.024)**
WTO	-0.128	-0.108	-0.111	-0.045	-0.024	-0.031
	(0.082)	(0.082)	(0.082)	(0.082)	(0.077)	(0.076)
ANY_SANCT	-0.102	-0.022	-0.021			
	(0.019)**	(0.023)	(0.023)			
TRADE_SANCT		-0.174				
		(0.025)**				
COMPL_SANCT			-1.111	-0.762	-1.015	-1.024
			(0.174)**	(0.212)**	(0.191)**	(0.186)**
PARTL_SANCT			-0.169	-0.066	-0.069	-0.049
			(0.025)**	(0.026)*	(0.025)**	(0.026)$^{+}$
ARMS_SANCT				-0.045	0.009	-0.002
				(0.039)	(0.039)	(0.036)
MLTRY_SANCT				-0.086	-0.067	-0.030
				(0.036)*	(0.035)$^{+}$	(0.031)
FINCE_SANCT				0.022	0.026	
				(0.031)	(0.031)	
TRAVL_SANCT				-0.164	-0.161	-0.114
				(0.049)**	(0.049)**	(0.038)**
OTHER_SANCT				-0.408	-0.021	0.126
				(0.093)**	(0.053)	(0.049)*
FIN_PAYMENT					-1.288	-0.758
					(0.139)**	(0.095)**
FIN_FREEZE						0.067
						(0.059)
FIN_AID						-0.095
						(0.042)*
FIN_SERVICES						-0.053
						(0.064)
FIN_INVESTMENT						-0.226
						(0.085)**
FIN_OTHER						-0.717
						(0.150)**
N	1235025	1235025	1235025	1235025	1235025	1235025

Notes: This table reports the estimates of the effects of economic sanctions on international trade, 1950–2025. The estimates in each column are obtained from our main econometric model, equation (1). The dependent variable is trade in levels and the estimator is Poisson Pseudo Maximum Likelihood (PPML). In addition to the other policy controls, the estimates in each column are obtained with exporter-time fixed effects, importer-time fixed effects, and directional country-pair fixed effects. The differences between the columns in this table are due to the different sanctions variables that are used. Column (1) uses a single dummy variable for Any Sanction. Column (2) distinguishes between the effects of Trade Sanctions vs. Non-trade Sanctions. Column (3) further allows for heterogeneous effects of Complete Trade Sanctions vs. Partial Trade Sanctions. Column (4) breaks the Non-trade Sanctions by type. Column (5) distinguishes between Financial Sanctions on Payment Services vs. Other Financial Sanctions. Finally, column (6) breaks all Financial Sanctions by type. Standard errors are clustered by country pair. + $p < 0.10$, * $p < .05$, ** $p < .01$. See text for further details.

between senders and targets by about 67%, while the impact of partial trade sanctions is smaller, but still statistically significant.[19]

The estimates in column (4) of Table 2 allow for the effects of sanctions to be heterogeneous across different sanction types by replacing the indicator for ANY_SANCT with indicators for the other five types of sanctions (in addition to the partial and complete trade sanctions) that comprise it. The estimates of the effects of all but one of the sanction variables in column (4) are negative, and all of the negative estimates (except that on $ARMS\_SANCT$) are also statistically significant. Importantly, the only positive estimate we obtain (although not statistically significant) is on financial sanctions ($FINCE\_SANCT$). This result suggests that, on average, financial sanctions have no discernible impact on international trade, and it is consistent with puzzling findings of small to no effects of financial sanctions on trade obtained in the existing literature.

3.2 The Heterogeneous Effects of Financial Sanctions

This subsection introduces several new financial sanctions variables, which come from the GSDB-FS. Motivated by the hypothesis that international trade should be impacted negatively by the inability of countries and banks to finance international trade transactions, in column (5) of Table 2 we include as an additional covariate an indicator variable for restrictions on payment-service infrastructure ($FIN\_PAYMENT$).[20] For convenience, henceforth we will use 'sanctions on payment services' or 'payment restrictions' to refer to $FIN\_PAYMENT$.

We draw the following conclusions from the results in column (5) of Table 2. Our main finding is that the estimate on $FIN\_PAYMENT$ is large, negative, and statistically significant. A direct implication of this result is that international payment infrastructure is

[19] Calculated as $(\exp(-1.111) - 1) \times 100$, where -1.111 is the estimate on complete trade sanctions from column (3) of Table 2.

[20] To preserve the interpretation of the estimate on $FINCE\_SANCT$, we adjust the $FINCE\_SANCT$ indicator by setting it to zero when the indicator for $FIN\_PAYMENT$ is equal to one. Thus, the estimates on both $FINCE\_SANCT$ and $FIN\_PAYMENT$ can be interpreted as level effects.

a binding constraint on real trade, i.e., the medium of exchange for trade matters alongside complete trade sanctions and tariffs. On a related note, another implication of the significant effects of payment restrictions is that the average effect of financial sanctions in column (4) conceals how potent financial sanctions can be as policy instruments. Thus, our results resolve the 'missing trade effects of financial sanctions' puzzle from Felbermayr et al. (2020). Moreover, they strengthen the evidence in Besedeš et al. (2024) that financial sanctions spill over to trade in goods and services, and quantify the trade effects of the payment-system exclusions described by Cipriani et al. (2023).

In terms of magnitude, the effect of payment restrictions is very large. Our large negative estimates on payment restrictions also challenge the "smart/humane" narrative about targeted sanctions. Financial/payment sanctions are frequently promoted as targeted and less harmful (to civilians) measures than comprehensive sanctions. Our results undercut the claim that smart sanctions have limited collateral damage.

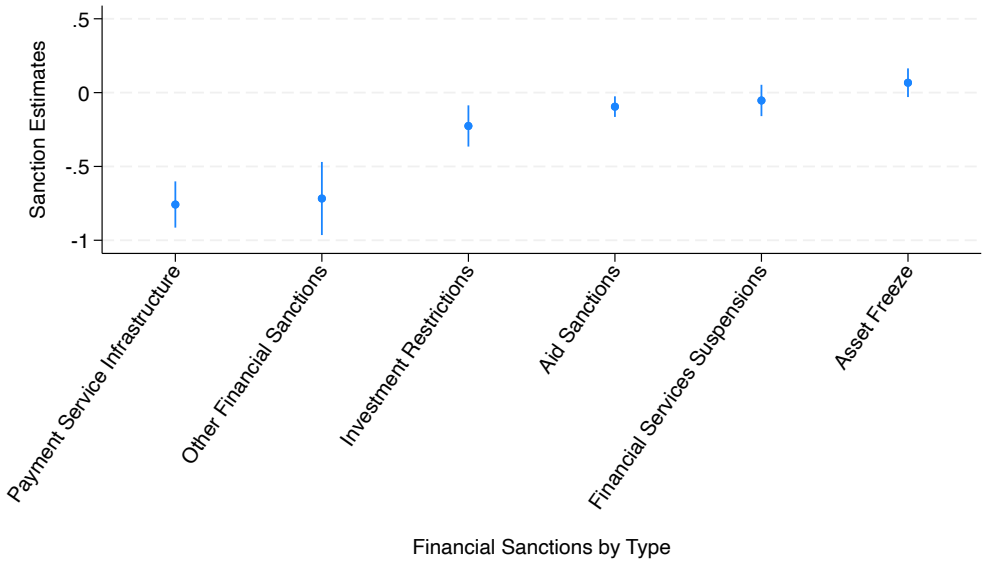
We explore further the heterogeneity of the effects of financial sanctions in column (6), where we replace the indicator for $FINCE\_SANCT$ with the full set of six indicators that distinguish between all types of financial sanctions from the new GSDB-FS. We also highlight the new estimates in Figure 4. Based on these results, we draw the following conclusions. First, we confirm the large, negative, and statistically significant estimate on $FIN\_PAYMENT$. Second, we obtain negative and statistically significant, but much smaller, estimates of the effects of aid sanctions (FIN_AID) and investment restrictions ($FIN\_INVESTMENT$). Third, the estimate on other financial sanctions (FIN_OTHER) is also negative, statistically significant, and relatively large in magnitude. The implication of this result is that there may be some important additional information that can be extracted from this category.[21]

