

# The ties that bind global governance: Using media-reported events to disentangle the global interorganizational network in a global pandemic

Ryan Federo<sup>a,\*</sup>, Xavier Bustamante<sup>b</sup>

<sup>a</sup> Universitat de les Illes Balears, Campus Cra, Valldemossa, Km 7, 07122 Palma de Mallorca, Spain

<sup>b</sup> Universitat Politècnica De Catalunya, Carrer Jordi Girona 31, 08034 Barcelona, Spain

## ARTICLE INFO

### Keywords:

Global interorganizational network  
Grand challenges  
Theory of networks  
COVID-19  
Network analysis  
GDELT

## ABSTRACT

This article disentangles the global interorganizational network by analyzing the ties of international actors – comprising multinational companies, intergovernmental organizations, and international nongovernmental organizations. The onset of COVID-19 is a rare opportunity to explore how this network has evolved in an exogenous event. Using a unique GDELT big dataset of events reported by the world's media, we extract and analyze the interorganizational interactions of international actors before and after the World Health Organization (WHO) announced that the COVID-19 outbreak was a public health emergency of international concern. Adopting an exploratory and descriptive approach at multiple levels of analysis, we draw on the theory of networks to uncover the fragmented, polycentric, and complex characteristics of the global interorganizational network. Our study highlights the use of media-reported events and the Goldstein scale as means to unpack the difficult-to-capture relational dynamics of international actors, which can help in theory development of the global interorganizational network that is crucial for collective action to address societal grand challenges.

## 1. Introduction

Global governance is traditionally in the realm of the public sector, whereby different state actors typically formalize a network of cooperation through intergovernmental organizations (IGOs) to deliver global public goods (Federo et al., 2020). In our current world with increasing interconnectedness of actors who face grand challenges that often affect both private and public interests (George et al., 2016), multinational companies (MNCs as the private sector) and international non-governmental organizations (NGOs as the third sector) have also become important players of global governance and value creation (Abbott, 2012; Teegen et al., 2004). This is because finding solutions to society's most pressing issues that transcend national jurisdictions require cross-sectoral collective action, since the private, public, and third sectors may lack the capacity to do so independently (Doh et al., 2019). Given the non-excludability and large scale of grand challenges, the global interorganizational network of MNCs, IGOs, and NGOs is well-positioned to spearhead global governance and value creation because these networked actors have the inherent international presence, resources, and competencies to effectively facilitate collective action (Teegen et al., 2004).

Understanding the global interorganizational network has become crucial as the rapid spread of the coronavirus disease (COVID-19) evolved into a global pandemic that continues to claim lives worldwide. A global pandemic is a distinctive type of societal grand challenge that results in an instantaneously spreading catastrophe. In contrast to other grand challenges (e.g., economic crisis, poverty, climate change, and biodiversity loss) where the starting point is hard to determine and that typically evolve and affect societies over time, a global pandemic has an identifiable inception point and causes an extensive shock that immediately disrupts daily activities and the wellbeing of the general populace. Unlike other previous health crises such as the H1N1 pandemic and the Ebola virus epidemic, which were detected relatively earlier and controlled faster, COVID-19 has been characterized by numerous waves of infections and lockdowns in many different countries.

Consequently, COVID-19 has not only become an international public health emergency but has also developed into a global political and economic crisis that requires multi-sectoral collective action transcending national borders (c.f., Doh et al., 2019; Hitt et al., 2021; Ostrom, 2004). In fact, the 2021 Global Risks Report of the World Economic Forum ranks infectious diseases (e.g., COVID-19) as first in the category of global risk in terms of their impact on society and fourth

\* Corresponding author.

E-mail addresses: [ryan.federo@uib.es](mailto:ryan.federo@uib.es) (R. Federo), [xavier@bustawin.com](mailto:xavier@bustawin.com) (X. Bustamante).

<https://doi.org/10.1016/j.socnet.2022.02.012>

Received 18 August 2021; Received in revised form 13 February 2022; Accepted 18 February 2022

Available online 24 February 2022

0378-8733/© 2022 The Authors. Published by Elsevier B.V. This is an open access article under the CC BY license (<http://creativecommons.org/licenses/by/4.0/>).

in terms of their likelihood to occur. Although a global pandemic is an unfortunate event, the current catastrophic times highlight the salience of unpacking how actors interact with each other, forming the ties in the global interorganizational network that is expected to take charge of addressing and resolving the grand challenge. A relational view of the actors and the network formed between them is important because it can be crucial for mitigating collective action problems that typically underlie pluralistic efforts to deliver public goods (e.g., [Diani and McAdam, 2003](#); [Ostrom and Ahn, 2009](#)).

Up to now, much of the literature focuses on the subset interorganizational networks of these international actors – i.e., MNC collaborations with several actors from other sectors (e.g., [Olsen et al., 2016](#); [Perez et al., 2019](#)), NGO partnerships with other non-profit organizations (e.g., [Atouba and Shumate, 2010](#); [Murdie, 2014](#)), and multiple joint programs of IGOs (e.g., [Gest and Grigorescu, 2010](#); [Kapucu and Beaudet, 2020](#)). As a result, we still know little about the architecture of the interorganizational network of all international actors who are responsible for global governance ([Kim, 2020](#)). This motivates our empirical exercise to answer the research questions: how do we capture the interactions of international actors and how are such interactions interconnected to constitute the global interorganizational network before and during an ongoing global pandemic?

To do so, we use a unique dataset from the Global Database of Events, Language, and Tone (GDELT) Project, which compiles all media-reported events that show the interactions between any actors worldwide. GDELT contains trillions of data points that exceed the processing capacity of conventional database systems, and thus referred to as big data ([Dumbill, 2012](#)). From such big data, we specifically extract the media-reported interactions of international actors to analyze the properties of the global interorganizational network before and after the World Health Organization's (WHO) announcement of the COVID-19 outbreak as a public health emergency of international concern. Given the difficulty in capturing all the interactions between international actors, media-reported events can offer a preliminary snapshot of the relational dynamics of any actors worldwide. Adopting an exploratory and descriptive approach at multiple levels of analysis, we find three interesting insights regarding the global interorganizational network in the context of a rare exogenous shock (i.e., global pandemic).

First, at the network level, we find that the number of media-reported interactions (both cooperative and conflictive) within the network had a downward trend, which continued until the development and distribution of the COVID-19 vaccine. In contrast, the degree of cooperation between the actors had an increasing trend before COVID-19 and has shifted to a downward trend during the global pandemic. These findings suggest the importance of simultaneously accounting for the number and the degree of cooperation between actors to gain a nuanced understanding of the relational dynamics between the actors comprising the global interorganizational network. Moreover, as we mapped the interactions between actors, we find that the network is fragmented and shows an evident divide between the nonprofit and for-profit sectors, which persists from before to during the global pandemic.

Second, at the dyad level, we find that the world media reports international actors to behave differently with other actors during a global pandemic. Using the Goldstein scale to identify the type of interactions and degree of cooperation between actors ([Goldstein, 1992](#)), our analysis uncovers that intra-sectoral interactions are seen as more cooperative on average than inter-sectoral dyads, in terms of the number of interactions and the degree of cooperation. Moreover, interactions between IGOs seem to have both the highest number of cooperative interactions and the greatest degree of cooperation. Meanwhile, although MNC-MNC dyads have the highest number of conflictive interactions, the interactions between MNCs and IGOs have the lowest degree of cooperation. In addition, we find that the global interorganizational network consists of multiple sub-groups among similar actors, thus suggesting a polycentric characteristic of the network. This evidence supports the tenet of homophily, the principle suggesting that “birds of a

feather flock together” ([McPherson et al., 2001](#)), which has continued through the global pandemic.

Third, at the ego level, we find that few actors consistently remain central in the network and there is no clear leader driving the entire network. The European Union (EU) and the United Nations (UN) rank high, in terms of strength of ties, number of connections, and influence in the network throughout the period of interest of this study. In a similar vein, several large technology firms (e.g., Google, Microsoft, and Samsung) are consistently on the top of the list. As expected, the WHO emerged as among the most central actors during the pandemic, along with AstraZeneca and Pfizer, which are the prominent organizations responsible for the distribution of COVID-19 vaccines. Surprisingly, despite that NGOs barely made it to the list of central actors in the network in terms of number of interactions and extent of influence, several of these NGOs rank high in terms of the number of connections within the network. These results ultimately suggest that the network is highly concentrated on the “usual suspects” of the international arena.

