

Global politico-economic dynamics during a local conflict: Reciprocal patterns of cooperation and sanctions

Reinhard A. Weisser

Nottingham Trent University

Department of Economics - Nottingham Business School

Nottingham, NG1 4BU

Email: reinhard.weisser@ntu.ac.uk

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Abstract: Employing global daily news coverage on interactions between stakeholders in G20 countries, this research offers a near-real-time analysis of changing interaction patterns between Russia and other G20 economies after the onset of open military conflict. Building on an event study over eight months, further analyses of reciprocal response dynamics point to potentially costly short-term consequences of sanctions, such as the breakdown and diversion of international cooperation amongst major economies in a broader sense. Once such a reciprocal cooperation decay has set in, re-establishing international cooperation between major societal actors may take considerable time.

Keywords: international cooperation; conflict responses; GDELT; big data

Declarations of interest: none

1 Introduction

The recent outbreak of hostilities in Ukraine led to immediate political and economic consequences. Sanctions were imposed on Russia within days. However, there is considerable heterogeneity regarding how stakeholders in other G20 economies altered their approach toward Russia. Whilst some changes may only be temporary, others may be lasting and affect global trade and diplomatic cooperation in the future.

The literature establishes limited or ambiguous effects of sanctions with respect to achieving the goals of the sanctioning party (for an interdisciplinary overview see Felbermayr et al., 2021). Their potential ineffectiveness may relate to rally-around-the-flag effects, where populations in sanctioned countries refrain from demanding accommodating responses (Seitz and Zazzaro, 2020). This may also occur for ‘smart’ sanctions in the aftermath of the Crimea annexation, targeting predominantly wealthy individuals (Alexseev and Hale, 2020). Low political costs for leaders in sanctioned economies, especially in autocratic countries, may further restrict sanctions’ effectiveness to spur the desired change.

Sanctioning actors should also be aware of a target’s overall economic strengths when they design sanctions (Lektzian and Patterson, 2015). Otherwise unexpectedly low or no economic costs of sanctions for the sanctioned party may defang seemingly tough sanctions, as a recent example demonstrates: In addition to banning major Russian corporations, such as Gazprom, from accessing international financial services, European states announced plans akin to a boycott of Russian fossil fuels. Due to the resulting demand shifts, and scarcity on the world market, prices surged. This, in turn, allowed the majority state-owned Gazprom to realise a record profit of \$ 41.75 billion in the first two quarters of 2022 whilst sanctions were in place (CNBC, 2022).

Threatening and imposing sanctions may be of differing effectiveness (Afesorgbor, 2019). Moreover, the costs of being sanctioned depend on long-term political relations, i.e. the origins of sanctions are relevant. Sanction threats originating from the US are more effective than those issued by the European Union; the reverse is observed for imposed sanctions (Weber and Schneider, 2020). Furthermore, imposed sanctions’ effectiveness is conditional on who applies a certain tool: Sanctions from highly relevant trading partners may be more successful to achieve desired outcomes (McLean and Whang, 2010).

This research provides timely insights into the short-term implications of sanctions, and how they alter cooperation patterns around the globe. Investigating sanction-related cooperation dynamics in a broader sense, going beyond an evaluation of whether sanctions achieve their immediate goal or not, adds an important dimension to the literature. Moreover, by focusing on sanctions in the public discourse across 20 major economies around the globe, this near-real-time analysis refines our understanding of how long-term politico-economic outcomes may emerge on the international stage eventually.

2 Data and methodology

2.1 Data on international patterns of interaction: GDEL T

Changing cooperation patterns among G20 countries are examined by employing near-real-time data from the Global Database of Events, Language, and Tone (GDEL T v2.0, <https://www.gdel tproject.org/>). GDEL T algorithms extract the following relevant information on interaction events from English news outlets or those in one of 100 major languages: primary and secondary actors, actors’ country affiliation, actor types, and interaction mode (Leetaru and Schrod t, 2013).

This information is retrieved building on the CAMEO coding scheme (Schrod t, 2012), implemented in the GDEL T text-mining algorithm that evaluates the written content of the global news sphere. To identify interaction events, news items are assessed sentence by sentence and screened for used verbs. Applying verb dictionaries, various verbs of similar meaning can be grouped: If a primary actor (being a sentence’s subject) threatens, announces potentially adverse actions, or plans to impose restrictions, the interaction event would be categorised as a *threat*. A threat, in turn, would be classified as an occurrence of verbal conflict. Material conflict, such as a primary actor *reducing relations* would be retrieved based on actions such as cancelling state visits, suspending support, or halting negotiations. Imposing sanctions or a boycott would also fall into this category. Such more specific

classifications are derived from related statements or clarifying verbs, further describing what an actor does, e.g. what kind of sanctions (administrative or economic) are imposed.¹

For instance, a news report featuring the sentence “A French minister threatened today to impose import restrictions against West German goods today as the leaders of the two countries sought to ease tensions in Franco-German relations” would be classified as a sanction threat. Using further information, e.g. actor dictionaries, the type of the primary actor can be identified. In the above example, the primary (sanctioning) actor would be a government, with France as its country affiliation, and Germany would be identified as the secondary actor (who is sanctioned). Governments are one of 24 main and 9 auxiliary “role codes” assigned. The main role codes comprise the various executive branches, and actors from the civil society (health care or education sector, business representatives, media, elites, etc.). These role codes are used to identify various societal groups.

Complementing the two confrontational interaction modes (verbal or material conflict) are those interactions reflecting either verbal or material cooperation. Expressions of intended cooperation or consultations are classified as verbal cooperation. The provision of support, as well as actual economic, military, or judicial cooperation would be classified as material cooperation.

Within the analysed eight-month time horizon (30/12/2021 to 24/08/2022), 4.11 million interaction events have been retrieved where a primary actor from one G20 country interacted with a secondary actor from another G20 country. Amongst these within-G20 interactions, 65.2% (10.2%) were verbal (material) cooperation events, and 12.7% (11.9%) were verbal (material) conflict events. Information on primary actor types (societal groups) was retrieved for 22.7%.

During the eight months of increased international tensions, approximately 8.4% of all recorded interactions classified as material conflict were dedicated to the imposition of sanctions. Sanction threats, on the other hand, were only discussed in 0.8% of all interactions categorised as verbal conflict.

2.2 Quantifying politico-economic interaction dynamics

Using daily media records on interactions of stakeholders from different major economies, politico-economic dynamics are analysed based on the changing patterns of verbal or material cooperation in two ways: (i) an event study, focusing on cooperation dynamics related to the outbreak of hostilities in Ukraine; (ii) an analysis of reciprocal response dynamics accounting for prior interactions, such as threatening or imposing sanctions, embargos or boycotts.

Across the two empirical approaches, cooperation dynamics are represented by day-specific bilateral interaction probabilities of a primary and a secondary actor with different G20 country affiliations. These measures indicate the probability that a documented interaction event (I) on a specific day (t) is of a certain interaction mode (verbal or material cooperation, respectively conflict) for a given actor pair. The implemented probabilities implicitly normalise the underlying event data, such that different levels of representation in the global news sphere and political or media cycles do not distort results.

Two general types of interaction mode probabilities are derived: The first represents the probability that when a primary actor (a_1) engages in a specific interaction mode (m) it is directed at a specific secondary actor (a_2). This measure informs how frequently a secondary actor is exposed to a specific interaction mode originating from a primary actor, relative to other secondary actors. It can be interpreted as a sort of attention probability as it illustrates the fraction of cooperative interactions directed at a certain recipient. It is calculated as

$$P_{a_1,t}(a_2|m) = \frac{I_{a_1 a_2, m, t}}{\sum_{i=2}^{A_2} I_{a_1 a_i, m, t}}$$

where I_m represents the respective number of recorded interaction events of a certain mode.

¹ Administrative sanctions are typically applied by a state and directed at its own citizens, such as banning political parties or restricting political freedoms. These interactions are thus not suitable to evaluate internationally reciprocal patterns of cooperation.