Before proceeding, we note that the estimate on $FIN\_PAYMENT$ falls (in absolute value) from -1.288 in column (5) to -0.758 in column (6). The reason is that payment

[21]Our main results are also robust to dropping the individual payment-restriction cases one at a time (results available by request).

restrictions are almost never imposed alone: as documented in Section 2.2, the average case carrying a payment restriction carries 3.44 of the six financial subtypes, and 83.3% of these cases also suspend financial services. Since the other financial instruments do not enter column (5) separately, the estimate on $FIN\_PAYMENT$ in that column absorbs the effects of the accompanying instruments, while the estimate in column (6) isolates the effect of the payment restrictions themselves. We therefore treat the estimate from column (6), which implies a reduction of trade between senders and targets by about 53%, as our headline result.[22]

Figure 4: Trade and Financial Sanctions (by Type of Financial Sanction)



Note: This figure illustrates the estimates of the effects of financial sanctions by type from the last column of Table 2, with 95% confidence intervals. The estimates are obtained from our main econometric model, equation (1). The dependent variable is trade in levels and the estimator is Poisson Pseudo Maximum Likelihood (PPML). In addition to the other policy controls, the estimates in this figure are obtained with exporter-time fixed effects, importer-time fixed effects, directional country-pair fixed effects, and after controlling for complete trade sanctions, partial trade sanctions, other types of sanctions, and all financial sanctions by type. Standard errors are clustered by country pair. See text for further details.

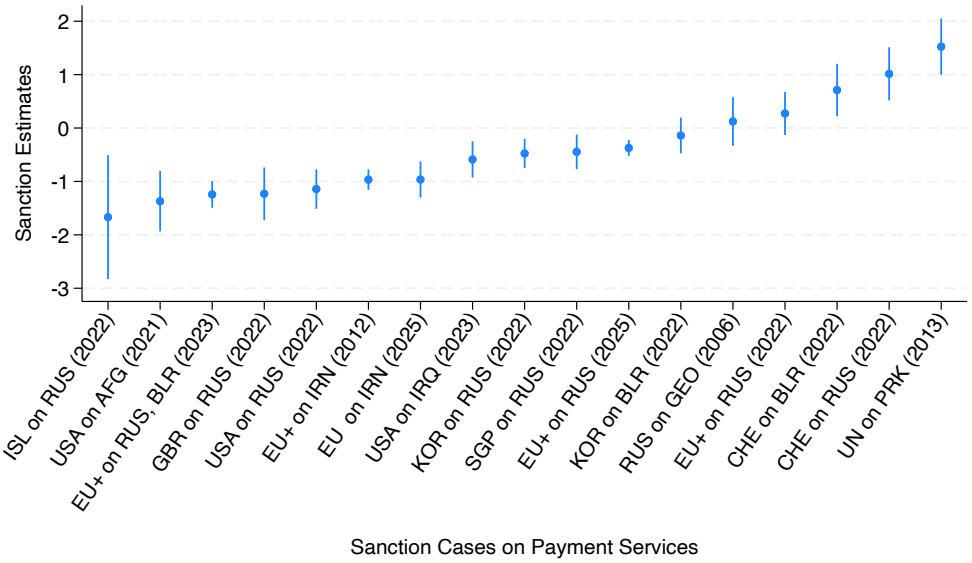
Finally, we obtain small and statistically insignificant estimates of the impact of financial services suspensions ($FIN\_SERVICES$) and asset freezes (FIN_FREEZE). The result for asset freezes has two implications. First, it explains the insignificant estimate on

[22]Calculated as $(\exp(-0.758) - 1) \times 100$. We note that only three of the 18 payment-restriction cases are not accompanied by a suspension of financial services, so the distinction between the estimates in columns (5) and (6) is identified from a relatively small number of cases.

financial sanctions from column (4). The reason is that asset freezes account for (by far) the largest share of financial sanctions, e.g., about 88% of the financial sanctions in force in 2025 include asset freezes. Second, from a methodological perspective, the insignificant estimate on asset freezes may also mask hidden heterogeneity.

Motivated by the large impact of payment restrictions, we zoom in on their effects by obtaining heterogeneous estimates for each of the payment-restriction cases in our sample. To this end, we replicate the specification in column (6) of Table 2 after replacing the single indicator $FIN\_PAYMENT$ with 17 new indicator variables, one for each of the payment-restriction cases in our estimating sample.[23] For brevity, Figure 5 reports only the case-specific estimates of the payment restrictions. The estimates on the remaining covariates are very similar to the ones in column (6) of Table 2.

Figure 5: Sanctions on Payment Services and Trade (by Sanction Case)



Note: This figure illustrates the estimates of the effects of each case of payment restrictions, with 95% confidence intervals. The estimates are obtained from the specification in column (6) of Table 2 after replacing the single indicator for payment restrictions with dummy variables for each of the underlying cases within this category. The dependent variable is trade in levels and the estimator is Poisson Pseudo Maximum Likelihood (PPML). In addition to the other policy controls, the estimates in this figure are obtained with exporter-time fixed effects, importer-time fixed effects, directional country-pair fixed effects, and after controlling for complete trade sanctions, partial trade sanctions, other types of sanctions, and all other financial sanctions by type. Standard errors are clustered by country pair. See text for further details.

[23]The GSDB-FS records 18 payment-restriction cases. However, the sanctions imposed by Liechtenstein on Russia from 2022 cannot be estimated, since Liechtenstein does not appear in the DOTS data either as a reporter or as a partner country.

Consistent with our main finding of a large negative average effect of payment restrictions, we see in Figure 5 that 12 out of the 17 case-specific payment-restriction estimates we obtain are negative, and 11 of the 12 estimates are also statistically significant. In addition, the case-specific estimates in Figure 5 are very heterogeneous. The U.S. sanctions on payments (against Afghanistan (2021), Russia (2022), and Iraq (2023)) have been among the most effective in decreasing trade between the targets and the senders. Interestingly, two of the three positive and statistically significant estimates we obtain are for the Swiss sanctions on Russia and on Belarus.[24]

3.3 Disaggregated Estimates of the Effects of Payment Restrictions

This subsection presents disaggregated estimates of the effects of payment restrictions. To this end, we use the International Trade and Production Database for Estimation (ITPD-E) of the USITC.[25] The time coverage of the ITPD-E is 1986–2022,[26] which is shorter than the period (1950–2025) covered by the aggregate data we used in the analysis thus far. Nevertheless, the ITPD-E has two important advantages for our purposes. First, it covers 170 industries, which are listed in Table A-1 of the Online Appendix. As such, it enables us to capitalize on the industry dimension of the ITPD-E and thereby obtain both industry-level and more aggregated sectoral payment-restriction effects. The second advantage of the ITPD-E is that it includes consistently constructed domestic trade

[24]Switzerland adopted the European Union's measure by ordinance and designated the same banks, so the positive Swiss estimates cannot be attributed to the design of the payment restriction itself. Instead, they more likely reflect the composition of Swiss–Russian trade, which is heavily concentrated in pharmaceutical products that are exempt from the sanctions on humanitarian grounds. By 2024, pharmaceutical products accounted for more than 80% of Swiss exports to Russia (https://www.swissinfo.ch/eng/foreign-affairs/swiss-pharmaceutical-exports-to-russia-continue-despite-war/90199356). The third positive and significant estimate that we obtain is for the 2013 sanction imposed by the United Nations on North Korea.

[25]The ITPD-E was originally developed by Borchert et al. (2020) and, for the current analysis, we use the latest (third) edition of the data (Larch et al., 2025c), available at https://www.usitc.gov/data/gravity/itpde.htm.

[26]The time coverage of the ITPD-E varies by sector depending on the raw data used. Specifically, it is 1986–2022 for Agriculture, 1988–2022 for Mining & Energy and for Manufacturing, and 2000–2022 for Services.

flows, which enable us to obtain estimates of the effects of sanctions on third countries. We utilize this dimension and discuss it in detail in the next subsection.