Our study offers two main contributions. First, it presents novel insights into the global interorganizational network vis-à-vis the interactions between international actors whilst a global pandemic unfolds. By examining and mapping how international actors interact with each other over time, we uncover the multi-level properties of the global interorganizational network. Simultaneously analyzing the different levels of network properties emphasizes the use of the theory of networks to explain such a network's structure, dynamics, and evolution. Second, our study demonstrates the prospect of using big data from worldwide media reports to generate interesting discoveries about the patterns of organizational behavior in society. Our empirical data comes from GDELT, which is a unique dataset to capture networks of actors worldwide and can offer a source of information for future studies. In addition, our study uses the Goldstein scale to obtain a more refined classification of interorganizational interactions that constitute networks than the conventional categorization of interactions (i.e., conflict, neutral, and cooperation). These contributions have important implications for theory development of the global interorganizational network and our understanding of collective action that is vital for addressing and adapting to a global pandemic, as well as grand challenges in general.

## 2. Analytical framework

Much of the extant research on the global interorganizational network focuses on the effects of networks on the network members. However, we still know little about what this network looks like and why it is structured the way it is (see the review by [Kim, 2020](#) of networks in the global governance literature). Thus, this article leverages the theory of networks to explore the global interorganizational network of international actors. The theory of networks explains how non-network variables (e.g., network members' relationships and similarities/homophily) determine why networks have the structures they do. It involves three levels of analysis: “models of who forms what kind of tie with whom, who becomes central, and what characteristics the network as a whole will have” ([Borgatti and Halgin, 2011](#): 1168). Understanding who forms what kind of tie with whom is at the dyad level (i.e., the interactions between actors); identifying who becomes central is at the ego level (i.e., the centrality of each actor); and uncovering the overall characteristics is at the network level. In this study, we specifically explore the properties of the network at the network, dyad, and ego levels.

In an ongoing global pandemic, unpacking how international actors continuously interact with each other and how their interactions are interconnected at multiple levels of analysis can offer a holistic picture of the interorganizational network and how such network evolves over time. A multi-level approach helps in understanding the complexity of the global system, particularly during a grand challenge like COVID-19 that requires exactly such a coordinated multi-level effort (c.f. [George](#)

et al., 2016; Hitt et al., 2021). The interactions can either be intra-sectoral (i.e., interactions between actors in the same sector: MNC-MNC, IGO-IGO, and NGO-NGO) or inter-sectoral (i.e., interactions between actors from different sectors: MNC-NGO, MNC-IGO, and NGO-IGO) dyads.

Obtaining a holistic view of the interactions can help in managing the relationships between international actors who are expected to oversee global governance and facilitating collective action that benefits everyone. This is because repeated, continuous interactions denote the type of relationship between actors by showing whether such actors have established ties and trust with one another (e.g., Schilke and Cook, 2013; Sydow, 1998). Interactions are either cooperative or conflictive and they form a dynamic social structure of positive and negative ties that influence the behavior of the networked actors (e.g., Boda and Néray, 2015; Everett and Borgatti, 2014; Sytch and Tatarynowicz, 2014). On the one hand, cooperation is an exchange between actors resulting in some sort of relationships for mutual benefit (Smith et al., 1995). Cooperative interactions include agreements, mergers, and joint ventures, among others. On the other hand, conflict is broadly defined as perceived divergence of interests between actors (Pruitt and Rubin, 1986). Some examples of conflictive interactions are disagreements, criticisms, and hostile takeovers. The interplay between cooperation and conflict can also be observed at the global level and affects how collective action emerges in a relatively fractured world (Crocker et al., 2011).

Understanding how interactions constitute the global interorganizational network is even more crucial in a global pandemic because the actors need to adapt to the “new world (dis)order” to effectively address an instantaneous and rapidly spreading catastrophe (i.e., global pandemic) or other current and future grand challenges (Hitt et al., 2021). Prior research contends that this network is characterized by fragmentation (i.e., the lack of clustered cooperation among actors), polycentricity (i.e., the decentralization of the formed network among actors), or complexity (i.e., a dynamic system consisting of several interlinking components). However, given that previous studies have a narrow focus on specific actors (Kim, 2020) and the challenges in obtaining data to capture the global interorganizational network of international actors (e.g., Tischer, 2020), we are yet to establish what and how this network is structured. In this study, we thus tackle this research gap to overview the global interorganizational network and doing so may contribute to our knowledge of global governance and collective action, particularly in a context of a grand challenge that entails a fast-moving and large-scale catastrophe affecting everyone.

### 3. Empirical data

Our dataset comes from the GDELT Project – an initiative supported by Google Jigsaw – which compiles in real time all worldwide media-reported events about how different actors interact with each other. GDELT collects event data from multiple broadcast, print, and online sources in over 100 different languages to create a catalog of what is happening globally, who is involved, and the dynamics of such events (Leetaru and Schrodt, 2013). It is important to note that more than 97 per cent of the events are recorded within 24 h of happening, thus indicating the time accuracy of each data point. An event only appears once in the dataset, meaning that it will not be included again if another media source mentions the same event. Nevertheless, if the event appears in several media outlets or different types of sources, GDELT includes a separate column in the file to show the number of times in which the event was mentioned.

Currently, it is the most extensive record of events in the world, containing trillions of data points covering more than a quarter billion (and counting) documented world events annually and is updated daily at a data collection interval of every 15 min. This huge amount of information is known as big data, referred to as “data that exceeds the processing capacity of conventional database systems” (Bodas-Sagi and

Labeaga, 2016: 38). Using big data allows us to identify patterns of human interactions and behaviors that ultimately form a network of relationships and linkages which can be useful for organizational decision making (McAfee and Brynjolfsson, 2012). For instance, GDELT has been used to analyze the sociological evolution of specific important events – such as the Spanish government’s energy policies (Bodas-Sagi and Labeaga, 2016), the 2011 Egyptian revolution (Ward et al., 2013), the political conflicts in Afghanistan and Syria (Yonamine, 2013), and the Arab Spring (Levin et al., 2018). Here, we follow those previous studies in using GDELT to understand how different actors are interconnected and form networks among them.

Nevertheless, despite the inherent limitations of the GDELT data to capture all the interactions between various actors, we contend that it may allow researchers to gain a more comprehensive overview of the relational dynamics between the actors, which can help in the initial theory development and empirical understanding of the global interorganizational network. GDELT has broader coverage in terms of its media sources than the scope of previous research that relies on a limited pool of media sources such as major national and international newspapers (e.g., McDonnell and King, 2013), business news (e.g., Carroll and McCombs, 2003; Lee and Riffe, 2019), proprietary media (e.g., Besiou et al., 2013), and social media networks such as Twitter and LinkedIn (e.g., Quinton and Wilson, 2016; Vu et al., 2020). Our approach to unpack networks by using events from media reports in different formats (i.e., broadcast, print, and online) may complement other means of capturing actor interactions that constitute a network (e.g., Tischer, 2020). Previous studies have already demonstrated how media sources can be useful to capture the interactions between different societal actors (e.g., Das and Chen, 2007; Etter et al., 2018).

We extracted from GDELT the events that cover the relevant interorganizational dyads for our study – the interactions among MNCs, IGOs, and NGOs. GDELT uses the Conflict and Mediation Events Observations (CAMEO) Event and Actor codebook to identify the type of actor, based on their characteristics such as international versus domestic operations, roles, and specialty, among others (Schrodt, 2012). Our initial data included all media-reported interorganizational dyads between January 1, 2018 and May 31, 2021, which covers the period before and after the announcement by the WHO on January 30, 2020 that the COVID-19 outbreak was a public health emergency of international concern. We then filtered the dyads between international actors who are observed in both before and after the WHO’s announcement to examine whether the behaviors of these actors have changed throughout a specific, identifiable event and to rule out alternative explanations about the changes in the network properties. Since we focus on interorganizational dyads, we excluded those dyads attributed to the same organizations. For example, we removed any interactions between the UN Security Council and the UN Secretariat, since both identified actors belong to the UN. The overall network comprises a total number of 327 unique actors who interacted with one another over the entire period of interest of the research. MNCs are predominant in the network with a total number of 167 actors, while NGOs and IGOs have 89 and 71 actors, respectively.