This is complemented by an alternative measure, the substitution probability, which integrates the perspective of the secondary actor. It represents the degree a primary actor substitutes one mode for another when addressing a certain secondary actor, and is derived as

$$P_{a_1,t}(m|a_2) = \frac{I_{a_1 a_2, m, t}}{\sum_{i=1}^M I_{a_1 a_2, m_i, t}}.$$

Both attention and substitution probabilities, focusing on Russia as a secondary actor, are used in the event study. Bilateral substitution probabilities for all country pairs are employed to evaluate reciprocal response dynamics across all G20 members. The respective descriptive statistics are reported in Table A. 1.

2.3 Event study design

Initially, response dynamics are investigated by comparing the prevalence of interaction modes in the two months before and the six months after the outbreak of hostilities between Ukraine and Russia on 24/02/2022. For each of the 19 relevant primary actors (G20 without Russia, G19 for short), daily attention and substitution probabilities related to a certain interaction mode directed at Russia are derived as described above.²

Changing interaction dynamics, based on 7-day moving averages of $P_{a_1}(RUS|m)$, are examined in a graphical event study design.³ This allows an immediate evaluation of shifting levels of attention, such as which countries targeted Russia more frequently when engaging in confrontational interactions.

The analysis of shifting attention is complemented by an event study estimation of substitution probabilities in the aftermath of the conflict outbreak. The following model allows to estimate politico-economic responses, i.e. how actors across countries substituted cooperative with conflict-laden interactions in their dealings with each other:

$$P_{a_1,t}(m|a_2) = \beta_0 + \beta_1 post_t + \sum_{m=1}^M \beta_{2,m} post_t \times mode_{a_1 a_2, m, t} + \mu_A + \mu_M + \varepsilon_{a_1 a_2, m, t} \quad (1)$$

This model is estimated from two perspectives: first, it is employed to estimate how G19 countries alter their interaction patterns when dealing with Russia; then it is used to estimate how Russia may have adapted a less cooperative stance when interacting with any of the G19 countries. In both cases, the respective sample is a balanced panel of size $A \times M \times T = 15,232$, reflecting relevant G19 actors, 4 interaction modes and 238 days.⁴ To compare interaction patterns after the outbreak of open hostilities with those before, and thus to retrieve the magnitude of the change in cooperation, the indicator *post* is equal to one for all days from 24/02/2022 onwards, and zero otherwise. From the G19 (Russian) perspective, μ_A denotes primary (secondary) actor fixed effects on the country-level, and μ_M represents interaction mode fixed effects; ε represents the error term.

A country-level event study model

$$P_{a_1,g,t}(m|RUS) = \beta_0 + \beta_1 post_t + \sum_{g=1}^G \beta_{2,g} post_t \times group_g + \mu_G + \varepsilon_{g,t} \quad (2)$$

examines which societal forces drive the observed dynamics. It estimates country-specific changes in substitution cooperation probabilities with Russia, which may differ across the following major societal groups (G): Government, state (legislature, judiciary), economy (business, multinational companies), society (civilians, elites, opposition), forces (police, military), and services (education, health care, labour, media), as well as a residual group. Sample sizes in the country-level event study amount to $G \times T = 1,666$; μ_G represents group fixed effects.

2.4 Modelling reciprocal responses

Offering a broader perspective on reciprocal patterns of cooperation and sanctions, the second analysis focuses on bilateral cooperation across all G20 economies.

The basic reciprocal response model is

$$P_{a_1,t}(m|a_2) = \beta_0 + \beta_1 P_{a_2 a_1, t}(VC) + \beta_2 P_{a_2 a_1, t}(MC) + \beta_3 P_{a_2 a_1, t}(ST) + \beta_4 P_{a_2 a_1, t}(SI) \\ + \mu_{A_1} + \mu_{A_2} + \mu_t + \varepsilon_{a_1 a_2, t} \quad (3)$$

² The G20 comprises 19 countries plus the European Union. EU members France, Germany, and Italy are also individual G20 members.

³ In the event study, moving averages referring to day t are based on this day's probability and the six previous days' probabilities.

⁴ In the context of the event study, a EU27 aggregate is used. Thus, the overall number of relevant actors is 16.

It estimates the probability to observe present-day cooperative interactions initiated by actor 1 and directed at actor 2, given previous interactions initiated by actor 2 addressing actor 1.⁵ The latter integrates the probability of past verbal cooperation (VC) or material cooperation (MC), and the probability actor 2 threatened actor 1 with sanctions, boycott or embargo (ST) or imposed any of them (SI). All models include country fixed effects on both actor levels (μ_{A_1}, μ_{A_2}) and for each day (μ_t).

Past cooperation probabilities ($P_{a_2 a_1, t}$) are the substitution probabilities introduced in the empirical event study, $P_{a_2}(m|a_1)$, yet differentiating between the interaction modes of verbal and material cooperation.

Sanction-related interactions are integrated in two forms: $P_{a_2}(S|a_1)$ represents the perspective of the sanctioning actor 2 and informs how likely a sanction event occurred when dealing with actor 1. It is calculated as

$$P_{a_2}(S|a_1) = \frac{I_{a_1, a_2, S_1, t}}{\sum_{i=0}^1 I_{a_1, a_2, S_i, t}},$$

with I_{S_1} as daily count of interactions between the two actors which are classified as sanctions, and I_{S_0} as respective non-sanction event count. The perspective of the sanctioned actor 1 is given by

$$P_{a_1}(a_2|S) = \frac{I_{a_1, a_2, S_1, t}}{\sum_{i=2}^{A_2} I_{a_1, a_i, S_1, t}},$$

which shows how likely a faced sanction originates from actor 2.

To account for sluggish politico-economic processes, three definitions of past interactions are evaluated: a one-day lag to capture speedy responses, and seven- or fourteen-day averages representing more deliberate responses. All past interactions, i.e. cooperation and sanction probabilities, apply the same lag procedure in a given specification.

Since the severity of reciprocal responses may depend on the relevance of the other actor, an extension integrates bilateral relevance:

$$\begin{aligned} P_{a_1, t}(m|a_2) = & \beta_0 + \beta_1 P_{a_2 a_1, t}(VC) + \beta_2 P_{a_2 a_1, t}(MC) + \beta_3 P_{a_2 a_1, t}(ST) + \beta_4 P_{a_2 a_1, t}(SI) + \gamma_1 BR \\ & + \gamma_2 BR \times P_{a_2 a_1, t}(VC) + \gamma_3 BR \times P_{a_2 a_1, t}(MC) + \gamma_4 BR \times P_{a_2 a_1, t}(ST) + \gamma_5 BR \times P_{a_2 a_1, t}(SI) \\ & + \mu_{A_1} + \mu_{A_2} + \mu_t + \varepsilon_{a_1 a_2, t} \end{aligned} \quad (4)$$

Bilateral relevance (BR) variables are based on overall bilateral trade in 2020 (OECD, 2022), the total stock of immigrants from one country living in the other (World Bank, 2022), and distance between capitals. To facilitate comparability, they are rescaled to the interval between zero and 100, where 100 reflects the highest observed level of bilateral relevance in the overall sample. A second heterogeneity analysis investigates how different major economic powers react to sanctions.

To demonstrate the robustness of the reciprocal responses analyses, sensitivity analyses evaluate the influence of alternative fixed effect specifications. A fundamental difference in interaction patterns before and after 24/02/2022 are examined in a responsiveness-shift model. The sensitivity analyses conclude by assessing the potential impact of alternative assumptions concerning the functional form of the modelled reciprocal response dynamics.

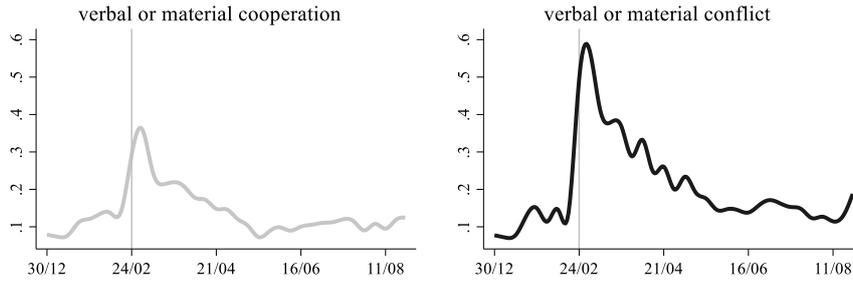
3 Main results

3.1 Event study: Response dynamics by interaction modes

After the conflict broke out, the discourse shifted towards Russia: Across the G19, average attention probabilities of both cooperative and conflict interactions rose. In the seven days from 24/02/2022 onwards, up to 60% of all conflict-laden interactions within G20 states were directed at Russia (Figure 1). Twelve weeks later, the average attention probability was close to the baseline again.