To obtain the estimates of the disaggregated effects of sanctions on payments, we amend equation (1) as

$$X_{ij,t}^{k} = \exp[\overrightarrow{\mu}_{ij}^{k} + \pi_{i,t}^{k} + \chi_{j,t}^{k} + POLICY_{ij,t} \times \alpha^{k} + GLOB_{ij,t}^{k} \times \eta^{k}] \times \exp[OTHER\_SANCT_{ij,t} \times \gamma^{k} + \beta^{k} \times FIN\_PAYMENT_{ij,t}] \times \epsilon_{ij,t}^{k}, \quad (2)$$

where k denotes an industry. The rest of the differences between equations (1) and (2) are as follows. $X_{ij,t}^{k}$ denotes nominal bilateral trade at the industry level and, consistent with trade theory, it includes both international and domestic trade (Yotov, 2022). The directional country-pair fixed effects ($\overrightarrow{\mu}_{ij}^{k}$) are now industry-specific as well, e.g., to reflect the fact that transportation costs could be very heterogeneous across industries, as in the cases of mining vs. light manufacturing. The exporter-time and importer-time fixed effects ($\pi_{i,t}^{k}$ and $\chi_{j,t}^{k}$) become industry-specific as well. This is also motivated by theory, e.g., to reflect the dimensions of the structural multilateral resistances of Anderson and van Wincoop (2003) that vary by exporter-industry-time and importer-industry-time (Anderson and van Wincoop, 2004; Costinot et al., 2012).

The vector of policy variables in equation (2) is the same as before. $POLICY_{ij,t}$ is not modified to include an industry dimension because all policies in our model are bilateral at the country level. However, we note that, even when a policy is implemented at the country level (e.g., WTO membership), the impact of this policy may be heterogeneous across industries and sectors. Therefore, we allow for the coefficients (α^{k}) on the policy variables to vary by industry or sector and by type of policy.

The next term in equation (2) is new. $GLOB_{ij,t}^{k}$ denotes a vector of time-varying border indicators, one for each year and industry in our sample, which take a value of one for international flows and equal zero for domestic trade flows. The estimates on these dummy variables capture the impact of common (de-)globalization trends that have affected international relative to domestic trade, e.g., improvements in communication and

transportation, global recessions, etc. Thus, our sanctions estimates would capture effects in addition to those embodied in any common (de-)globalization trends among the countries in our sample.[27]

Finally, and most importantly for our analysis, the last two terms in equation (2) account for sanctions. Specifically, as before, $FIN\_PAYMENT_{ij,t}$ is the key indicator for the presence of payment restrictions, and $OTHER\_SANCT_{ij,t}$ is a vector that includes all other sanctions from column (6) of Table 2.

Capitalizing on the separability property of the theoretical gravity model (Larch et al., 2025b), we estimate equation (2) industry by industry for each of the 170 industries that are covered by the ITPD-E. Since the number of estimates we obtain is large, we present them in a figure. Figure 6 reports the industry-level estimates of the effects of payment restrictions along with their confidence intervals. For clarity, we have dropped the top and bottom 5% of the estimates. The full set of estimates is included in Table A-1 of the Online Appendix.

Two main findings stand out from the estimates in Figure 6. First, consistent with our benchmark results, the majority of the industry estimates of the effects of payment restrictions are negative, and most of them are sizable and statistically significant. Second, Figure 6 indicates that the payment-restrictions estimates are very heterogeneous across the ITPD-E industries. However, an important drawback of Figure 6 is that, due to the large number of estimates, it does not permit us to identify the nature of individual industries.

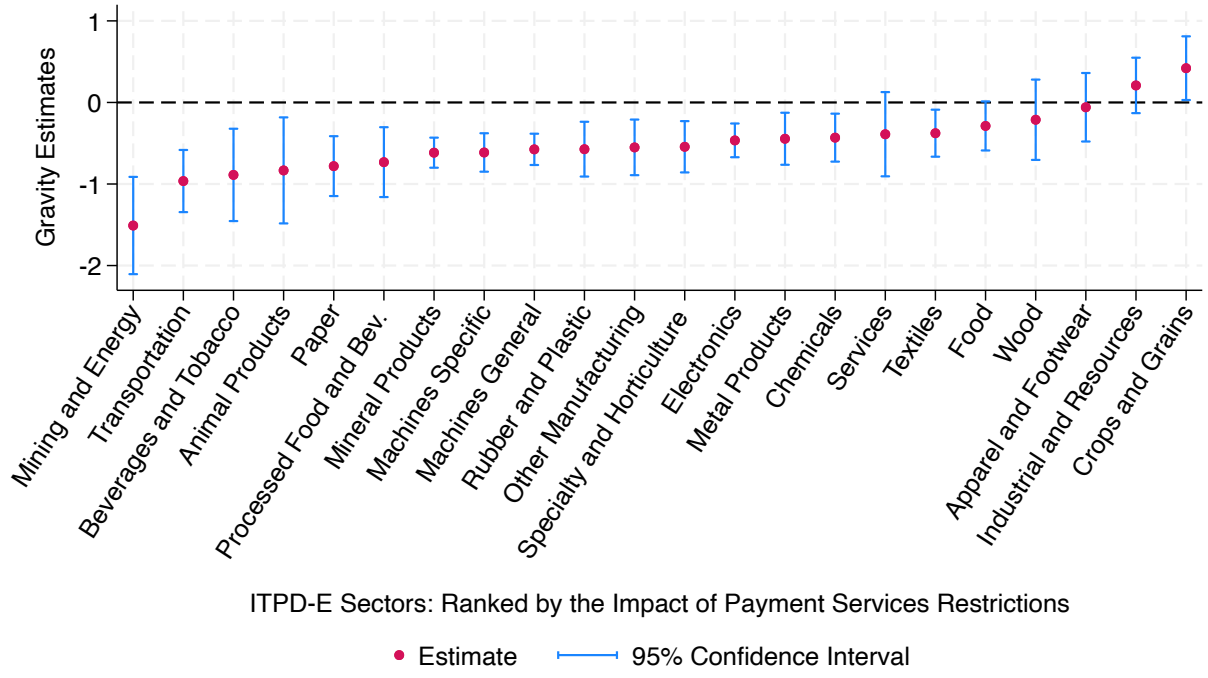
[27] Due to perfect collinearity with the pair fixed effects in our preferred specification, we cannot obtain estimates on the full set of globalization variables, and we need to drop one of them. This is irrelevant given our focus: the choice of reference group for the globalization dummies does not affect our sanctions estimates.

Figure 6: Sanctions on Payment Services and Trade (by Industry)

Note: This figure displays the estimates of the effects of the payment restrictions on trade for the ITPD-E industries in our sample. The estimates are obtained from the disaggregated econometric model, equation (2). The dependent variable is trade in levels over 1986–2022 (1988–2022 for Mining & Energy and Manufacturing; 2000–2022 for Services), and the estimator is Poisson Pseudo Maximum Likelihood (PPML). In addition to the other policy controls, the estimates in this figure are obtained with exporter-industry-time fixed effects, importer-industry-time fixed effects, directional country-industry-pair fixed effects, time-varying border indicators, and after controlling for complete trade sanctions, partial trade sanctions, other types of sanctions, and all financial sanctions by type. Standard errors are clustered by country pair. For clarity, the figure does not include the bottom and top 5% of the industry-level estimates. However, the full set of estimates is included in Table A-1 from the Online Appendix. See text for further details.

To address this challenge, we obtain more aggregate, sectoral estimates. Specifically, we use equation (2), but rather than obtaining individual industry-level estimates, we pool together the industries into 22 sectors, which are listed in the second column of Table 3.[28] Since we pool (rather than aggregate) the data, the estimates in Table 3 are obtained with the most disaggregated data and with the same set of fixed effects included in equation (2). The only difference is that we now constrain the policy effects, including the estimates on the payment restrictions, to be common across the industries within each broad sector. Our sectoral estimates of the effects of payment restrictions, along with their standard errors, appear in Table 3, and they are illustrated in Figure 7.