Ultimately, the interorganizational dyads consist of a total of 43,601 intra-sectoral and 10,063 inter-sectoral dyads, with a final sample of 53,664 interorganizational dyads (see Table 1 for the sample description and (Federo and Bustamante, 2022) for the link to the dataset). The distribution of interorganizational dyads is evidently unbalanced between intra-sectoral and inter-sectoral dyads. Intra-sectoral dyads represent more than 81 per cent of the dyads, while the rest are inter-sectoral, thus confirming prior research showing that organizations tend to engage more within their sector than with organizations from other sectors (e.g., Atouba and Shumate, 2010; Rondinelli and London, 2003). By far, interactions between IGOs are the highest, followed by those between MNCs. Although previous research argues that the media is biased in focusing more on reporting conflictive interactions than cooperation (Weidmann, 2016), our data shows

**Table 1**  
Sample description.

Interorganizational dyads	Before pandemic			During pandemic			Entire period Total
	Number of conflictive interactions	Number of cooperative interactions	Total	Number of conflictive interactions	Number of cooperative interactions	Total	
<i>Intra-sectoral dyads</i>							
MNC-MNC	2971 (24)	9408 (76)	12,379	1661 (25)	4954 (75)	6615	18,994
NGO-NGO	274 (45)	336 (55)	610	121 (28)	315 (72)	436	1046
IGO-IGO	2444 (16)	13,104 (84)	15,548	1359 (17)	6654 (83)	8013	23,561
Total intra-sectoral dyads	5689 (20)	22,848 (80)	28,537	3141 (21)	11,923 (79)	15,064	43,601
<i>Inter-sectoral dyads</i>							
MNC-NGO	110 (26)	314 (74)	424	31 (15)	171 (85)	202	626
MNC-IGO	1789 (58)	1276 (42)	3065	1196 (32)	2516 (68)	3712	6777
NGO-IGO	438 (26)	1263 (74)	1701	193 (20)	766 (80)	959	2660
Total inter-sectoral dyads	2337 (45)	2853 (55)	5190	1420 (29)	3453 (71)	4873	10,063
Grand total dyads	8026 (24)	25,701 (76)	33,727	4561 (23)	15,376 (77)	19,937	53,664

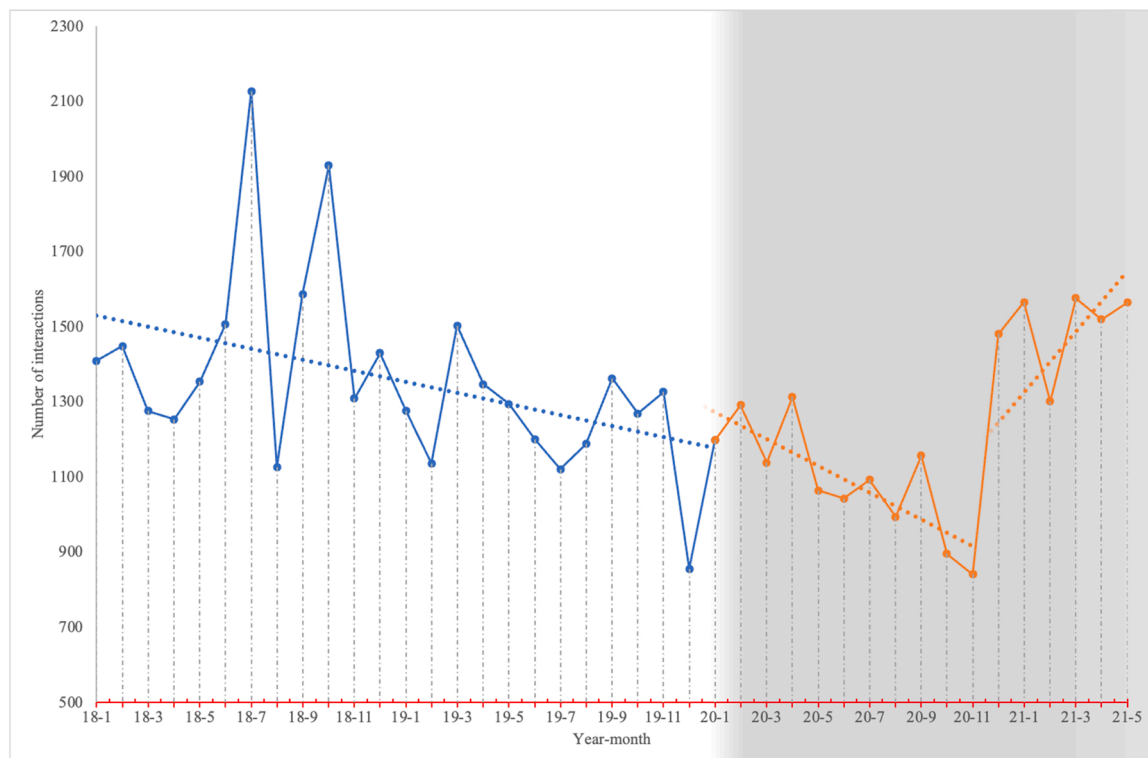
Note: Numbers in parentheses show the percentage of total interorganizational dyads in the corresponding period.

otherwise as we find that the number of cooperative interactions (more than 76 per cent of the total interorganizational dyads) dwarfs that of conflictive interactions.

To identify the type of interaction between the actors, we used the Goldstein scale which classifies any interaction of two actors as either cooperation or conflict based on a set of word actions that are scored ranging between  $-10$  to  $+10$  (Goldstein, 1992). Positive scores are assumed as cooperative interactions, while negative scores are deemed conflictive or less cooperative interactions. The scores indicate the degree of cooperation/conflict between the actors. Those values that are closer to  $-10$  and  $+10$  suggest the extremes suggesting greater conflict and cooperation than those closer to 0, respectively.

GDELT codes and presents the Goldstein scale score for each media-reported interaction in its database, and we used it as our indicator of cooperative/conflictive interaction and the basis for calculating the

degree of cooperation between the actors. Although the Goldstein scale was intended to identify the interactions between countries, we contend that its coding scheme may also be applicable to understand the interactions between any other actors, including IGOs, MNCs, and NGOs. For instance, in GDELT, the most conflictive reported events are scored with  $-10$ , corresponding to a military attack, clash, or assault. An interorganizational interaction scored with  $-10$  in our dataset is when the European Union sanctioned Syngenta (an agricultural-product manufacturing company) by banning its pesticides that affect bees. In contrast, the most cooperative events are scored with  $+10$ . An example of this interaction is when the United Nations extended developmental aids to the African Union peace mission to Somalia (see Appendix A for more illustrative examples showing varying levels of the Goldstein scale scores).



**Fig. 1.** Evolution of the number of interorganizational interactions from January 2018 to May 2021. Note: The shaded area shows the period from the official WHO declaration of the COVID-19 outbreak.



## 4. Findings

### 4.1. The structure of the global interorganizational network

Our first set of analysis is at the network level. We started by focusing on the whole network as we examined whether all the captured interactions of international actors are cooperative or conflictive before and during a global pandemic, and whether the changes (if any) were statistically significant.

Fig. 1 displays the evolution of the interorganizational dyads between January 2018 and May 2021. Both the trends of cooperative and conflictive interactions are decreasing until the onset of COVID-19 (see Fig. 2). The trends have continued downward from January 2020 (the month the WHO announced the COVID-19 outbreak) until December 2020. Afterwards, the trends have started to reverse. Interestingly, the degree of cooperation between those actors is in stark contrast with the number of reported cooperative/conflictive interactions (see Fig. 3). Before COVID-19, the global interorganizational network already tended to be cooperative, and the trend is gradually evolving into a more cooperative one. However, the degree of cooperation indicates a downward trend as the global pandemic unfolded, meaning that the relationships between organizations from the public, private, and third sectors are becoming less cooperative over time; this trend has steeply dropped in December 2020 onwards. These findings suggest that looking at whether actors have interacted in a cooperative or conflictive manner may not be sufficient to understand the relational dynamics between them. Instead, our analysis offers evidence that it is also important to consider the degree of cooperation between them, since the extent of cooperative interactions are likely to vary among the actors. In sum, we have not observed an immediate impact on the number of interactions after the announcement of the pandemic, whereas the degree of cooperation had a noticeable change with the shock.