⁵ This also implies that the explanatory variables $P_{a_2 a_1, t}$ are not simply lagged versions of the dependent variable, $P_{a_1 a_2, t}$.

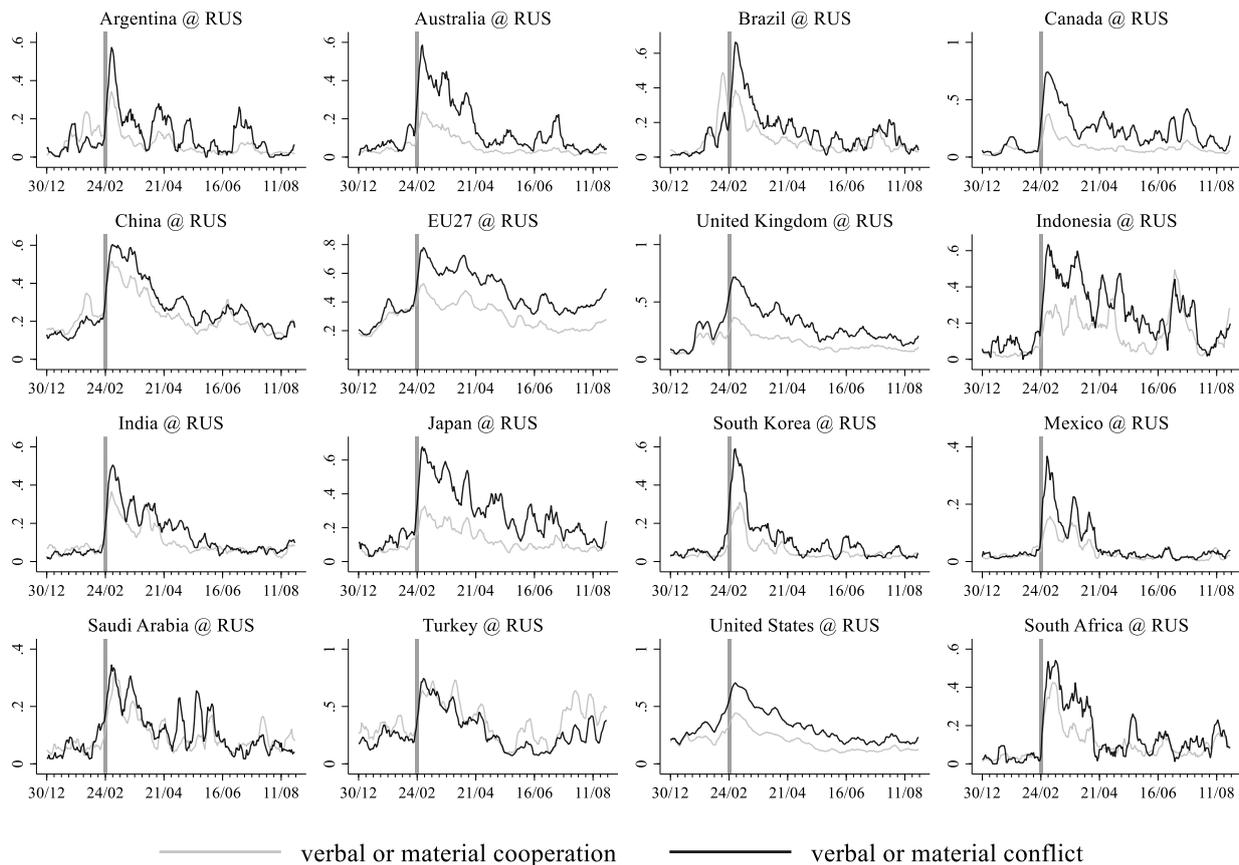
Figure 1: Average predicted attention probabilities $P_{G19}(\text{RUS}|m)$



Note: Predicted attention probabilities are based on a cubic-spline regression with 34 weekly intervals and country fixed effects for the G19 (with the EU27 aggregate).

Yet there are notable differences regarding the attention shift's magnitude and persistence, i.e. how long increased levels of confrontational interactions lasted (Figure 2). EU countries, many of them being geographic neighbours to the conflict, feature not only the strongest attention shift (from 20% to 80%) but also maintain distinctly elevated probabilities of both verbal and material conflict when addressing Russia for a longer time. The United States, the United Kingdom, Australia, and Japan sustain increased, yet gradually diminishing levels of confrontational interactions with Russia.

Figure 2: Observed attention probabilities $P_{a1}(\text{RUS}|m)$



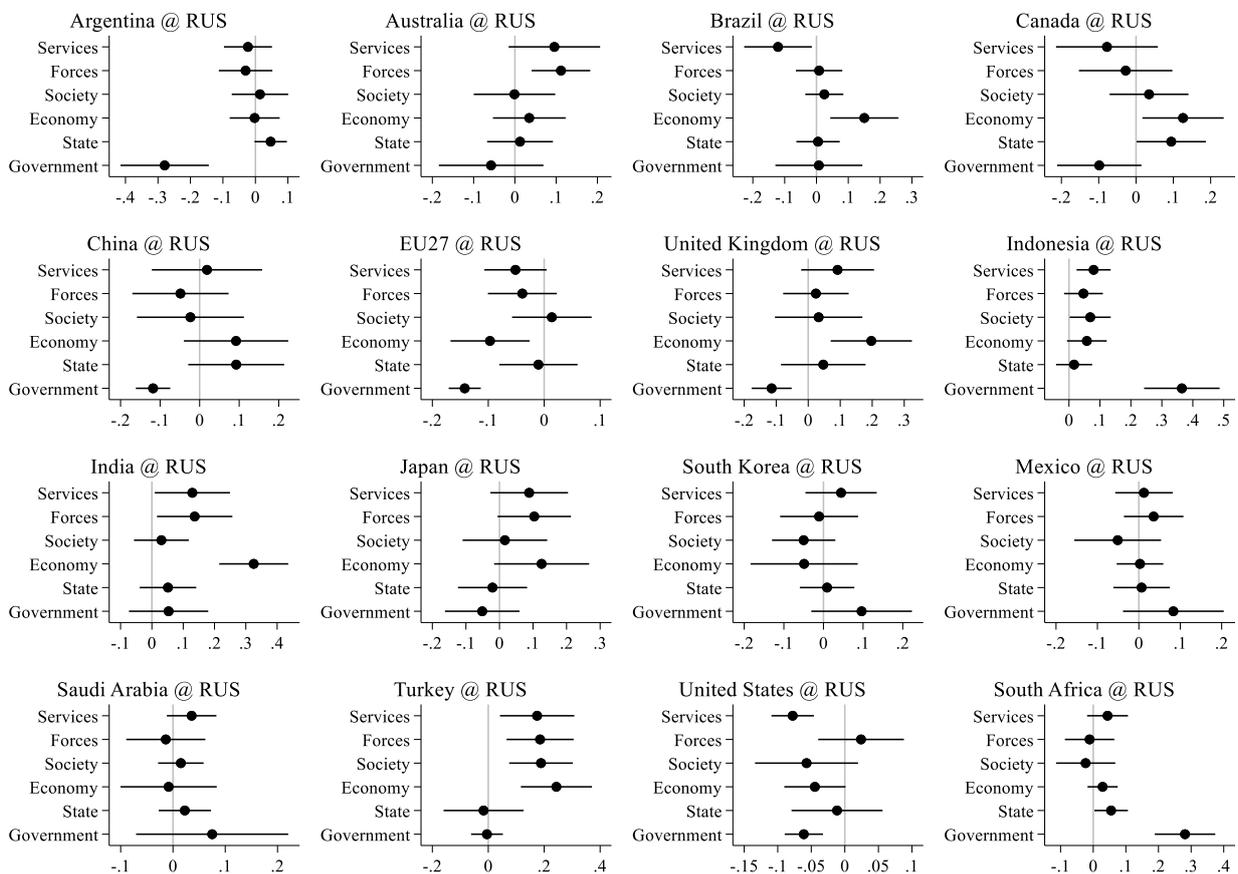
Note: Observed attention probabilities are 7-day moving averages. A value of 0.4 indicates that 40% of all interaction events of a given aggregate interaction mode were directed towards Russia.