Figure 7: Sanctions on Payment Services and Trade (by Sector)



Note: This figure highlights the sectoral estimates of the direct effects of payment restrictions from Table 3. Specifically, it reports the sectoral estimates of the direct effects of the sanctions on Payment Services on sectoral trade. The estimates for each sector are obtained from a pooled version of equation (2), which constrains the coefficients to be common across the industries within each sector. For example, the estimates for rops and Grains are obtained by pooling the six industries in that sector. The dependent variable is trade in levels 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. Standard errors are clustered by country pair. See text for further details.

[28]The correspondence between the industries and the sectors in our analysis can be found in Table A-1 of the Online Appendix.

Table 3: Sanctions on Payment Services and Trade (by Sector)

Sector ID	Sector Description	Payment Sanction Effects Estimate	Standard Error
1	Crops and Grains	.420	(.199)*
2	Specialty and Horticulture	-.543	(.160)**
3	Processed Food and Bev.	-.732	(.218)**
4	Animal Products	-.833	(.332)*
5	Industrial and Resources	.209	(.173)
6	Mining and Energy	-1.509	(.304)**
7	Food	-.288	(.153)+
8	Beverages and Tobacco	-.888	(.289)**
9	Textiles	-.377	(.147)*
10	Apparel and Footwear	-.059	(.214)
11	Wood	-.212	(.251)
12	Paper	-.781	(.187)**
13	Chemicals	-.432	(.150)**
14	Rubber and Plastic	-.573	(.171)**
15	Mineral Products	-.616	(.094)**
16	Metal Products	-.445	(.163)**
17	Machines General	-.575	(.098)**
18	Machines Specific	-.613	(.120)**
19	Electronics	-.465	(.105)**
20	Transportation	-.964	(.194)**
21	Other Manufacturing	-.551	(.174)**
22	Services	-.390	(.263)

Notes: This table reports the sectoral estimates of the effects of the sanctions on Payment Services on sectoral trade. The estimates for each sector are obtained from a pooled version of equation (2), which constrains the coefficients to be common across the industries within each sector. For example, the estimates for Crops and Grains are obtained by pooling the six industries in that sector. The dependent variable is trade in levels over 1986–2022 (1988–2022 for Mining & Energy and Manufacturing; 2000–2022 for Services) 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. Standard errors are clustered by country pair. + $p < 0.10$, * $p < .05$, ** $p < .01$. See text for further details.

Overall, the sectoral results lend strong support to our conclusions based on the aggregate data. Specifically, nearly all estimates presented in Table 3 and Figure 7 are negative and statistically significant, with only two exceptions: 'Crops and Grains' and 'Industrial and Resources', whose estimated coefficients are positive, with only the former estimate being statistically significant. A possible explanation for the resilience of trade in crops and grains comes from the trade-finance literature that emerged after the global financial crisis: trade in grains and other primary commodities proved comparatively robust to disruptions of trade finance, as such transactions are standardized, well collateralized, and comparatively easy to shift toward alternative financing channels and intermediaries (Amiti and Weinstein, 2011; Chor and Manova, 2012). We also see that the payment-restrictions estimates are relatively large but also heterogeneous across the broad sectors in our sample.

3.4 The Third-Country Effects of Payment Restrictions

We conclude the empirical analysis with an investigation of the effects of payment restrictions on the trade between targets and third countries. We call these 'third-country effects' of payment restrictions, and our analysis of them is motivated by two policy and two methodological considerations. The first policy reason is that the payment restrictions are multilateral by design, e.g., removing a target from the SWIFT system is intended to reduce this country's trade not only with the sender, but with third countries too. The second policy reason is related to the impact and effectiveness of sanctions. Specifically, if payment restrictions are indeed successful in eliminating trade between targets and third countries, then this will have a significantly larger negative impact on the target since its trade with third countries is often larger than its trade with the sender(s), e.g., consider the trade of Belarus or Russia with the U.S.

The two reasons that motivate our third-country analysis from a methodological perspective are as follows. First, the availability of domestic trade flows in our data en-

ables us to obtain both the direct and the third-country effects of payment restrictions on trade even in the presence of the full set of exporter-industry-time and importer-industry-time fixed effects in our setting.[29] Second, from an identification perspective, if the third-country effects of payment restrictions on targets' trade with third countries are indeed significant, then not controlling for them explicitly results in biased estimates of the direct effects of the payment restrictions on trade between senders and targets.

To estimate the third-country effects of payment restrictions, we introduce an additional covariate to equation (2), which becomes:

$$X_{ij,t}^k = \exp[\overrightarrow{\mu}_{ij}^k + \pi_{i,t}^k + \chi_{j,t}^k + POLICY_{ij,t} \times \alpha^k + GLOB_{ij,t}^k \times \eta^k + OTHER\_SANCT_{ij,t} \times \gamma^k] \times \exp[\beta^k \times FIN\_PAYMENT_{ij,t} + \delta^k \times PAYMENT\_EXTRA_{ij,t}] \times \epsilon_{ij,t}^k. \quad (3)$$

Here, the new covariate, $PAYMENT\_EXTRA_{ij,t}$, is an indicator variable that takes a value of one for trade between targets and third countries, and all other covariates in equation (2) are as defined above. The estimate on $PAYMENT\_EXTRA_{ij,t}$ can be identified even in the presence of all fixed effects in equation (3) and, given the nature of payment restrictions, we expect the estimates of δ^k to be negative.

For clarity and brevity, we focus on the pooled sectoral estimates of the direct and third-country effects of payment restrictions, which are detailed in Table 4 and illustrated in Figure 8. Consistent with the motivation for the third-country analysis, we draw the following conclusions. Most (about two-thirds) of the estimates of the third-country effects of payment restrictions are negative and many of these effects are statistically significant. This finding is important from a policy perspective because (i) it captures the multilateral nature of payment restrictions, and (ii) it implies that their negative impact on the trade and welfare of the target states can be significant.[30]

[29] This is not possible with international trade data alone due to perfect collinearity between the country-industry-time fixed effects and the indicator variable for the third-country effects of payment restrictions.

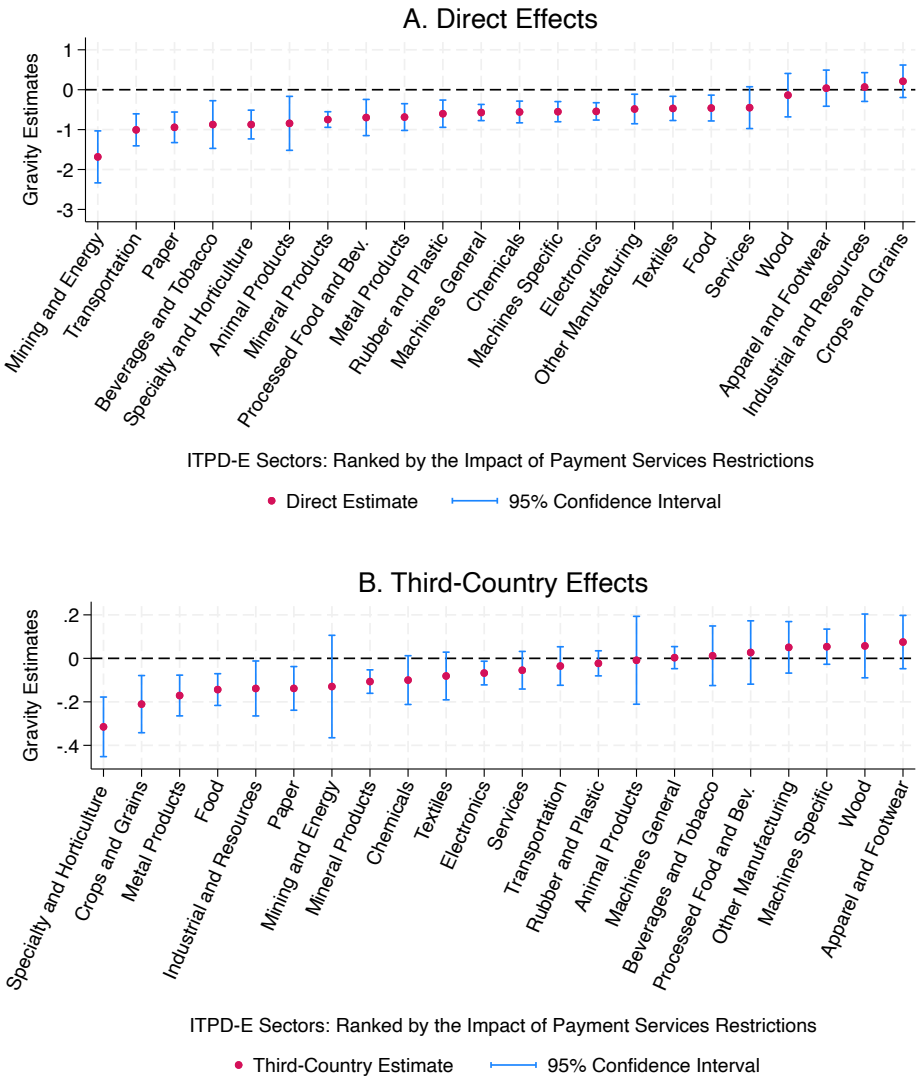
[30] We also obtain a few positive estimates of the third-country effects of payment restrictions, e.g., for 'Apparel and Footwear', 'Wood', and 'Machines Specific'; however, none of the positive estimates is statistically significant.