The evident spike in the total number of reported interactions during December 2020 (see Fig. 1) can be attributed to the discovery, approval,

and initial distribution of the COVID-19 vaccines. The degree of cooperation seemed to decrease in the same month (see Fig. 3), which is likely influenced by specific problems regarding the acceptance, manufacturing, distribution, and logistics of the vaccine rollout (e.g., Kim et al., 2021; Lazarus et al., 2021). The average Goldstein score of all the interorganizational dyads in our dataset before the pandemic is 2.00 (see Table 2). This score has increased to 2.13 during the pandemic, a difference that is statistically significant ( $\Delta = 0.13$ ;  $p < 0.001$ ).

We subsequently mapped the network using the *NetworkX* package for Python (Hagberg et al., 2008) by adopting the Kamada-Kawai algorithm, which assumes nodes are connected by springs to other nodes in the network and iteratively optimizes the nodes from their initial position to reposition them according to the energy of the overall spring system (Kamada and Kawai, 1989). We further enhanced the map layout using the Fruchterman-Reingold algorithm to displace the nodes in a gravitational way to distinguish possible sub-groups within the network by keeping adjacent nodes together and segregating those nodes that do not necessarily become part of the sub-groups (Fruchterman and Reingold, 1991). Using these two algorithms together is recommended to improve the visualization of the network graph (Collberg et al., 2003). Afterwards, we plotted the networks using Plotly (Plotly Technologies Inc, 2015).

The formed networks from the reported interorganizational dyads confirm the more cooperative interactions among the actors, as shown by many green graph edges, the lines connecting the nodes (see Fig. 4). The undirected multigraphs in Fig. 4 also show that few actors tend to interact more with one another which can be considered as core within the network, while many others interact less with others and can be construed as peripheral (c.f., Borgatti and Everett, 2000). To check whether actors are core or peripheral in the network, we used the *cpnet* package for python to perform a core-periphery analysis using the algorithm of Rombach et al. (2017). Fig. 5 confirms the presence of several core and peripheral actors of the network, as observed with the varying degrees of coreness in the multigraphs (i.e., darker circles are deemed as

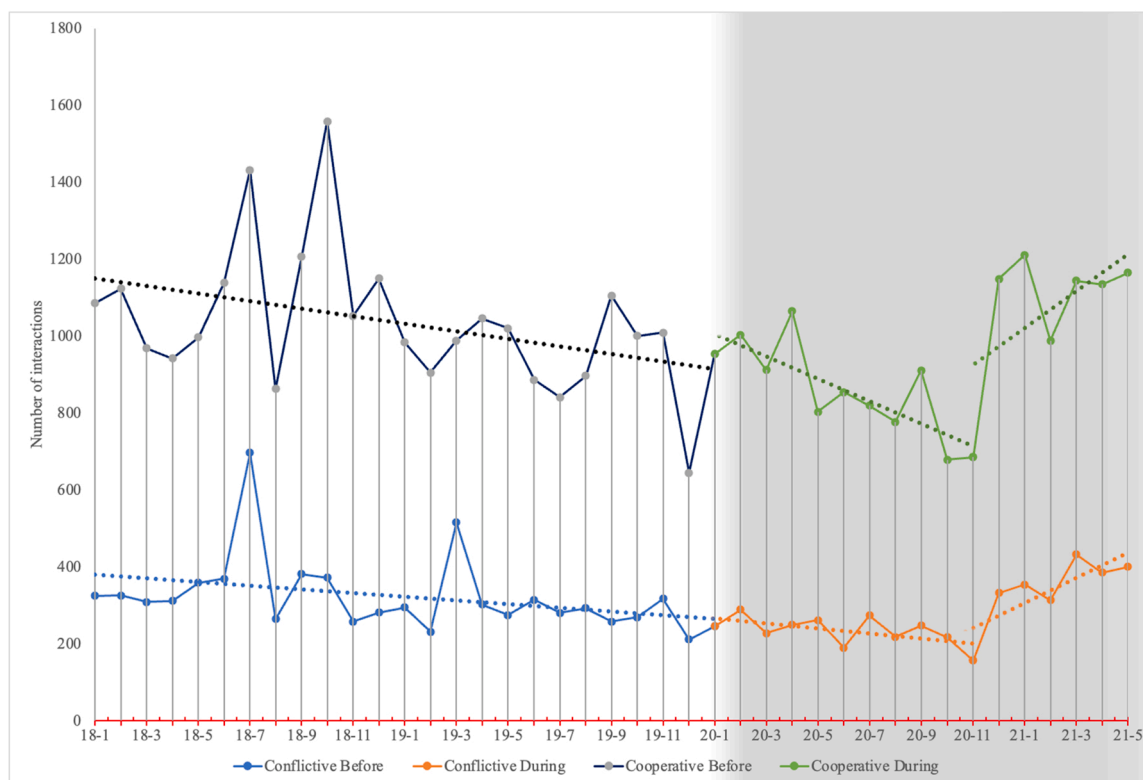
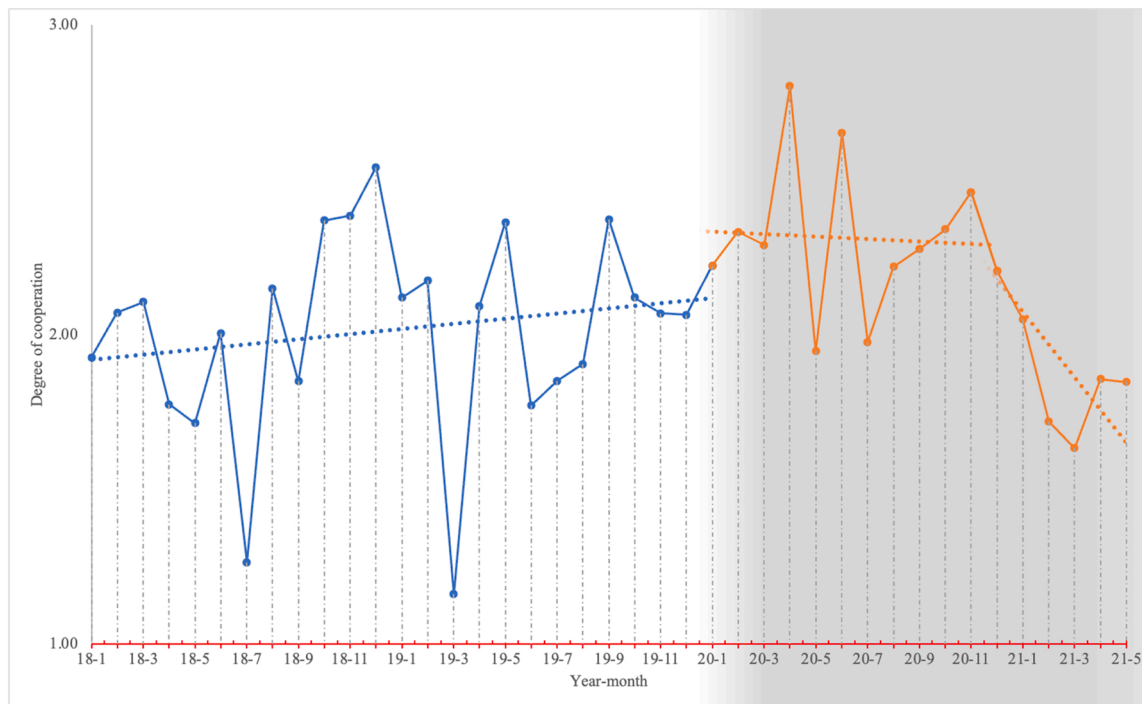


Fig. 2. Evolution of the number of interorganizational cooperative/conflictive interactions from January 2018 to May 2021. Note: The shaded area shows the period from the official WHO declaration of the COVID-19 outbreak.



**Fig. 3.** Evolution of average degree of cooperation from January 2018 to May 2021. Note: The shaded area shows the period from the official WHO declaration of the COVID-19 outbreak.

**Table 2**

Average degree of cooperation between international actors.