Saudi Arabia, Turkey, and to some degree India, also exhibit the familiar pattern of initially elevated attention levels. Most notably, however, there is hardly any difference between cooperative and confrontational interaction probabilities. For some periods in post-conflict months, cooperative interactions were even more frequently re-directed towards Russia than confrontational interactions.

On the aggregate level, G19 countries are 6 percentage points (pp) less likely to engage in verbal cooperation when dealing with Russia since hostilities in Ukraine started (Figure A.1). During these six months, verbal and material conflict became 4 to 4.5 pp more likely. When interacting with G19 states, Russia displays some reciprocity: verbal cooperation declined by 4 pp, and verbal or material conflict interactions increased by 2 and 3.5 pp, respectively. On this aggregate level, not differentiating between G19 countries, the observed cooperation decline in the public discourse seems to reflect predominantly a less frequent exchange of friendly words. In the end, material actions (or the lack thereof) speak louder than words.

A disaggregation of substitution probability dynamics by societal groups in G19 countries highlights the driving forces behind the observed shifts (Figure 3). Irrespective whether cooperation probability increased or decreased, the main drivers are governments. Stakeholders from the economy in the EU display significantly decreased cooperation probabilities. In other EU countries, such as Brazil, Canada, the UK, India, and Turkey, economic stakeholders became more likely to engage in cooperation with Russia. Government representatives of Indonesia and South Africa exhibited a similar response. Compared to the US, where observed cooperative behaviour of government actors declined by 6pp relative to the pre-conflict period, European governments showed with a drop of 14pp a much stronger response.

Figure 3: Cooperation substitution dynamics by societal groups



Note: Substitution dynamics are estimated based on equation 2. Reported marginal effects represent the change of substitution probabilities for $P_{a_1}(VMCoop|RUS)$ in the time since 24/02/2022 compared to the two months prior. 95% confidence intervals are depicted.

These findings reveal notable differences regarding how stakeholders react. Economic interests may have the potential to counteract governmental responses. Yet there are also instances where political and economic responses are aligned. On the global level, and due to potential trade diversion effects of sanctions (Dong and Li, 2018), less cooperation from some countries may be an opportunity for others to fill in. Examining international cooperation represented in the public discourse suggests that such a diversion of cooperation is not necessarily the outcome of a lengthy adjustment process but can manifest rather quickly.

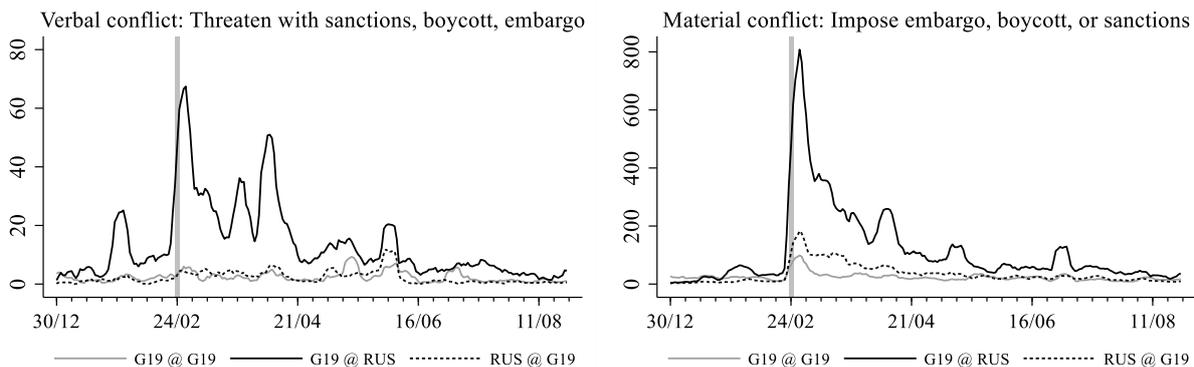
3.2 Reciprocal response analysis: Cooperation and sanctions

Reflecting different political agendas or economic priorities, cooperation patterns between G19 countries and Russia have evolved in a rather diverse fashion. Such country-specific politico-economic heterogeneity is further explored in the subsequent analysis, which evaluates reciprocal responses amongst all G20 countries to experienced cooperation or sanctions in the recent past.

Sanction threats tend to be exchanged regularly between the G20 (Figure 4), and some have been realised. Since late February, however, sanctions directed at Russia have gained centre stage in the public discourse of the 20 major economies.

This is picked up immediately by the GDELT text-mining algorithm, which identified interactions referring to sanction threats or the implementation of sanctions. Identified sanction threats during the first week of open conflict are based on news items, for instance, referring to Germany announcing plans to halt the Nord Stream 2 pipeline project or Poland calling for fiercest possible sanctions against Russia. Corresponding imposed sanctions are extracted from news items listing Russian companies who are denied access to British banks, or news on the US sanctioning a Russian Direct Investment Fund. In addition to these interactions retrieved from English-language news outlets, local non-English news sources also provide relevant information on country-level sanction activities: Czech and Romanian news websites reported their respective country's decision to close their airspace to Russian airlines only two days into the conflict.

Figure 4: Sanction events



Note: Interactions categorised as sanction events are depicted as 7-day moving averages.

The sudden rise of interactions categorised as imposing an embargo, a boycott or sanctions implies a substantial degree of variation, which can be exploited to identify reciprocal response patterns. The sanction variables used in the analysis are the sanction probabilities described in Section 2.4. They not only inform about whether an actor has been recently sanctioned or not, but also how the sanctioning party's activities compare relative to other actors. Responses may differ depending on whether an actor applies sanctions rather sparsely or they constitute a relatively frequent form of interaction.

3.2.1 Reciprocal response dynamics: Baseline results

Evaluating verbal and material substitution cooperation probabilities separately reveals strong reciprocal effects (Table 1): If a primary actor has experienced a one percentage point increased verbal cooperation probability from the secondary actor during the prior seven days, the primary actor becomes 0.5pp more likely to respond in kind by increasing verbal cooperation probability in the present. This reciprocal elasticity amounts to 0.12 in the case of material cooperation. Both verbal and material cooperation probabilities increase more strongly in response to prior cooperation of the same type. Responses to the other form of cooperation are positive, yet much smaller: A one percentage point higher verbal cooperation probability of a secondary actor in the past elicits a 0.04pp increase in a primary actor's material cooperation probability.

Table 1: Reciprocal cooperation and past interactions

Past experienced interactions (A2 @ A1)	Cooperation probability (A1 @ A2)			
	Verbal		Material	
Coop. (material)	0.317*** (0.017)	0.309*** (0.017)	0.125*** (0.010)	0.123*** (0.010)
Coop. (verbal)	0.518*** (0.007)	0.511*** (0.007)	0.040*** (0.004)	0.037*** (0.004)
Sanction imposed	0.036 (0.080)	-0.080*** (0.009)	0.077* (0.046)	-0.031*** (0.005)
Sanction threat	0.247 (0.369)	-0.101*** (0.0121)	-0.017 (0.136)	-0.013** (0.007)
Sanction def.	$P_{a_2}(S a_1)$	$P_{a_1}(a_2 S)$	$P_{a_2}(S a_1)$	$P_{a_1}(a_2 S)$
Obs.	90,440	90,440	90,440	90,440
R^2 (adj.)	0.1863	0.1870	0.0234	0.0236

*** p<0.01, ** p<0.05, * p<0.1

Note: Past experienced interactions reflect averages of the previous seven days. G20 definition is 19 countries plus EU24. Estimations are based on the model represented in equation 3.

Robust and highly significant results emerge for past sanction experiences taking the perspective of the sanctioned party. This probability, $P_{a_1}(a_2|S)$, informs about how likely experienced sanctions originated from a secondary actor. If this 7-day sanction probability increases by 1 pp, verbal (material) cooperation probability decreases by 0.08 (0.03) pp. Corresponding sanction threat experiences also display a negative elasticity: If sanction threat probabilities were one percentage point higher during the past seven days, verbal (material) cooperation becomes 0.1pp (0.013pp) less likely. In times of increasing tensions, implying surging sanction threat probabilities, the overall effect seems to result in a notable and immediate decline in reciprocal cooperation.