Table 4: Direct vs. Third-Country Effects of the Sanctions on Payment Services

		Panel A		Panel B	
Sector	Sector	Direct Effects		Third-Country Effects	
ID	Description	Estimate	Std. Err.	Estimate	Std. Err.
1	Crops and Grains	.211	(.207)	-.211	(.067)**
2	Specialty and Horticulture	-.873	(.184)**	-.315	(.070)**
3	Processed Food and Bev.	-.697	(.231)**	.027	(.074)
4	Animal Products	-.843	(.345)*	-.009	(.103)
5	Industrial and Resources	.067	(.184)	-.138	(.064)*
6	Mining and Energy	-1.684	(.332)**	-.130	(.120)
7	Food	-.460	(.165)**	-.144	(.037)**
8	Beverages and Tobacco	-.873	(.305)**	.012	(.070)
9	Textiles	-.469	(.155)**	-.081	(.056)
10	Apparel and Footwear	.038	(.231)	.075	(.063)
11	Wood	-.137	(.278)	.057	(.075)
12	Paper	-.942	(.195)**	-.138	(.051)**
13	Chemicals	-.558	(.139)**	-.100	(.057)+
14	Rubber and Plastic	-.602	(.174)**	-.023	(.029)
15	Mineral Products	-.748	(.100)**	-.107	(.028)**
16	Metal Products	-.686	(.171)**	-.171	(.048)**
17	Machines General	-.572	(.103)**	.003	(.026)
18	Machines Specific	-.551	(.129)**	.054	(.041)
19	Electronics	-.543	(.111)**	-.068	(.028)*
20	Transportation	-1.006	(.204)**	-.035	(.045)
21	Other Manufacturing	-.483	(.189)*	.051	(.060)
22	Services	-.450	(.267)+	-.055	(.044)

Notes: This table reports the sectoral estimates of the direct and third-country effects of the sanctions on Payment Services on sectoral trade. Panel A reports the estimates of the direct effects of payment restrictions and panel B reports the corresponding third-country estimates. The estimates in the two panels for each sector are obtained from a pooled version of equation (3), which constrains the coefficients to be common across the industries within each sector. For example, the estimates for Crops and Grains are obtained by pooling the six industries in that sector. The dependent variable is trade in levels over 1986–2022 (1988–2022 for Mining & Energy and Manufacturing; 2000–2022 for Services) 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. Standard errors are clustered by country pair. + $p < 0.10$, * $p < .05$, ** $p < .01$. See text for further details.

Figure 8: Direct vs. Third-Country Effects of the Sanctions on Payment Services



Note: This figure illustrates the sectoral estimates of the direct and the third-country effects of payment restrictions from Table 4, with 95% confidence intervals. Specifically, it reports the sectoral estimates of the direct and third-country effects of the sanctions on Payment Services on sectoral trade. Both sets of estimates for a given sector are obtained from a pooled version of equation (3), which constrains the coefficients to be common across the industries within each sector. For example, the estimates for Crops and Grains are obtained by pooling the six industries in that sector. The dependent variable is trade in levels 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. Standard errors are clustered by country pair. See text for further details.

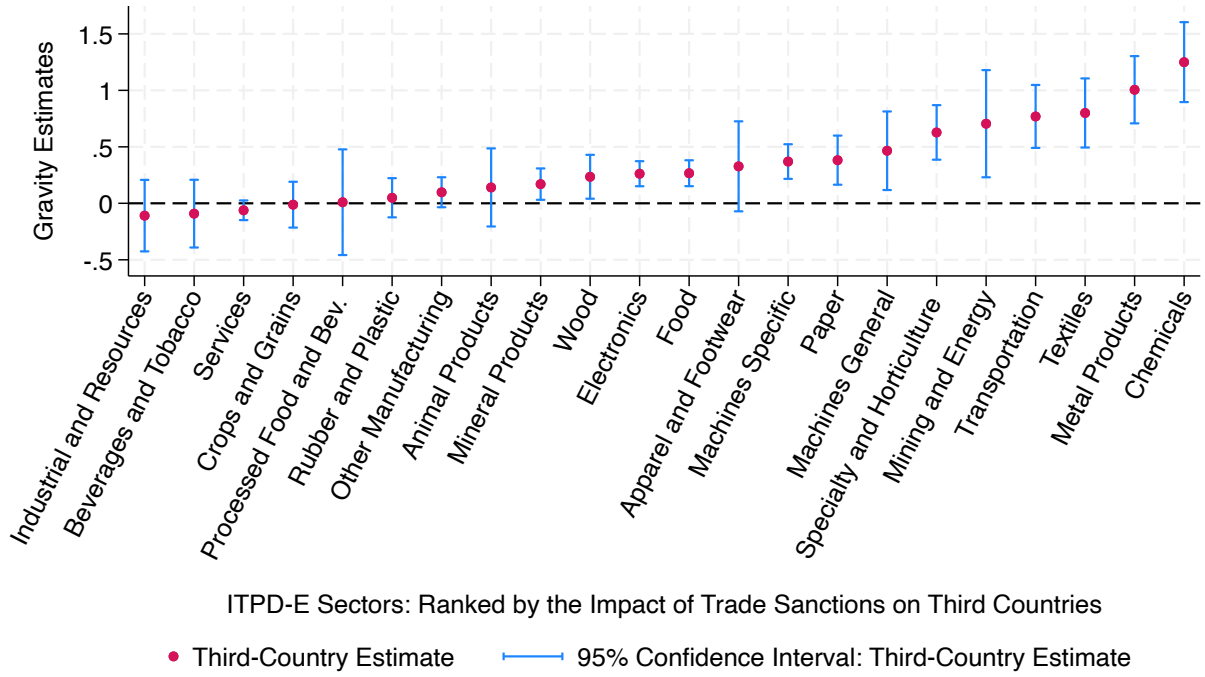
To reinforce this result, we compare our findings with corresponding results for the third-country effects of complete trade sanctions obtained in Felbermayr et al. (2026), who estimate a similar econometric model with the previous version of the GSDB (GSDB-R4) and without controlling for financial sanctions by type. In contrast to our current results, the main finding from Felbermayr et al. (2026) is that the impact of complete trade sanctions on trade between targets and third countries is large and *positive*; so much so that the third-country effects of complete trade sanctions may even outweigh their direct impact on trade between the senders and the targets.

To provide a fair comparison, we reproduce the results of Felbermayr et al. (2026) with our new data and based on equation (3), where, instead of estimating the third-country effects of 'payment restrictions', we estimate the third-country effects of complete trade sanctions. These estimates appear in Figure 9.