Interorganizational dyads	Degree of cooperation before the pandemic	Degree of cooperation during the pandemic	Degree of cooperation for the entire period	$\Delta$ in degree of cooperation over the entire period	T statistic
<i>Intra-sectoral dyads</i>					
MNC-MNC	1.98	1.96	1.97	(0.02)	0.27
NGO-NGO	0.47	2.11	1.15	1.64	-6.22 ***
IGO-IGO	2.64	2.59	2.62	(0.05)	0.99
Total intra-sectoral dyads	2.31	2.30	2.31	(0.01)	0.19
<i>Inter-sectoral dyads</i>					
MNC-NGO	1.51	2.63	1.87	1.12	-3.38 ***
MNC-IGO	-0.81	1.33	0.36	2.14	-19.32 ***
NGO-IGO	1.99	2.50	2.18	0.51	-3.07 ***
Total inter-sectoral dyads	0.30	1.61	0.93	1.31	-14.66 ***
<b>Grand total dyads</b>	<b>2.00</b>	<b>2.13</b>	<b>2.04</b>	<b>0.13</b>	<b>-3.52 ***</b>

Notes:

(1) Average degree of cooperation is the mean of Goldstein scale scores of the dyads.

(2) T-tests were performed to identify the statistical significance between the degree of cooperation before and during the pandemic.

(3) Significant relationships are: \*\*\*  $p < 0.001$ , \*\*  $p < 0.05$ , and \*  $p < 0.10$

part of the network's core, while lighter circles are assumed as peripheral in the network).

Moreover, as we computed the density of the network multigraphs, we find that the network density had a value of 0.63 before the pandemic. Interestingly, despite the increasing trend in the number of interactions between the actors, the network has since become sparser and decreased to a density of 0.37 during the pandemic (see Table 3), a difference that is statistically significant ( $\Delta = -0.26$ ;  $p < 0.001$ ). These findings suggest that the global interorganizational network during the global pandemic is sparser, and thus even more fragmented than before the global pandemic, because many interactions between actors are peripheral, or in some cases disconnected, from the entire network and lacking a clear common grouping among all of them.

#### 4.2. The interorganizational interactions of international actors

Our second set of analysis is at the dyad level. We initially explored the aggregate dyads at the sectoral level and then delved into each type of the dyads to identify which interorganizational interactions were cooperative or conflictive, whether the specific interactions had changed over time, and whether any changes would be statistically significant. Bearing in mind the cooperative state of the entire network on average, our further analysis at the dyad level uncovers that both intra-sectoral and inter-sectoral dyads were reported as cooperative on average before the pandemic, with Goldstein scale scores of 2.31 and 0.30, respectively (see Table 2). However, the average Goldstein scale score of intra-sectoral dyads shows a not statistically significant decrease to 2.30 during the pandemic ( $\Delta = -0.01$ ;  $p > 0.10$ ), while the average Goldstein scale score of inter-sectoral dyads shows a statistically significant increase to 1.61 in the same period ( $\Delta = 1.31$ ;  $p < 0.001$ ).

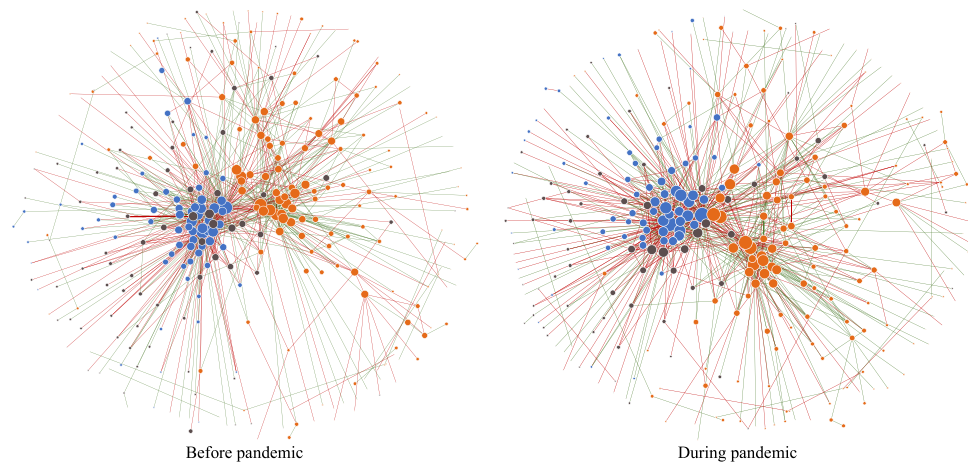


Fig. 4. The global interorganizational network of international actors. Note: Node colors are Orange = MNCs; Blue = IGOs; Gray = NGOs

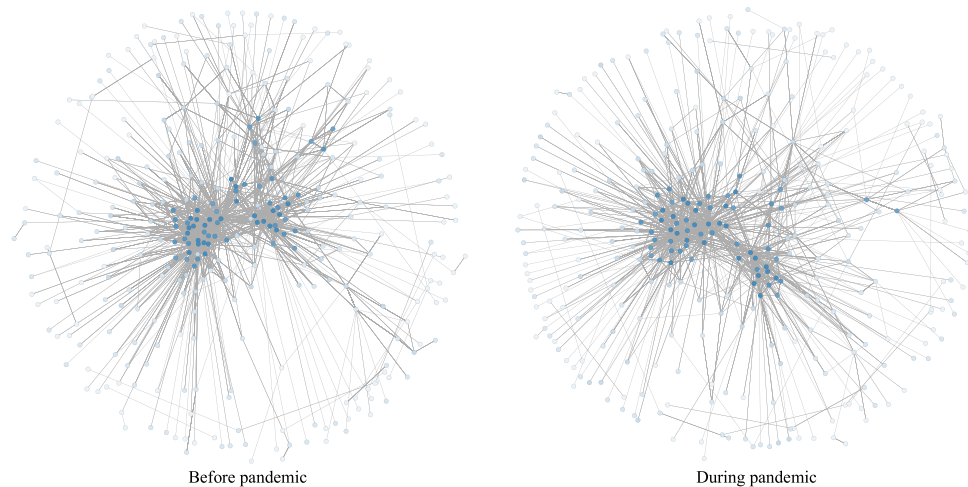


Fig. 5. Degree of coreness in the global interorganizational network.

Table 3  
Network structure of international actors.

Network features	Before pandemic	During pandemic	$\Delta$ over the entire period
Overall network density	0.69	0.34	(0.35)
Degree centrality (valued - interactivity)			
MNCs	0.57	0.29	(0.28)
NGOs	0.12	0.07	(0.05)
IGOs	1.68	0.83	(0.85)
Eigenvector centrality (valued)			
MNCs	0.01	0.01	0.00
NGOs	0.00	0.00	0.00
IGOs	0.04	0.03	(0.01)

We further disentangle the interorganizational dyads to identify which dyads contributed to the overall average in intra-sectoral and inter-sectoral Goldstein scale scores and their respective changes in the period of interest of this research (see Table 2). On the one hand, we find that the average intra-sectoral Goldstein scale score of MNCs and IGOs have decreased. MNCs were largely cooperative among themselves (with an average Goldstein scale score of 1.98) before the pandemic, which supports the growing literature on the overall collaborative undertakings by businesses (e.g., Schilling and Phelps, 2007). However, the average Goldstein scale score of their interactions reflects a not statistically significant drop to 1.96 during the pandemic ( $\Delta = -0.02$ ;

$p > 0.10$ ). Meanwhile, the intra-sectoral interactions of IGOs have an average Goldstein scale score of 2.64 before the pandemic. Over time, the decrease in the average Goldstein scale score of IGO-IGO interactions to 2.59 is not statistically significant ( $\Delta = -0.05$ ;  $p > 0.10$ ). In contrast, NGO intra-sectoral interactions have an average Goldstein scale score of 0.47. The increase during the pandemic to 2.11 is statistically significant ( $\Delta = 1.64$ ;  $p < 0.001$ ).

On the other hand, as we inspect the different inter-sectoral dyads, we find that the average Goldstein scale score has generally increased. With regard to MNC-NGO dyads, their interactions have an average Goldstein scale score of 1.51, and it has a statistically significant increase to 2.63 during the pandemic ( $\Delta = 1.12$ ;  $p < 0.001$ ). The interactions between MNCs and IGOs shifted from being conflictive before the pandemic (with an average Goldstein scale score of  $-0.81$ ) to being cooperative during the crisis (with an average Goldstein scale score of 1.33;  $\Delta = 2.14$ ;  $p < 0.001$ ). These findings complement extant research on the importance of MNCs—and businesses in general—in inter-sectoral collaboration (e.g., Stadler, 2018), particularly during a global pandemic (c.f., Doh et al., 2019; Lawton et al., 2020; Park and Chung, 2021). In addition, the interactions between NGOs and IGOs remain cooperative. Their average Goldstein scale score shows a statistically significant increase from 1.99 before the pandemic to 2.50 during the crisis ( $\Delta = 0.51$ ;  $p < 0.001$ ).