To evaluate overall patterns of reciprocal interaction behaviour, verbal and material cooperation events are aggregated. Accounting for different time horizons of politico-economic responses, alternative sanction measures and country-level aggregation, three major results emerge (Table 2 and Table A.2): The strength of reciprocal responses accumulates over time. Elasticities of experienced material cooperation range from 0.15 for the one-day delay, over 0.4 for the past seven days, to about 0.6 accounting for experienced material cooperation over the previous 14 days. Second, estimates based on the sample drawing on the official G20 definition (19 countries, including three EU countries, plus the EU) are highly comparable to those from the specification where all EU countries are included individually (yielding 43 countries in total).⁶

Table 2: Robustness checks (any cooperation, A1 @ A2)

Sanction definition Past experienced interactions (A2 @ A1)	$P_{a_2}(S a_1)$			$P_{a_1}(a_2 S)$		
	1 day	7 days	14 days	1day	7 days	14 days
Coop. (material)	0.152*** (0.008)	0.442*** (0.017)	0.591*** (0.022)	0.149*** (0.008)	0.431*** (0.017)	0.579*** (0.022)
Coop. (verbal)	0.206*** (0.004)	0.557*** (0.007)	0.696*** (0.008)	0.204*** (0.004)	0.549*** (0.007)	0.686*** (0.008)
Sanction imposed	-0.053 (0.048)	0.112 (0.077)	0.248*** (0.088)	-0.075*** (0.005)	-0.111*** (0.009)	-0.097*** (0.010)
Sanction threat	0.094 (0.188)	0.230 (0.369)	-0.145 (0.473)	-0.078*** (0.006)	-0.114*** (0.012)	-0.104*** (0.014)
Obs.	90,440	90,440	90,440	90,440	90,440	90,440
R^2 (adj.)	0.1737	0.2157	0.2316	0.1748	0.2166	0.2322

*** p<0.01, ** p<0.05, * p<0.1

Note: Past interactions over the prior 7 or 14 days are moving averages. G20 definition is 19 countries plus EU24. Estimations are based on the model represented in equation 3.

⁶ Alternative sanction probabilities, reflecting the sanctioning party's perspective when engaging in sanction, $P_{a_2}(a_1|S)$, and the probability an observed sanction is due to a specific primary actor sanctioning a specific secondary actor, $P_S(a_2, a_1)$, reproduce the main results (cf. Table A.2).

The third finding refers to significant positive elasticities in some instances for the measure taking the perspective of the sanctioning party, $P_{a_2}(S|a_1)$. If a secondary actor has been more frequently engaging in sanctioning events when dealing with a primary actor during the past 7 or 14 days, the primary actor becomes more likely to engage in cooperative interactions subsequently.

Apparently, primary actors react negatively to increasing probabilities that a faced sanction originates from a secondary actor, $P_{a_1}(a_2|S)$, yet positively to a rising probability that this actor engaged in sanction activities when dealing with the primary actor, $P_{a_2}(S|a_1)$. At first glance, this seems to be a conundrum.

3.2.2 Heterogeneity analysis: Bilateral relevance, sanction intensity, and differences across economies

The previous analyses implicitly assumed that all actors have the same relevance for each other, e.g. Russia has the same relevance for the EU and South Africa. Economic interdependencies between the EU and Russia, however, may be much stronger than those between South Africa and Russia. Pre-existing bilateral idiosyncrasies, such as geographic distance, trade volume, or social interconnectedness in the form of international migration could result in differing levels of responsiveness of a primary actor.

Bilateral relevance models (based on equation 4) account for these actor-pair-specific conditions and allow to assess their strength as well. As hypothesised, cooperation probability is higher when interacting with a more relevant partner, as indicated by higher bilateral migrant stocks or trade volume (Table 3). Moreover, bilateral relevance models also resolve the above conundrum: For any imposed sanction probability experienced during the prior 14 days, taking the perspective of the sanctioning party, and represented by $P_{a_2}(S|a_1)$, a one-point higher relevance of the sanctioning partner is associated with a 0.08 to 0.28 pp reduced cooperation probability. Higher bilateral trade or migration relevance also features a negative elasticity of 0.17 to 0.19 for any given sanction threat experience features. In the context of sanction probabilities taking the perspective of the sanctioned party, $P_{a_1}(a_2|S)$, significant bilateral relevance effects can be established for imposed sanctions. In the case of distance between capitals, shorter distances would imply a potentially higher relevance due to closer social, economic, or historic entanglement. Here, the observed effects are generally in line with those for trade and migration specifications, albeit somewhat smaller.

Table 3: Reciprocal cooperation and Bilateral Relevance (BR)

Sanction definitions	$P_{a_2}(S a_1)$			$P_{a_1}(a_2 S)$		
	BR: migration	BR: trade	BR: distance	BR: migration	BR: trade	BR: distance
BR	1.704*** (0.136)	0.912*** (0.086)	0.174*** (0.025)	1.730*** (0.134)	1.154*** (0.092)	0.186*** (0.025)
Coop. (mat.) × BR	-0.019*** (0.003)	-0.008*** (0.002)	0.001 (0.001)	-0.019*** (0.003)	-0.011*** (0.002)	0.001 (0.001)
Coop. (verb.) × BR	-0.023*** (0.002)	-0.013*** (0.001)	-0.002*** (0.000)	-0.023*** (0.002)	-0.016*** (0.001)	-0.002*** (0.000)
SI × BR	-0.277*** (0.022)	-0.083*** (0.012)	-0.015*** (0.004)	-0.001* (0.001)	-0.002*** (0.000)	0.000 (0.000)
ST × BR	-0.189** (0.077)	-0.166*** (0.048)	-0.040** (0.020)	-0.001 (0.001)	0.001 (0.001)	-0.002** (0.001)
Obs.	90,440	90,440	90,440	90,440	90,440	90,440
R^2 (adj.)	0.2323	0.2323	0.2334	0.2367	0.2329	0.2342

*** p<0.01, ** p<0.05, * p<0.1

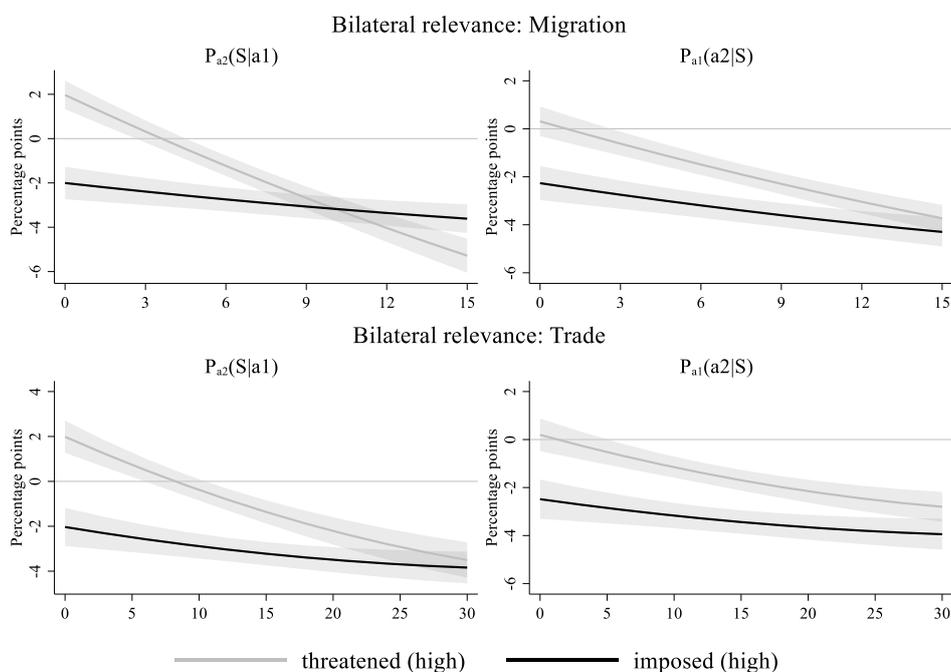
Note: Estimations are based on the model represented by equation 4, including non-interacted past interaction probabilities, and the full set of actor and time fixed effects. Past interactions are measured as moving averages of the prior 14 days.