Consistent with Felbermayr et al. (2026), Figure 9 shows that the third-country effects of complete trade sanctions on trade between targets and third countries are overwhelmingly positive. That is, over and above any general-equilibrium trade-diversion effects, which are fully captured by the fixed effects in the econometric model, complete trade sanctions also have direct positive effects on trade between targets and third countries. This result contrasts sharply with our findings of negative effects of payment restrictions on the targets' trade. This contrast reinforces the multilateral nature of payment restrictions.

Finally, we note that most of the estimates on the direct effects of payment restrictions from Table 4 and Figure 8 are larger (in absolute value) than the corresponding results from Table 3 and Figure 7, e.g., the estimate for 'Food' in Table 4 is -0.460 (std.err. 0.165) vs. -0.288 (std.err. 0.153) in Table 3. The explanation for this result is that the third-country links were in the reference group for the estimates of the direct effects of payment restrictions in Table 3. Thus, when the third-country estimates are negative, once we account for them explicitly, the negative estimates of the direct effects of payment restrictions should

Figure 9: The Third-Country Effects of Complete Trade Sanctions



Note: This figure visualizes the sectoral estimates of the third-country effects of complete trade sanctions. The estimates for each sector are obtained from a pooled version of equation (3), which constrains the coefficients to be common across the industries within each sector. For example, the estimates for Crops and Grains are obtained by pooling the six industries in that sector. However, we have replaced the indicator for third-country effects of payment restrictions ($PAYMENT\_EXTRA_{ij,t}$) with an indicator for third-country effects of complete trade sanctions ($TRADE\_EXTRA_{ij,t}$). The dependent variable is trade in levels 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. Standard errors are clustered by country pair. See text for further details.

be larger in absolute value.[31] effects are positive, once we account for them explicitly, the negative estimates of the direct effects of payment restrictions should be smaller in absolute value.

4 Conclusion

In this paper, we introduced the Global Sanctions Data Base – Financial Sanctions (GSDB-FS), an extension of the GSDB that provides the most comprehensive coverage of financial sanctions to date, over the period 1950–2025, and disaggregates these sanctions into their constituent types, including asset freezes and restrictions on aid, investment, financial services, and, most notably, payment-service infrastructure. Along with the new GSDB-FS, we also updated the original Global Sanctions Data Base to provide the most comprehensive coverage of sanctions to date, through 2025. Thus, the resulting fifth release of the GSDB (GSDB-R5) and the GSDB-FS are perfectly compatible and consistent with each other. Finally, we introduced a new high-frequency (monthly) time dimension in the GSDB-R5.

Capitalizing on the new disaggregated data from the GSDB-FS, we also revisited the relationship between financial sanctions and international trade. Our main findings can be described as follows. First, previous estimates that did not distinguish between the effects of the different types of financial sanctions may be biased toward zero. Second, we obtain very large and heterogeneous (across cases, industries, and sectors) estimates of the direct effects of payment restrictions. This result demonstrates the importance of the international payment infrastructure for real trade. It has potentially important implications for the effectiveness of sanctions, and suggests that not all financial sanctions may be 'smart.' Finally, consistent with the multilateral nature of payment restrictions, we provide evidence that they impede trade not only between senders and targets but also

[31] Similarly, when the third-country

between targets and third countries, thus imposing significantly higher costs on targets.

Our paper opens many avenues for future research. For example, our empirical findings suggest that the link between financial sanctions and trade is strong. Along with inspiring new applications, this may require us to revisit past applications that rely on aggregate data for financial sanctions. The significant partial estimates we obtain also imply potentially significant welfare effects, which have not been explored in the literature. More importantly, the new GSDB-FS supports applications well beyond international trade, including the links between financial sanctions and financial flows, capital flows, FDI, aid, development, etc. The strong third-country effects of payment restrictions that we document also call for a theoretical framework of payment-network disruption in international trade, which we leave for future research. Finally, we have not exploited the new monthly dimension of the GSDB-R5, which may prove valuable for event studies with high-frequency data.

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ONLINE APPENDIX

This Appendix is not intended for publication. It provides the full set of industry-level estimates of the effects of payment restrictions as well as additional descriptive evidence on the duration of sanctions.

Table A-1: The Effects of Sanctions on Payment Services by Industry

Industry ID	Industry Description	Sector Description	Broad Sector Description	Payment Sanction Effects	
				Estimate	Standard Error
1	Wheat	Crops and Grains	Agriculture	.573	(.393)
2	Rice (raw)	Crops and Grains	Agriculture	-1.449	(.732)**
3	Corn	Crops and Grains	Agriculture	.21	(.287)
4	Other cereals	Crops and Grains	Agriculture	-.377	(.31)
5	Cereal products	Processed Food and Bev.	Agriculture	-.07	(.615)
6	Soybeans	Crops and Grains	Agriculture	.972	(.341)***
7	Other oilseeds (excluding peanuts)	Crops and Grains	Agriculture	-.538	(.232)**
8	Animal feed ingredients and pet foods	Processed Food and Bev.	Agriculture	-.311	(.164)*
9	Raw and refined sugar and sugar crops	Processed Food and Bev.	Agriculture	-3.174	(2.028)
10	Other sweeteners	Processed Food and Bev.	Agriculture	-1.708	(.659)***
11	Pulses and legumes, dried, preserved	Specialty and Horticulture	Agriculture	-.658	(.404)
12	Fresh fruit	Specialty and Horticulture	Agriculture	-.885	(.258)***
13	Fresh vegetables	Specialty and Horticulture	Agriculture	-1.513	(.39)***
14	Prepared fruits and fruit juices	Processed Food and Bev.	Agriculture	-.808	(.302)***
15	Prepared vegetables	Processed Food and Bev.	Agriculture	18.916	(1.963)***
16	Nuts	Specialty and Horticulture	Agriculture	-.24	(.207)
17	Live Cattle	Animal Products	Agriculture	-1.693	(.809)**
18	Live Swine	Animal Products	Agriculture	.434	(.873)
19	Eggs	Animal Products	Agriculture	-.199	(.971)
20	Other meats, livestock products, and live animals	Animal Products	Agriculture	-.841	(.385)**
21	Cocoa and cocoa products	Specialty and Horticulture	Agriculture	-2.156	(1.247)*
22	Beverages, nec	Processed Food and Bev.	Agriculture	.237	(.291)
23	Cotton	Industrial and Resources	Agriculture	-2.251	(.925)**
24	Tobacco leaves and cigarettes	Industrial and Resources	Agriculture	.604	(.537)
25	Spices	Specialty and Horticulture	Agriculture	.582	(.274)**
26	Other agricultural products, nec	Industrial and Resources	Agriculture	.118	(.197)
27	Forestry	Industrial and Resources	Agriculture	.62	(.209)***
28	Fishing	Industrial and Resources	Agriculture	.304	(.475)
29	Mining of hard coal	Mining and Energy	Mining and Energy	-.343	(.399)
30	Mining of lignite	Mining and Energy	Mining and Energy	-1.294	(1.58)
31	Extraction crude petroleum and natural gas	Mining and Energy	Mining and Energy	-1.733	(.358)***
32	Mining of iron ores	Mining and Energy	Mining and Energy	-2.631	(.919)***
33	Other mining and quarrying	Mining and Energy	Mining and Energy	-1.044	(.307)***
34	Electricity production, collection, and distribution	Mining and Energy	Mining and Energy	.581	(.995)
35	Gas production and distribution	Mining and Energy	Mining and Energy	0	(0)
36	Processing/preserving of meat	Food	Manufacturing	-1.297	(.261)***
37	Processing/preserving of fish	Food	Manufacturing	-1.841	(.417)***
38	Processing/preserving of fruit and vegetables	Food	Manufacturing	-.502	(.189)***
39	Vegetable and animal oils and fats	Food	Manufacturing	.26	(.269)
40	Dairy products	Food	Manufacturing	-.426	(.251)*
41	Grain mill products	Food	Manufacturing	-.361	(.432)
42	Starches and starch products	Food	Manufacturing	-.843	(.315)***
43	Prepared animal feeds	Food	Manufacturing	-.321	(.409)
44	Bakery products	Food	Manufacturing	.397	(.36)
45	Sugar	Food	Manufacturing	-.982	(.309)***
46	Cocoa chocolate and sugar confectionery	Food	Manufacturing	-.141	(.242)
47	Macaroni noodles and similar products	Food	Manufacturing	-.305	(.349)
48	Other food products n.e.c.	Food	Manufacturing	-.267	(.159)*
49	Distilling rectifying and blending of spirits	Beverages and Tobacco	Manufacturing	-.683	(.549)
50	Wines	Beverages and Tobacco	Manufacturing	-.73	(.498)
51	Malt liquors and malt	Beverages and Tobacco	Manufacturing	.14	(.287)
52	Soft drinks; mineral waters	Beverages and Tobacco	Manufacturing	-.792	(.303)***
53	Tobacco products	Beverages and Tobacco	Manufacturing	-.988	(.582)*
54	Textile fibre preparation; textile weaving	Textiles	Manufacturing	-.503	(.29)*
55	Made-up textile articles except apparel	Textiles	Manufacturing	-.61	(.228)***
56	Carpets and rugs	Textiles	Manufacturing	-.27	(.194)
57	Cordage rope twine and netting	Textiles	Manufacturing	.921	(.607)
58	Other textiles n.e.c.	Textiles	Manufacturing	-.531	(.289)*
59	Knitted and crocheted fabrics and articles	Apparel and Footwear	Manufacturing	-.469	(.33)
60	Wearing apparel except fur apparel	Apparel and Footwear	Manufacturing	.643	(.332)*
61	Dressing and dyeing of fur; processing of fur	Apparel and Footwear	Manufacturing	.093	(.667)
62	Tanning and dressing of leather	Apparel and Footwear	Manufacturing	-.558	(.3)*
63	Luggage handbags etc.; saddlery and harness	Apparel and Footwear	Manufacturing	-.714	(.287)**
64	Footwear	Apparel and Footwear	Manufacturing	-.625	(.324)*
65	Sawmilling and planing of wood	Wood	Manufacturing	-.071	(.35)