In sum, our analysis uncovers how international actors interact differently within and across their sectors. Our findings provide

evidence of a systemic-wide behavioral differences between the private, public, and third sectors (c.f., [Doh et al., 2019](#)). Thus, our study shows the changing complexity of the global interorganizational network, since we unpack how different elements (i.e., the interorganizational dyads) are interlinked in a dynamic manner as the network structure shifts during a specific period.

#### 4.3. Prominent international actors within the interorganizational network

Our third set of analysis is at the ego level (i.e., organizational level) to identify the central actors in the network. We also used the *NetworkX* package for Python to compute the centrality variables (i.e., degree and eigenvector). Centrality is the measure that identifies the most important network nodes (i.e., the endpoints in a network). To identify the central players in a network, we focused on degree centrality, which measures the number of times a node is connected and/or interacted with other nodes in the entire network ([Freeman, 1978](#)) in order to identify each node's strength of ties in the network, and eigenvector centrality which measures the influence of a node within the network by considering the importance of its connected neighbors ([Bonacich, 1987](#)). These two types of centrality measures suggest the position of the actors within a network – i.e., actors with high centrality scores are assumed to be more important in the network than those with low scores ([Borgatti, 2005](#)) – and thus help us determine whether there is a clear leader or a set of leaders in the network.

Following previous studies, we computed the degree centrality of a node by dividing the number of interactions/connections of the node by the total number of nodes of the network, while we computed eigenvector centrality using valued data by dividing the node's degree centrality score by the sum of the degree centrality scores of the nodes attached to it. In this study, we compare the actors' ranking based on their centrality scores before and during the pandemic. Moreover, we identify and compare the average Goldstein scale score of the high-ranking actors in terms of centrality.

Despite being the fewest actors in the network, IGOs have the highest average centrality scores, in terms of both degree and eigenvector (see [Table 3](#)). MNCs follow and NGOs come last. Moreover, corresponding to the Goldstein scale scores of the dyads, the average Goldstein scale score for each type of international actor has increased during the pandemic period (see [Table 4](#)). IGOs also have the highest average degree of cooperation among the sectors. Overall, these numbers show the prominence of IGOs in the global interorganizational network, being the entities responsible for global governance and for the delivery of global public goods ([Federo and Saz-Carranza, 2018](#)).

[Tables 5 and 6](#) show the top 20 international actors based on their degree centrality in terms of the number of interactions and connection within the network. Noticeably, five actors consistently rank highly in the list of the most-interactive and most-connected actors throughout the period of interest of this research. Two IGOs (the EU and the UN) and three MNCs (Google, Microsoft, and Samsung) are among the actors with the highest degree centrality scores, denoting that they have the most interactions and connections in the entire network, which also corresponds to their high coreness in the overall network. As expected, the WHO – being the entity responsible for global public health – has

**Table 4**  
Number and average degree of cooperation of international actors.

Type of international actor	Total number of actors	Average degree of cooperation before pandemic	Average degree of cooperation during pandemic	$\Delta$ in degree of cooperation over the entire period
MNCs	167	2.45	2.55	0.10
NGOs	89	2.02	2.41	0.39
IGOs	71	2.55	2.58	0.03

**Table 5**  
Most interactive actors in the network.

Before pandemic			During pandemic	
	Actor	Degree centrality	Actor	Degree centrality
1	United Nations*	31.10	European Union	16.51
2	European Union	27.28	United Nations	13.67
3	Google	19.62	Google*	8.03
4	Microsoft*	9.90	AstraZeneca*	5.90
5	Samsung*	8.96	Microsoft	5.68
6	Boeing	6.14	Pfizer*	4.64
7	African Union*	5.71	Samsung*	3.85
8	NATO*	5.50	World Bank	2.83
9	World Bank	5.28	African Union*	2.79
10	Sony*	4.98	World Health Organization*	2.25
11	UNHCR*	4.26	UNICEF*	2.22
12	UNDP*	4.2	International Monetary Fund*	2.20
13	UNICEF*	4.08	Sony*	2.04
14	Embraer*	3.96	Boeing*	1.79
15	International Monetary Fund*	3.63	UNHCR*	1.74
16	Disney*	3.46	NATO*	1.53
17	Nokia*	3.46	Qualcomm*	1.06
18	Qualcomm	3.10	Nokia*	1.01
19	Lenovo*	2.15	Embraer	1.00
20	Amnesty International	2.03	UNDP*	0.99

Notes:

(1) Degree centrality is computed using valued data

(2) \* = core actors in the network, computed using the algorithm of [Kojaku and Masuda \(2018\)](#)

**Table 6**  
Most connected actors in the network.

	Actor	Degree centrality
1	European Union	0.35
2	United Nations	0.33
3	Google	0.20
4	Samsung	0.11
5	Microsoft	0.11
6	World Bank	0.09
7	UNICEF	0.08
8	African Union	0.08
9	Red Cross	0.08
10	ASEAN	0.08
11	World Health Organization	0.07
12	Credit Suisse	0.07
13	Human Rights Watch	0.06
14	World Economic Forum	0.06
15	UNHCR	0.06
16	Vodafone	0.06
17	International Monetary Fund	0.06
18	Amnesty International	0.06
19	Oxfam	0.06
20	Nokia	0.05

Note:

Degree centrality is computed using binary data

increased its interactions with other actors during the pandemic, rising to tenth place overall (see [Table 5](#)). Similarly, AstraZeneca and Pfizer, the two large pharmaceutical firms that immediately responded to develop the COVID-19 vaccine, have increased their number of interactions as the pandemic unfolded, rising to fourth and sixth respectively.

Both MNCs and IGOs dominate the list. Only one NGO (Amnesty International) appears in the top 20 international actors in terms of interactivity over the period. The lack of active involvement by NGOs is consistent with persistent criticism about whether they (and even civil society in general) create and deliver social value (e.g., [Lecy et al., 2012](#);



Zaidi, 1999). Unlike IGOs with governmental support and MNCs with private funding, NGOs tend to have highly constrained and limited resources (e.g., Brown and Kalegaonkar, 2002; Gupta and Koontz, 2019), which perhaps constrained or prevented them from operating during the pandemic and thus contributed to a lack of visibility that was exacerbated by the wave of lockdowns across the globe. However, despite having fewer interactions than other actors in the network, NGOs seem to be highly connected within the network, with five NGOs ranking in the top 20 of the highly connected actors in the network (see Table 6).

Similarly, many of the actors with the most connections and strongest ties within the network have also emerged as some of the most influential ones throughout the period (see Table 7). For example, as the WHO increased its interactions during the pandemic, it also accumulated influence over time – reaching ninth place. AstraZeneca and Pfizer have also risen as highly influential actors during the pandemic, since the media has increased its attention on how these firms have led in developing and distributing the COVID-19 vaccine. Our findings also show that highly central actors are generally cooperative on average (see Appendix C for the average Goldstein scale score for the top-ranking actors in terms of centrality score).

Since there are indications of polycentricity in the network graphs, we used the *KM-config* algorithm of Kojaku and Masuda (2018) to identify possible sub-groups in the network. We find that there are indeed multiple network sub-groups that have become more dispersed during the pandemic (see Fig. 6 and Appendix B for more details of the groupings). For example, some actors that seemed to congregate with one another (both before and during the pandemic) largely consist of financial institutions, automobile companies, energy-related corporations, aviation, technology firms, pharmaceuticals, social welfare NGOs, and development-oriented IGOs. These findings suggest the likelihood of homophily (i.e., similarity among actors) in the global interorganizational network (e.g., Atouba and Shumate, 2015; Sapat et al., 2019).

Interestingly, our analysis reveals that many IGOs (such as the EU and the World Bank) are not necessarily core in any of the sub-groups in

the network, thereby demonstrating the transversal role of these organizations in bridging different sub-groups of actors in global governance. Some actors have also shifted from being core to peripheral of the network during the pandemic (e.g., Privacy International, Ryanair, and the UN), while some have done the opposite (e.g., Google, Medecins Sans Frontiers, and Organization of African Unity). We also observed that some actors who belong to a sub-group before the pandemic are no longer part of the same sub-group during the pandemic (e.g., Bill and Melinda Gates Foundation and International Energy Agency), or vice versa (e.g., Daewoo, the EU, and Red Crescent). These findings provide evidence of changes in sub-group membership/composition as the pandemic unfolded.