To allow a direct comparison of effects across the range of the bilateral relevance variables, a modified bilateral relevance model estimates how sanction intensity (compared to other actors) plays a role in shaping reciprocal

cooperation probability.⁷ The underlying sanction probabilities are converted into binary variables, which indicate if the previously experienced sanction probability associated with the actions of a given secondary actor are low (at the mean or below), or high (above the mean). These binary relative intensity indicators, as well as the past experienced verbal and material cooperation probabilities, are interacted with a respective bilateral relevance variable and its square. The latter introduces potential non-linear dynamics over the range of the bilateral relevance variables.

Low sanction activities seem to pay off, respectively above-average relative sanction activities may come at a price: With the exemption of secondary actors of very low bilateral relevance, high sanction threat probabilities in the past 14 days are associated with a diminished reciprocal cooperation probability from the sanctioned actor (Figure 5). For most relevant secondary actors, i.e. those around the 95th percentile of bilateral relevance, this effect varies between -2.5 and -5pp. An unambiguous picture emerges across sanction definitions and measures of bilateral relevance for secondary actors showcasing high probabilities of having imposed sanctions: They can expect cooperative behaviour from the sanctioned party to decline, irrespective of their relevance in terms of social or economic interconnectedness. Approaching the 95th percentile of bilateral relevance, the observed reciprocal responses from the primary actor tend to reach their maximum strength, corresponding to a 4pp drop in cooperation probability, compared to secondary actors engaging in below-average sanctioning activities.

Figure 5: Sanction intensity and bilateral relevance



Note: To account for the skewness of the bilateral relevance variables, marginal effects are derived up to the 95th percentile of a respective bilateral relevance variable, depicted at the horizontal axes.

Actors are differentiating with respect to who sanctions them and how intensively these sanction activities are compared to other actors. Another question pertaining to heterogeneous response patterns revolves around overall differences in reciprocal responses between major G20 players when facing comparable sanction activities. More specifically, this analysis is conducted in two versions: In a first approach, it differentiates between the responses of a major economy to sanction events initiated by all other actors. The second version investigates how

⁷ The available GDELT classifications do not allow a further robust qualitative differentiation of sanctions. Whilst the algorithm offers information on what actors have been sanctioned, such as elites (oligarchs) or businesses (Gazprom), the exact details remain often unclear in the public discourse or are paraphrased. Financial sanctions, for instance, can range from being banned from access to investment opportunities to having all assets frozen. Adding more detail on the type of imposed sanctions from alternative sources may allow further refined analyses yet will add some analytical delay.

all other actors respond to sanction events initiated by a major economy. The results are reported for the 10 largest G20 economies in terms of GDP.

All major economies but Russia display significantly reduced cooperation probabilities in response to higher experienced probabilities of imposed sanctions during the 14 days before (Table 4, top panel). Increased experienced sanction threat probabilities elicit a significant negative response only in the case of the USA, the UK, or Russia.⁸

Table 4: Heterogeneous responsiveness across major economies

Past experienced interactions (A2 @ A1)	USA	CHN	EU27	JPN	IND	GBR	CAN	BRA	RUS	KOR
	Major economy's responsiveness to sanction events initiated by other actors									
Sanction imposed	-0.028 (0.019)	-0.144*** (0.028)	-0.073*** (0.024)	-0.131*** (0.046)	-0.056 (0.046)	-0.130*** (0.030)	-0.213*** (0.056)	-0.130 (0.143)	0.174*** (0.047)	-0.241*** (0.067)
Sanction threat	-0.087*** (0.019)	-0.024 (0.062)	-0.015 (0.016)	-0.221 (0.200)	0.339 (0.252)	-0.164*** (0.048)	-0.007 (0.240)	0.505 (0.340)	-0.122*** (0.034)	0.182 (0.284)
	Other actors' responsiveness to sanction events initiated by major economy									
Sanction imposed	-0.018 (0.017)	-0.007 (0.046)	-0.115*** (0.024)	-0.205 (0.181)	-0.636 (0.542)	0.229*** (0.077)	0.015 (0.167)	0.519 (2.104)	-0.014 (0.027)	0.277 (0.261)
Sanction threat	0.059*** (0.022)	-0.112 (0.076)	-0.041 (0.031)	0.707** (0.3077)	-0.780 (0.713)	0.032 (0.117)	0.062 (0.252)	-5.141 (3.950)	0.006 (0.020)	-0.210 (0.394)
Obs.	3,808	3,808	3,808	3,808	3,808	3,808	3,808	3,808	3,808	3,808

*** p<0.01, ** p<0.05, * p<0.1

Note: Sanction definition is $P_{a_1}(a_2|S)$, taking the perspective of the sanctioned actor. Past 14-day cooperative interaction probabilities, and feasible actor and day FE included.

When one of the 10 largest economies acts as sanctioning party, only elevated sanction threat probabilities originating from the USA or Japan seem to translate into higher levels of cooperation by the sanctioned actor (Table 4, bottom panel). A positive reciprocal cooperation elasticity for higher experienced imposed sanction probabilities emerges only for the UK as sanctioning party. For the EU, a more frequent imposition of sanctions is associated to significantly reduced cooperation probability by the sanctioned actor. If an actor faced a ten-percentage point higher probability that an experienced imposed sanction originated from the EU, the observed reciprocal cooperation probability would decline by 1.15pp.

When it comes to eliciting cooperation from major economies by imposing sanctions more frequently, the affected side may not react in a cooperative manner. Being a major economy insulates from the need to accommodate the sanctioning party in the short to medium-term. Overall, there is rather limited evidence that increasing politico-economic pressure by imposing sanctions may be used as a universal tool to spur cooperation in a timely fashion.

4 Sensitivity analyses

4.1 Alternative fixed effects specifications

As the event study demonstrated, attention probabilities spiked in the beginning and then in some subsequent weeks. Whereas general unobserved week-specific patterns would have already been absorbed by the previously employed day fixed effects, actors' behaviour may have displayed week-specific variation too. To account for this possibility, actor-by-week fixed effects are explored as well. In addition to observable country-pair-specific factors, such as bilateral relevance, other unobserved bilateral factors may potentially impact estimates of reciprocal cooperation. To absorb all time-constant bilateral idiosyncrasies, the basic reciprocal response model is also re-estimated implementing a full set of bilateral fixed effects.

Modelling unobserved heterogeneity to manifest on the week-level instead the day-level does replicate the baseline results (Table A.4, column 2). The same is observed for the specification modelling actor-specific patterns varying over weeks. Implementing the full set of bilateral fixed effects, with either date or week fixed effects,

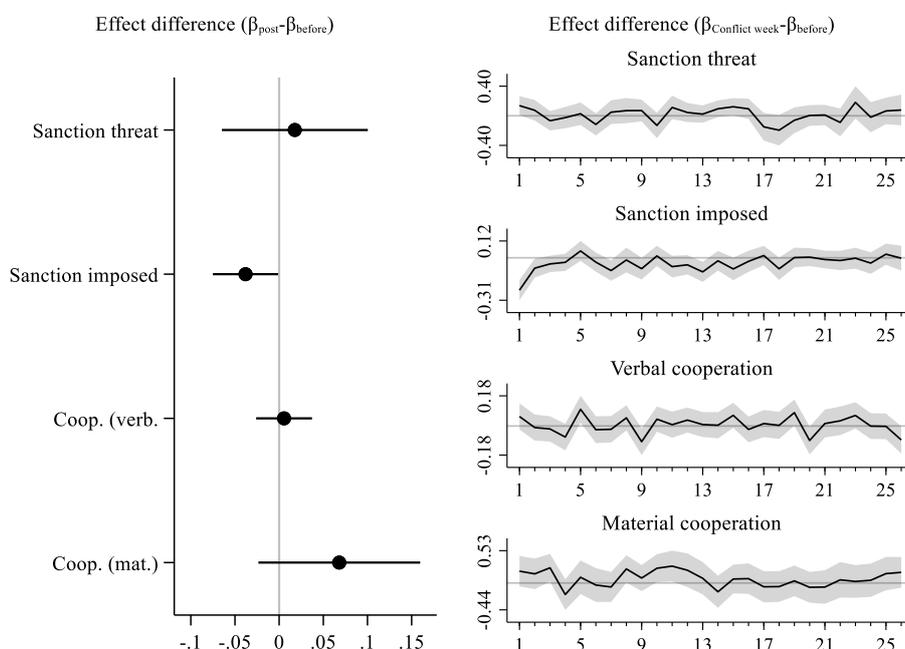
⁸ A disaggregation between verbal and material cooperation probabilities as outcome for Russia, China, the European Union, and the United States can be found in Table A.3.

generates reciprocal cooperation estimates which are still highly significant yet notably smaller in size. The reduction in the effect size for having been more frequently the target of imposed sanctions is less distinct, i.e. it still amounts to 70% of the initially established effect.