Continued on next page

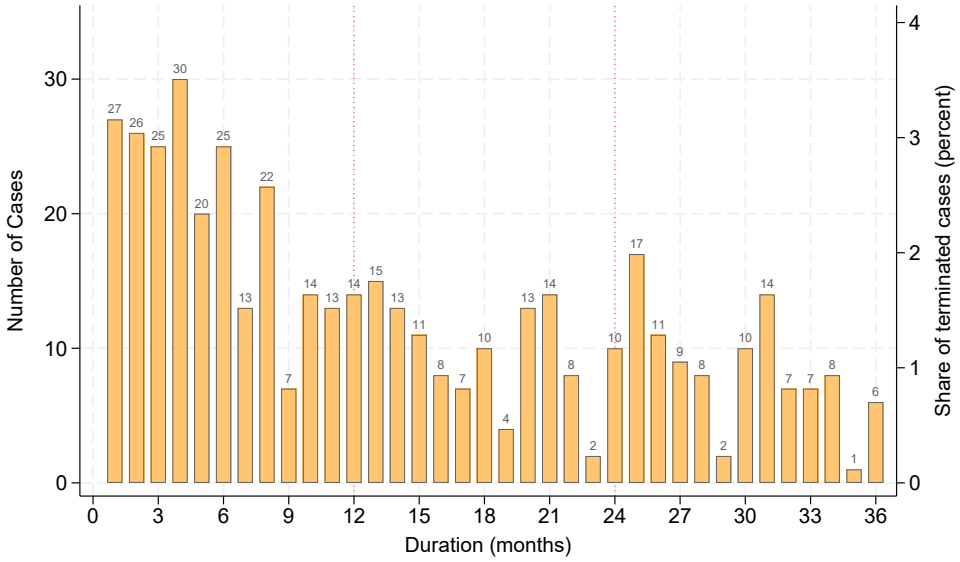
66	Veneer sheets plywood particle board etc.	Wood	Manufacturing	-.303	(.37)
67	Builders' carpentry and joinery	Wood	Manufacturing	-.373	(.28)
68	Wooden containers	Wood	Manufacturing	-.637	(.417)
69	Other wood products; articles of cork/straw	Wood	Manufacturing	-.745	(.318)**
70	Pulp paper and paperboard	Paper	Manufacturing	-.815	(.242)***
71	Corrugated paper and paperboard	Paper	Manufacturing	-.232	(.5)
72	Other articles of paper and paperboard	Paper	Manufacturing	-.662	(.234)***
73	Publishing of books and other publications	Paper	Manufacturing	-.434	(.302)
74	Publishing of newspapers journals etc.	Paper	Manufacturing	-1.231	(.499)**
75	Publishing of recorded media	Paper	Manufacturing	-.983	(.674)
76	Other publishing	Paper	Manufacturing	-1.058	(.451)**
77	Printing	Paper	Manufacturing	-1.417	(.312)***
78	Service activities related to printing	Paper	Manufacturing	.906	(.555)
79	Coke oven products	Chemicals	Manufacturing	-.952	(.405)**
80	Refined petroleum products	Chemicals	Manufacturing	.155	(.32)
81	Processing of nuclear fuel	Chemicals	Manufacturing	-.509	(.546)
82	Basic chemicals except fertilizers	Chemicals	Manufacturing	-.808	(.149)***
83	Fertilizers and nitrogen compounds	Chemicals	Manufacturing	-.515	(.335)
84	Plastics in primary forms; synthetic rubber	Chemicals	Manufacturing	-1.083	(.153)***
85	Pesticides and other agro-chemical products	Chemicals	Manufacturing	-.192	(.217)
86	Paints varnishes printing ink and mastics	Chemicals	Manufacturing	-1.746	(.311)***
87	Pharmaceuticals medicinal chemicals etc.	Chemicals	Manufacturing	.146	(.114)
88	Soap cleaning and cosmetic preparations	Chemicals	Manufacturing	-.491	(.31)
89	Other chemical products n.e.c.	Chemicals	Manufacturing	-1.047	(.235)***
90	Man-made fibres	Rubber and Plastic	Manufacturing	-.108	(.295)
91	Rubber tyres and tubes	Rubber and Plastic	Manufacturing	.288	(.415)
92	Other rubber products	Rubber and Plastic	Manufacturing	-.718	(.157)***
93	Plastic products	Rubber and Plastic	Manufacturing	-.849	(.208)***
94	Glass and glass products	Mineral Products	Manufacturing	-.677	(.157)***
95	Pottery china and earthenware	Mineral Products	Manufacturing	-1	(.289)***
96	Refractory ceramic products	Mineral Products	Manufacturing	-.707	(.284)**
97	Struct.non-refractory clay; ceramic products	Mineral Products	Manufacturing	-.778	(.356)**
98	Cement lime and plaster	Mineral Products	Manufacturing	-1.065	(.703)
99	Articles of concrete cement and plaster	Mineral Products	Manufacturing	-.282	(.427)
100	Cutting shaping and finishing of stone	Mineral Products	Manufacturing	.393	(.225)*
101	Other non-metallic mineral products n.e.c.	Mineral Products	Manufacturing	-.474	(.179)***
102	Basic iron and steel	Metal Products	Manufacturing	-.376	(.188)**
103	Basic precious and non-ferrous metals	Metal Products	Manufacturing	-.603	(.306)**
104	Structural metal products	Metal Products	Manufacturing	1.183	(1.221)
105	Tanks reservoirs and containers of metal	Metal Products	Manufacturing	.023	(.529)
106	Steam generators	Metal Products	Manufacturing	-.608	(.541)
107	Cutlery hand tools and general hardware	Metal Products	Manufacturing	-.836	(.16)***
108	Other fabricated metal products n.e.c.	Metal Products	Manufacturing	-.919	(.207)***
109	Engines and turbines (not for transport equipment)	Machines General	Manufacturing	-.4	(.296)
110	Pumps compressors taps and valves	Machines General	Manufacturing	-.613	(.176)***
111	Bearings gears gearing and driving elements	Machines General	Manufacturing	-.607	(.153)***
112	Ovens furnaces and furnace burners	Machines General	Manufacturing	-1.132	(.215)***
113	Lifting and handling equipment	Machines General	Manufacturing	-.4	(.295)
114	Other general purpose machinery	Machines General	Manufacturing	-.528	(.176)***
115	Agricultural and forestry machinery	Machines Specific	Manufacturing	-.015	(.324)
116	Machine tools	Machines Specific	Manufacturing	-.491	(.176)***
117	Machinery for metallurgy	Machines Specific	Manufacturing	-.822	(.311)***
118	Machinery for mining and construction	Machines Specific	Manufacturing	-.87	(.243)***
119	Food/beverage/tobacco processing machinery	Machines Specific	Manufacturing	-.512	(.133)***
120	Machinery for textile apparel and leather	Machines Specific	Manufacturing	-.53	(.308)*
121	Weapons and ammunition	Machines Specific	Manufacturing	-.999	(.429)**
122	Other special purpose machinery	Machines Specific	Manufacturing	-.144	(.192)
123	Domestic appliances n.e.c.	Electronics	Manufacturing	-1.202	(.233)***
124	Office accounting and computing machinery	Electronics	Manufacturing	-.694	(.182)***
125	Electric motors generators and transformers	Electronics	Manufacturing	-.843	(.2)***
126	Electricity distribution and control apparatus	Electronics	Manufacturing	-.802	(.152)***
127	Insulated wire and cable	Electronics	Manufacturing	-.367	(.368)
128	Accumulators primary cells and batteries	Electronics	Manufacturing	-.305	(.273)
129	Lighting equipment and electric lamps	Electronics	Manufacturing	-.787	(.253)***
130	Other electrical equipment n.e.c.	Electronics	Manufacturing	-.203	(.239)
131	Electronic valves tubes etc.	Electronics	Manufacturing	.099	(.388)
132	TV/radio transmitters; line comm. apparatus	Electronics	Manufacturing	-.164	(.6)
133	TV and radio receivers and associated goods	Electronics	Manufacturing	-.753	(.38)**
134	Medical surgical and orthopaedic equipment	Electronics	Manufacturing	.028	(.178)
135	Measuring/testing/navigating appliances etc.	Electronics	Manufacturing	-.857	(.281)***
136	Optical instruments and photographic equipment	Electronics	Manufacturing	-.364	(.311)
137	Watches and clocks	Electronics	Manufacturing	-.734	(.384)*
138	Motor vehicles	Transportation	Manufacturing	-1.278	(.336)***
139	Automobile bodies trailers and semi-trailers	Transportation	Manufacturing	-1.789	(.607)***
140	Parts/accessories for automobiles	Transportation	Manufacturing	-.573	(.242)**
141	Building and repairing of ships	Transportation	Manufacturing	-1.126	(.645)*
142	Building/repairing of pleasure/sport. boats	Transportation	Manufacturing	-.083	(.995)
143	Railway/tramway locomotives and rolling stock	Transportation	Manufacturing	-.26	(.288)
144	Aircraft and spacecraft	Transportation	Manufacturing	.091	(.421)
145	Motorcycles	Transportation	Manufacturing	-1.379	(.371)***
146	Bicycles and invalid carriages	Transportation	Manufacturing	.307	(.272)
147	Other transport equipment n.e.c.	Transportation	Manufacturing	-1.655	(.385)***
148	Furniture	Other Manufacturing	Manufacturing	.086	(.295)
149	Jewellery and related articles	Other Manufacturing	Manufacturing	-2.203	(.517)***
150	Musical instruments	Other Manufacturing	Manufacturing	-.582	(.346)*
151	Sports goods	Other Manufacturing	Manufacturing	-.386	(.267)