Remarkably, AstraZeneca and Pfizer have shifted closer to the sub-group of nonprofit organizations during the pandemic, which can likely be attributed to their increased media-reported engagements with public-value-oriented organizations leading the efforts in addressing the global pandemic. Our exploration also shows that the connections between for-profit and nonprofit organizations are largely between a few prominent MNCs and IGOs, while NGOs mainly appear to be peripheral in the network. This type of network can be considered akin to an Opinion-Leader network, where the majority of actors have few connections while a few actors have many (Siegel, 2009).

Overall, our analysis of the interorganizational interactions has allowed us to obtain an overview of the interconnections between international actors in the global landscape, particularly before and during a global pandemic. We find that the global interorganizational network is characterized by fragmentation and polycentricity. Despite the increasing trend in both the number of cooperative and conflictive interactions, the trend of the degree of cooperation between international actors is decreasing after the WHO announcement of COVID-19 as a public health emergency of international concern. These findings suggest that although the number of cooperative interactions outnumber conflictive interactions, the extent of conflictive interactions substantially offset the extent of cooperative interactions, thus driving the trend in the degree of cooperation to move downwards over time. Moreover, our findings reveal the complexity of the global network, as we disentangle the interlinks of interorganizational dyads that form the network. We find different ways in which international actors have interacted with one another in an unfolding global pandemic; some interactions between the actors were more cooperative than others. Furthermore, our analysis shows that some actors interact more with similar actors than others, resulting in multiple core-periphery network structures suggesting the polycentric characteristic of the network. Finally, we uncover that some influential IGOs like the EU, UNICEF, and the World Bank act as bridges that connect multiple sub-groups of the network.

## 5. Discussion

The onset of COVID-19 becoming a global pandemic – that brought the world with loss of lives, economic downturn, political upheaval, and uncertainty – highlights the importance of the global interorganizational network. Prior to this research, obtaining an overview of the global interorganizational network entailed challenges due to the lack of available data on the interactive dynamics between international actors. Our methodological approach contributes to network research by providing a method to unpack and analyze the global interorganizational network. As this article set out to explore and describe such network, we demonstrate in this study how building a unique dataset by extracting media-reported interorganizational interactions and using the Goldstein scale to identify a fine-grained categorization of interactions between international actors, and subsequently performing a network analysis at multiple levels can offer a holistic view of the network. In doing so, we find that the global interorganizational network is simultaneously characterized by fragmentation, polycentricity, and complexity.

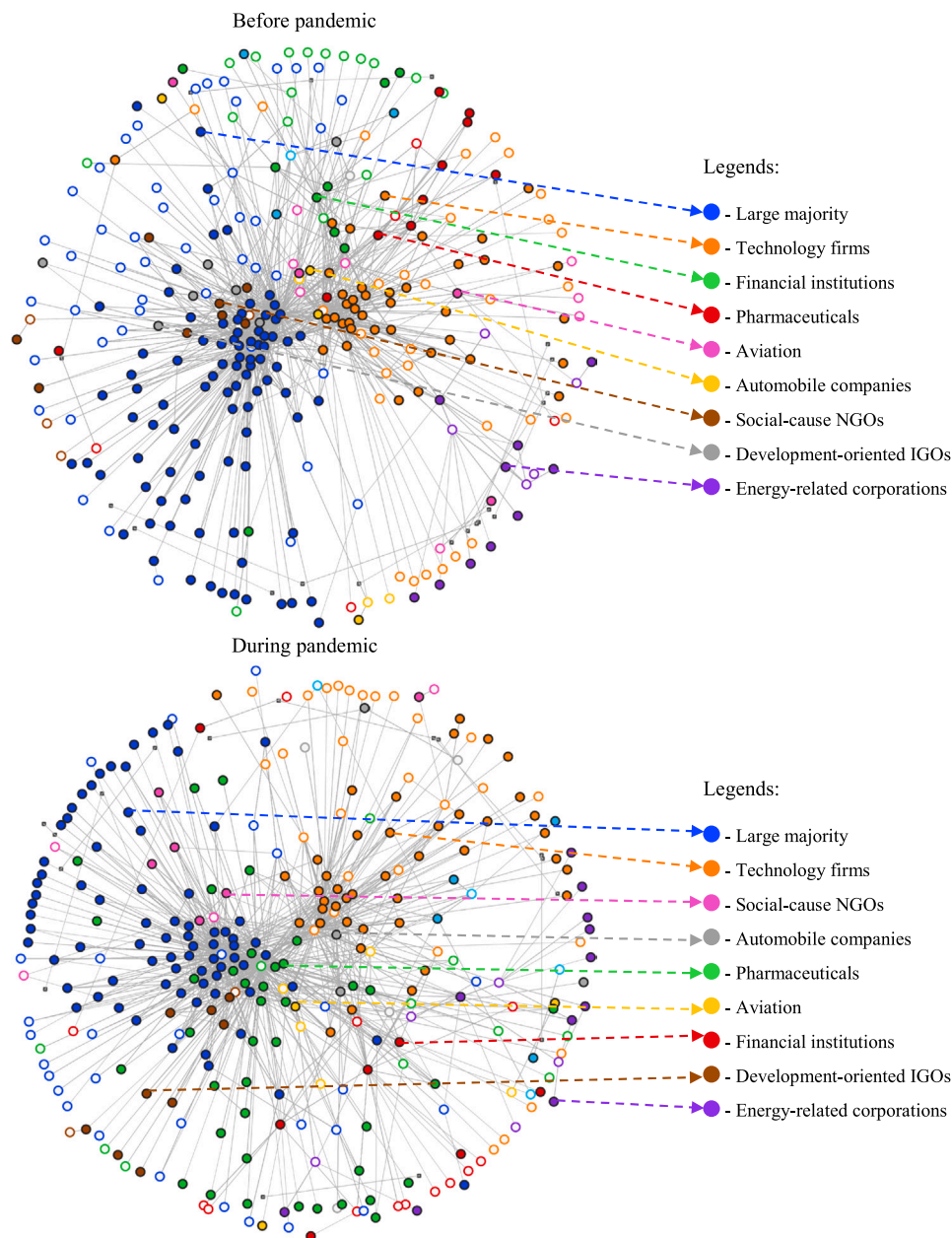
**Table 7**  
Most influential actors in the network.

Before pandemic			During pandemic	
	Actor	Eigenvector centrality	Actor	Eigenvector centrality
1	European Union	0.56	European Union	0.62
2	Google	0.45	AstraZeneca*	0.48
3	United Nations*	0.44	Pfizer*	0.37
4	Microsoft*	0.26	United Nations	0.31
5	NATO*	0.24	Google*	0.22
6	African Union*	0.16	Microsoft*	0.14
7	Samsung*	0.15	African Union*	0.13
8	UNDP*	0.15	NATO*	0.12
9	UNHCR*	0.14	World Health Organization*	0.12
10	UNICEF*	0.12	UNICEF*	0.08
11	World Bank	0.07	UNHCR*	0.08
12	Sony*	0.07	Samsung*	0.06
13	World Trade Organization*	0.07	ASEAN*	0.05
14	ASEAN*	0.06	UNDP*	0.05
15	Nokia*	0.06	World Bank	0.04
16	Qualcomm	0.06	Sony*	0.03
17	Boeing	0.05	World Food Program*	0.03
18	World Food Program*	0.05	UNESCO*	0.03
19	International Monetary Fund*	0.04	International Monetary Fund*	0.03
20	UNESCO*	0.04	Netflix	0.03

Notes:

(1) Eigenvector centrality is computed using binary data

(2) \* = core actors in the network, computed using the algorithm of Kojaku and Masuda (2018)



**Fig. 6.** Multiple sub-groups of actors in the global interorganizational network. Notes: (1) Core-periphery analysis to identify sub-groups is performed using the algorithm of Kojaku and Masuda (2018) (2) Colors represent the sub-groups of the nodes; Dark-colored circles are core; Light-colored circles with borders corresponding the colors of the sub-group are peripheral (3) Large circles show significant nodes, small squares show non-significant nodes.