4.2 Modelling fundamental responsiveness shifts

Politicians and security experts around the world referred to the outbreak of open warfare on 24/02/2022 as historical turning point (Bunde and Eisentraut, 2022). This suggests that interactions between (some) G20 members may have fundamentally changed in the months after the start of the conflict. To evaluate whether interaction patterns reflect such a turning point, triggered by an unforeseen external shock, the reciprocal response model is re-estimated allowing coefficient estimates to differ across time. In a first model, all past experienced cooperation and sanction probabilities are interacted with a binary indicator (post), differentiating between the period after and the period before 24/02/2022. In an alternative responsiveness-shift model, past experienced cooperation and sanction probabilities are interacted with a conflict week indicator, which is one for the first week of conflict, two for the second, and so on. Here, the reference group are the eight weeks before the outbreak of open warfare.

Figure 6: Responsiveness shifts



Note: Sanction definition is $P_{a_1}(a_2|S)$, i.e. the sanctioned party's perspective. Marginal effects with 95% confidence intervals are displayed. The sample size is 90,440.

Whereas interaction patterns have changed, as suggested by the event study, the elasticities of reciprocal responses to past experiences appear to be a more stable phenomenon (Figure 6). Only primary actors' responsiveness to experienced imposed sanction probabilities after 24/02/2022 is significantly different from their responsiveness before (at the 5% significance level). The corresponding analysis differentiating across conflict weeks reveals that this difference is attributable to the first two weeks of conflict. During this time, primary actors with higher experienced past imposed sanction probabilities reduced their cooperation probabilities more strongly than before in response to similar sanction activities.

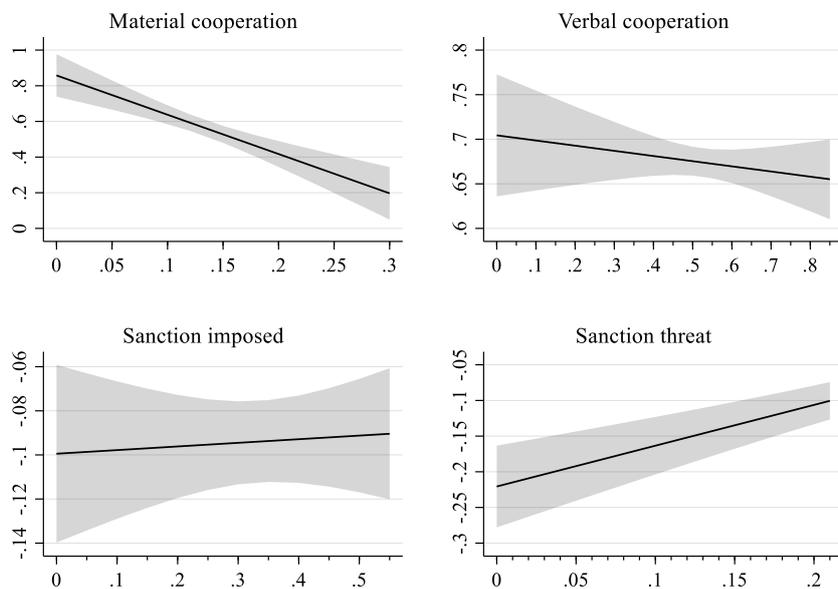
Whilst the outbreak of open hostilities may delineate a turning point in risk perception and security threat assessment, there is little to no short to medium-term evidence that the fundamental reciprocal dynamics have changed. Internationally active actors still reciprocate levels of experienced cooperation (positively) and sanctions (mostly negatively) – just as they did before.

4.3 Alternative functional forms: Non-linearities of reciprocal responses

In the heterogeneity analysis, estimated effects of past experienced cooperation or sanction probabilities were modelled to vary depending on a secondary actor's relevance. The underlying assumption was that reciprocal responses to past interactions of a more relevant secondary actor may provoke stronger responses from the primary actor. The effects of incremental changes in experienced cooperation or sanction probabilities, however, were assumed to be constant across all levels of past experiences: Rising experienced cooperation probabilities at an already high level would implicitly have the same impact as the same cooperation probability increase at a very low level.

This assumption is relaxed by a modification of the basic reciprocal response model. In addition to a linear effect of each past experienced cooperation or sanction probability, a square-term of each probability models non-linear effects.

Figure 7: Marginal reciprocal effects of past experienced cooperation and sanctions



Note: Sanction definition is $P_{a_1}(a_2|S)$, i.e. the sanctioned party's perspective. Marginal effects with 95% confidence intervals are derived up to the 99th percentile of a respective experienced cooperation or sanction probability during the past 14 days, as depicted on the horizontal axes. The sample size is 90,440.

Eventually, notable non-linearities can be detected for past material cooperation and sanction threat probabilities (Figure 7). For low levels of experienced material cooperation, e.g. 5%, a one percentage point increase in material cooperation probability is associated with an elasticity of 0.75. In the case of high levels of experienced past material cooperation, around 25%, the corresponding elasticity shrinks to 0.3. The strongest reciprocal responses can thus be found for periods and secondary actors with a low propensity to engage in material cooperation. Reciprocal negative responses to increasing sanction threat probability during the prior 14 days diminish in strength over the range of experienced sanction threats. If a sanctioning secondary actor increases their sanction threat activity from an already high level, cooperation from the primary actor will shrink less intensively than it would in a scenario where sanction threats were exchanged rather infrequently.

The interpretation of these results hinges, eventually, on the assumption that potentially existing non-linearities can be adequately captured within the context of a parametric estimation technique, such as OLS. Employing non-parametric kernel estimation, questions regarding the results' sensitivity concerning the misspecification of the model's functional form can be further investigated.⁹

⁹ The cross-validation and bootstrap procedures, required to obtain kernel bandwidths and conduct statistical inference, are computationally extremely challenging in a dataset with more than 90,000 observations. Even in a subset of only four major players, a simple model with week fixed effects took over 24 hours to complete with Stata 16.1. More complex specifications, representing non-linearities in a more precise

5 Conclusion

Cooperation between major G20 countries is highly reciprocal: Verbal and material cooperation become more likely after having experienced the respective cooperation in the recent past. Sanction threats or implementations, however, are typically not followed by increased cooperation from the sanctioned side in the short term. Relatively more intensive sanction experiences, or those originating from particularly relevant countries, may even elicit a more defiant stance from the sanctioned party. Concomitantly, cooperation may be redirected towards actors less actively involved in sanctioning.

Eventually, this research suggests another potential mechanism, beyond rally-around-the-flag effects or low political costs, to understand the previously documented limited effectiveness of sanctions: There could be important trade-offs between achieving desired politico-economic goals and short-term dynamics in international transactions. In the short to medium-term, higher levels of sanctioning activities may lead two interacting parties onto a negative reciprocal path, where cooperation levels continue to decline in a broader sense. It may take a while, possibly much longer than just a few months, for this cooperation degradation to fade away. Only then would it be possible to leave this path of negative reciprocity. Neither achieving a sanction's goal, nor re-establishing effective international cooperation amongst major economies, should be seen as something that can be achieved over a fortnight. Instead, it is more likely that sanction activities may constitute important negative externalities to be measured in lost cooperation between societal groups from various major economies.

Employing a continuous, near-real-time monitoring of international cooperation patterns, however, may help to overcome the emerging patterns of negative reciprocity in the meantime. If that proves to be infeasible, such a monitoring will at least allow to integrate the related externalities more immediately into political and economic decision-making processes.

manner, are thus hardly feasible. A comparison of results from the feasible kernel regressions with those from corresponding OLS estimations reveals closely aligned results.