Continued on next page

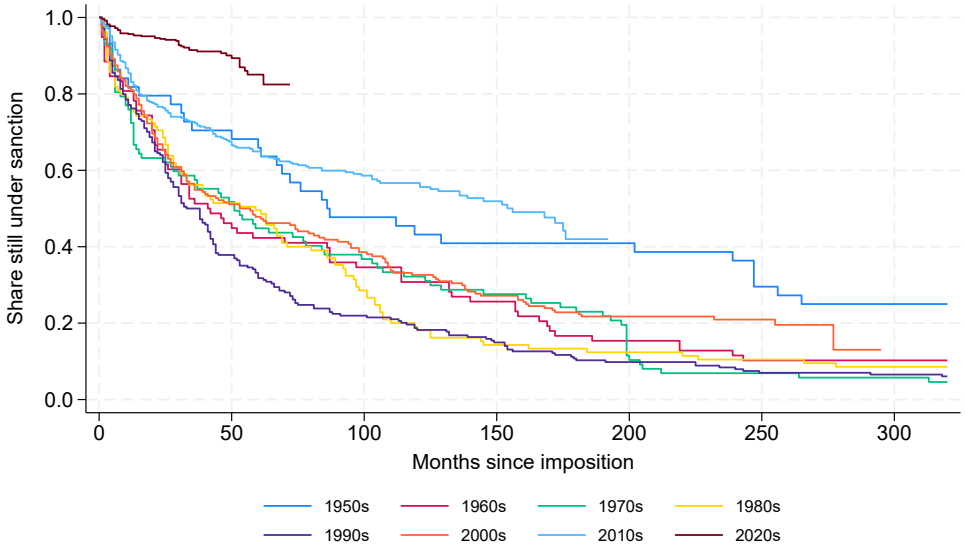
152	Games and toys	Other Manufacturing	Manufacturing	-.276	(.299)
153	Other manufacturing n.e.c.	Other Manufacturing	Manufacturing	-.613	(.22)***
154	Manufacturing services on physical inputs	Services	Services	2.499	(1.112)**
155	Maintenance and repair services n.i.e.	Services	Services	.147	(.65)
156	Transport	Services	Services	.017	(.403)
157	Travel	Services	Services	-.617	(.414)
158	Construction	Services	Services	-1.591	(.5)***
159	Insurance and pension services	Services	Services	-1.093	(.41)***
160	Financial services	Services	Services	-.328	(1.162)
161	Charges for use of intellectual property	Services	Services	-.001	(.54)
162	Telecom, computer, information services	Services	Services	-.249	(1.164)
163	Other business services	Services	Services	-.568	(.544)
164	Heritage and recreational services	Services	Services	2.243	(4.034)
165	Health services	Services	Services	-5.272	(0)
166	Education services	Services	Services	.348	(.187)*
167	Government goods and services n.i.e.	Services	Services	-.477	(.442)
168	Services not allocated	Services	Services	.539	(.578)
169	Trade-related services	Services	Services	.546	(.779)
170	Other personal services	Services	Services	.	(.)

Notes: This table reports industry-level estimates of the impact of sanctions on payment services on international trade. Columns (1)–(4) list the industry IDs, the industry descriptions, the sector descriptions, and the broad sector descriptions from the ITPD-E. Columns (5) and (6) report the gravity estimates and their corresponding standard errors, respectively, which are obtained from the main specification. The dependent variable is trade in levels and the PPML estimates for each industry are obtained with exporter-time fixed effects, importer-time fixed effects, directional pair fixed effects, time-varying border indicators, and a series of policy controls, whose estimates are omitted for brevity. The estimation for industry 35 did not converge, and industry 170 did not deliver estimates due to multicollinearity. The standard errors are clustered by country pair. + $p < 0.10$, * $p < .05$, ** $p < .01$. See text for further details.

Figure A-1: Sanction Duration and Survival, 1950–2025



(a) Completed durations of three years or less



(b) Survival by decade of imposition

Notes: Panel (a) reports the number of terminated sanction cases by completed duration in months, for cases lasting 36 months or less. The right axis expresses the same bars as a share of all terminated cases with known months, in percent. The dotted vertical lines mark durations of one and two years. Duration is measured inclusively as the number of calendar months in which a case was in force. Cases for which the month of imposition or of termination could not be identified are excluded. Panel (b) reports Kaplan–Meier estimates of the share of cases still in force, by decade of imposition and by months elapsed since imposition; cases in force at the end of December 2025 are treated as right-censored at that date. The flat segments in the most recent cohorts indicate intervals over which no case has yet terminated, not intervals over which termination has ceased.