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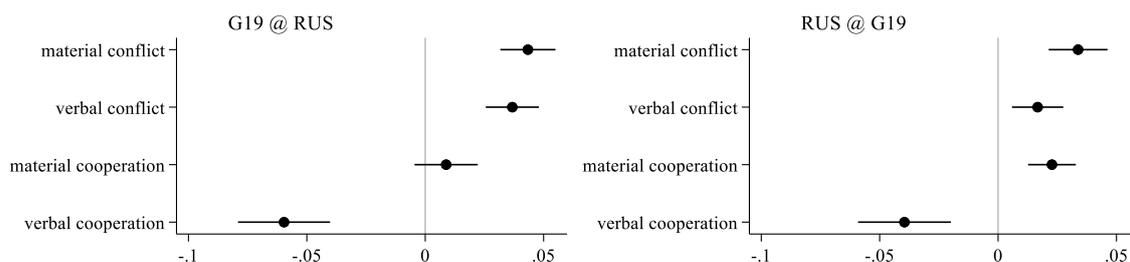
Appendix

Table A. 1: Variable overview and descriptive statistics

Variable	Description	N	min	max	mean	95 th pctile	std. dev.
Reciprocal responses (A1 @ A2)	Outcome variables, informing how primary actor responds to secondary actor today						
Verbal or material cooperation	Substitution probability, $P_{a_1,t}(VMCoop a_2)$	90,440	0	1	0.674	1	0.353
	Attention probability, $P_{G19(EU24),t}(RUS VMCoop)$	3,808	0	0.840	0.139	0.413	0.126
Verbal cooperation	Substitution probability, $P_{a_1,t}(VCoop a_2)$	90,440	0	1	0.576	1	0.345
Material cooperation	Substitution probability, $P_{a_1,t}(MCoop a_2)$	90,440	0	1	0.099	0.429	0.173
Verbal or material conflict	Attention probability, $P_{G19(EU24),t}(RUS VMConf)$	3,808	0	0.881	0.205	0.602	0.191
Past experiences (A2 @ A1)	Explanatory variables, representing how secondary actor interacted with primary actor in the past (14-day moving average)						
Verbal cooperation	Substitution probability, $P_{a_2,t}(VCoop a_1)$	90,440	0	0.960	0.576	0.796	0.187
Material cooperation	Substitution probability, $P_{a_2,t}(MCoop a_1)$	90,440	0	0.524	0.099	0.205	0.061
Sanction imposed	Sanctioning actor's perspective, $P_{a_2}(SI a_1)$	90,440	0	0.242	0.003	0.018	0.012
	Sanctioned actor's perspective, $P_{a_1}(a_2 SI)$	90,440	0	0.900	0.028	0.155	0.093
Sanction threat	Sanctioning actor's perspective, $P_{a_2}(ST a_1)$	90,440	0	0.146	0.000	0.001	0.003
	Sanctioned actor's perspective, $P_{a_1}(a_2 ST)$	90,440	0	0.821	0.008	0.063	0.040
Bilateral relevance	Rescaled measure, indicating how important secondary actors are for primary actors (100 corresponds to highest in-sample relevance)						
Migration	Total number of migrants from one actor's country living in the other in 2000 and vice versa, divided by the respective maximum	190	0	100	2.789	11.733	9.015
Trade	Total bilateral trade volume (imports plus exports) in 2020, divided by the respective maximum	190	0.038	100	4.892	27.268	11.283
Distance	Distance between capitals, divided by the maximum, reverse scaling such that 100 corresponds to the closest pair	190	0	98.651	55.797	94.052	22.974

Note: Reported descriptive statistics typically refer to the G20 definition, including 19 individual member states and the European Union (integrated as the EU24 aggregate without the individually represented members Germany, France, and Italy). Sample size N refers to unique observations on the $A1 \times A2 \times T$ level.

Figure A.1: Interaction mode substitution



Note: Results are based on equation 1. Reported marginal effects represent the change of substitution probabilities for $P_{a_1}(m|a_2)$ in the time since 24/02/2022 compared to the two months prior. 95% confidence intervals are depicted.

Table A.2: Robustness checks for alternative G20 and sanction definitions (any cooperation, A1 @ A2)

G20 def. Sanction def.	43 countries						19+EU	19+EU
	$P_{a_2}(S a_1)$			$P_{a_1}(a_2 S)$			$P_{a_2}(a_1 S)$	$P_S(a_2, a_1)$
Past experienced interactions (A2 @ A1)	1 day	7 days	14 days	1day	7 days	14 days	7 days	7 days
Coop. (material)	0.192*** (0.004)	0.545*** (0.009)	0.666*** (0.011)	0.191*** (0.004)	0.543*** (0.009)	0.665*** (0.011)	0.433*** (0.017)	0.433*** (0.017)
Coop. (verbal)	0.228*** (0.002)	0.598*** (0.003)	0.725*** (0.003)	0.227*** (0.002)	0.596*** (0.003)	0.723*** (0.003)	0.551*** (0.007)	0.550*** (0.007)
Sanction imposed	0.048 (0.030)	0.184*** (0.058)	0.382*** (0.072)	-0.065*** (0.006)	-0.085*** (0.008)	-0.068*** (0.009)	-0.046*** (0.010)	-0.585*** (0.047)
Sanction threat	0.193** (0.076)	0.571*** (0.182)	0.746*** (0.248)	-0.085*** (0.010)	-0.135*** (0.015)	-0.133*** (0.018)	-0.086*** (0.009)	-0.121*** (0.034)
Obs.	429,828	429,828	429,828	429,828	429,828	429,828	90,440	90,440
R^2 (adj.)	0.3125	0.3575	0.3703	0.3127	0.3576	0.3703	0.2161	0.2162

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Note: Past interactions over the prior 7 or 14 days are moving averages. Estimations are based on the model represented in equation 3. The 43-countries specifications include all individual G20 member states plus the 24 EU countries not being individual members.

Table A.3: Heterogeneous responses of major economies to sanction events initiated by other actors

Past experienced interactions (A2 @ A1)	EU27		USA		CHN		RUS		Other G20	
	Verbal	Material	Verbal	Material	Verbal	Material	Verbal	Material	Verbal	Material
Sanction imposed	-0.112*** (0.028)	0.039** (0.016)	-0.061*** (0.023)	0.033*** (0.011)	-0.163*** (0.030)	0.019 (0.019)	0.189*** (0.051)	-0.015 (0.025)	-0.079*** (0.015)	-0.032*** (0.009)
Sanction threat	-0.043** (0.017)	0.027*** (0.011)	-0.040* (0.022)	-0.047*** (0.012)	-0.048 (0.069)	0.024 (0.044)	-0.109*** (0.035)	-0.013 (0.018)	-0.031 (0.047)	-0.032 (0.024)
Obs.	3,808	3,808	3,808	3,808	3,808	3,808	3,808	3,808	49,504	49,504

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Note: Sanction definition is $P_{a_1}(a_2|S)$, taking the perspective of the sanctioned actor. Past 14-day cooperative interaction probabilities, and feasible actor and day FE included.

Table A.4: Reciprocal overall cooperation for various FE specification

Past experienced interactions (A2 @ A1)	Baseline				
	(1)	(2)	(3)	(4)	(5)
Coop. (mat.)	0.579*** (0.022)	0.579*** (0.022)	0.591*** (0.023)	0.096*** (0.026)	0.094*** (0.026)
Coop. (verb.)	0.686*** (0.008)	0.684*** (0.008)	0.697*** (0.008)	0.191*** (0.014)	0.189*** (0.014)
Sanction imposed	-0.097*** (0.010)	-0.097*** (0.010)	-0.091*** (0.011)	-0.069*** (0.010)	-0.069*** (0.010)
Sanction threat	-0.104*** (0.014)	-0.106*** (0.014)	-0.105*** (0.015)	-0.017 (0.015)	-0.019 (0.014)
Obs.	90,440	90,440	90,440	90,440	90,440
FE specification	A1, A2, date	A1, A2, week	A1 by week, A2 by week	A1 by A2, date	A1 by A2, week
FE number	276	72	1,326	617	413

*** p<0.01, ** p<0.05, * p<0.1

Note: Sanction definition is $P_{a_1}(a_2|S)$, i.e. the sanctioned party's perspective. Past experienced interactions are 14-day moving averages. G20 definition is 19 countries plus EU24. Estimations are based on the model represented in equation 3, yet with modified fixed effects.