### 5.1. Implications

There are several implications of our study. First, to the best of our knowledge, we believe that this study is the first to shed light about how MNCs, IGOs, and NGOs interact with each other and how their interactions are interconnected to form an overarching network among them. We contend that doing so allowed us to move toward theory development of the global interorganizational network. Understanding the properties of this network is necessary because these networked actors are crucial for the effectiveness and efficiency of global governance and the provision of global public goods. As we mapped the interorganizational interactions between the international actors of the global interorganizational network, our study offers a snapshot of how global governance has evolved into its current form. In doing so, we may be able to understand how it could develop in the future or how we can alter its overall structure to generate our intended impact. Our

simultaneous analysis at multiple levels allowed us to construe that the global interorganizational network has become even more fragmented, polycentric, and complex in an unfolding pandemic. The challenge that we raise here for researchers and practitioners is answering the question: how do we manage and govern the global interorganizational network, given its dynamically fragmented, polycentric, and complex characteristics?

Second, as we unpack how the interactions of these actors vary within or across their sectors and how they tend to shift with the changing contextual conditions (i.e., a global pandemic), our analysis brings out the relational dynamic behavior of international actors. Understanding the interactive dynamics of intersectoral relationship is important because each sector may not have the sufficient capability to independently tackle grand challenges and effectively combining each sector's resources and competencies through cooperation can better generate innovative and sustainable solutions to adapt to such

challenges (Doh et al., 2019). This knowledge has strong implications for global cooperation. The analyzed data shows the possible trade-off between the quantity (i.e., number) and quality (i.e., degree) of cooperative interactions between international actors. As the trend in the number of cooperative interactions increases (decreases), the trend in the degree of cooperation decreases (increases). Interestingly, our study in the context of a global pandemic reveals how the trends in global cooperation may shift in the presence of exogenous shocks, thereby corroborating a growing literature that elucidates the challenges of interorganizational collaboration during widespread disasters and crises (e.g., Berchtold et al., 2020; Moshtari and Gonçalves, 2017).

Third, our research reveals how the global interorganizational network is dominated by the “usual suspects” – those prominent IGOs and MNCs. Such a finding reinforces concerns about the lack of visibility that NGOs have in the international arena, despite their high connectivity in the network. This knowledge entails implications for policy making, specifically on how to incentivize actors to contribute to collective action. By knowing who has persisted to be central and/or core in the network over time, we may be able to encourage those highly central/core actors to help steer the network while also boosting participation of relatively peripheral actors in the network to achieve collective action. This is because highly central/core actors are more likely to have greater social capital than those who are not (Borgatti et al., 1998). For instance, regional IGOs such as the African Union, ASEAN, and the EU appear to have a transversal position in the network and are among those highly central actors known for being effective in conflict management. Perhaps, harnessing these organizations for a global response for grand challenges can be a prospective grand strategy for the global network. Although collective action may not necessarily provide a perfect recipe for success in addressing grand challenges, in catastrophic events like COVID-19, it can help in fostering social norms and developing innovative solutions that could reap collective benefits for all (e.g., Doh et al., 2019; Ostrom, 2000).

Fourth, as we focus on the global interorganizational network, we present a type of governance structure that can influence both organizational and collective strategies. There is an established literature about the benefits of network governance by reducing transaction costs, increasing access to resources, and sharing capabilities among the network members (e.g., Jones et al., 1997; Kapucu and Hu, 2020; Saz-Carranza et al., 2020). On the one hand, at the organization's perspective, knowing who is connected to whom and what type of relationships exists between the actors can help managers to identify which connection will be useful for establishing ties, securing resources (i.e., social capital), and avoiding conflict (especially those with conflictive interactions) when establishing and implementing its individual strategies. On the other hand, at the global governance perspective, international actors as a collective can consider their relationships with each other to jointly establish and implement strategies in addressing grand challenges (c.f., Crowe, 2007). This is because global governance is no longer restricted to IGOs (or governments), but MNCs and NGOs have already been increasing their roles in delivering global public goods (Abbott, 2012). For example, the networked actors can better orchestrate strategies for collective action by fostering a norm of cooperation, identifying the source of capabilities that will be pooled to benefit the network, avoiding duplicity of work, or establishing mechanisms to mitigate collective action problems such as free-riding, conflict between the actors, and incompatible self-interests.

## 5.2. Limitations and directions for future research

Since the current study is the first to examine the ties of international actors in the context of a unique type of grand challenge, it suffers from several limitations that should be addressed in future research. First, we focus specifically on international actors. However, many other actors are also intertwined in the global landscape. For instance, national governments, domestic firms, and civil society organizations operating

within a single national jurisdiction were not included in our analysis, despite being entangled in the global ecosystem of the interorganizational network (c.f., Shipilov and Gawer, 2020). Future research may benefit from accounting for the interactions of the identified international actors included in this study with other domestic actors to reveal a more complete picture of the relational dynamics surrounding the global interorganizational network. This approach may allow us to identify possible subnetworks that can emerge based on the geographical location of the actors. Such studies could explain the relatively lower engagement of NGOs observed in this study, which may be attributable to their more localized and narrower operations and relatively lower pool of international resources than those of MNCs and IGOs (e.g., Pearce, 2003; Teegen et al., 2004).

Second, our operationalization of interorganizational ties comes from a collection of different media sources worldwide. We encourage future researchers to further examine the relational dynamics between international actors that might not be captured by the sources collected by GDELT. For instance, GDELT does not account for events that occurred during private meetings, nor the minutes of intergovernmental summits where international actors typically engage with each other. Examining these sources or directly observing such meetings could be a fruitful source of information to better understand the reality of the interactive dynamics between the actors, particularly the negotiation or engagement processes that result in the reported events deemed newsworthy by media sources and subsequently captured by GDELT. This is because ties often emerge from the interactions of individuals working in specific organizations (e.g., Collet and Hedström, 2013). Moreover, GDELT is not explicit about the inaction of actors after a specific event, and we have not accounted for this in our analysis. However, the unbalanced number of interactions in the interorganizational dyads could be indicative of actor inaction. It would be interesting for future research to consider the interactions of actors over time and understand how actor inaction might affect the overall dynamics of the network.

Third, our analysis has not examined the specific topics covered by interorganizational interactions. This limitation opens another avenue for future research, namely, to identify the prevailing issues tackled by the actors during the period of interest. Were there any differences in the subject matter of different types of interorganizational interactions? Moreover, it would be interesting to identify what other grand challenges have continued to receive attention from actors during the global pandemic. Have the issues of climate change, human rights, and other global problems become less prominent during this period? Our brief post-hoc analysis of the topics suggests that many of the interactions during the period of interest of this research cover a number of themes, thus confirming the diverging interests among the actors who continue to carry on business-as-usual activities despite the existence of an ongoing grand challenge with devastating consequences.

Finally, we cannot conclude whether building a denser or more cooperative network is the recipe for collective action to effectively address and adapt to grand challenges. Our analysis only focuses on the topic of understanding the structure of the network in which international actors are embedded, and how these actors interact with each other. We have not examined the impact of the global interorganizational network and the intentions of the actors before and during the global pandemic. As we find evidence of an increase in the number of conflictive interactions during the global pandemic, it would be interesting for future work to investigate the impact of having both cooperative and conflictive interactions on overall interorganizational efforts. Previous research has emphasized the importance of having conflict (c.f., Amason, 1996; Jehn, 1995). Thus, understanding the benefits of conflict in interorganizational networks could be a fruitful path for future research. Nevertheless, since our study is limited to understanding the properties of the network over time, future studies on the consequences or implications of the interorganizational network and its relational dynamics for both the organizations involved and society in general are also greatly needed.

## 6. Conclusion

In conclusion, through the use of a unique dataset from events reported by the world media to capture relational dynamics and the Goldstein scale to categorize interorganizational interactions, our study of the global interorganizational network offers insights about the world order, particularly during a rare unfolding catastrophic event. In an attempt to answer our research questions, our empirical exercise has compiled a novel dataset and produced nuanced knowledge of interorganizational interactions comprising the global interorganizational network of international actors, which we hope will inspire theory development of the global interorganizational network and further research on the subject. Moreover, we believe that our methodological approaches in this study contribute not only to our empirical understanding of the global interorganizational network but also pave way in using media-reported events for the overall development of empirical network research. We trust that our study may start a conversation about this network and encourage other researchers and practitioners to take into account the relational behavior and interconnectedness of international actors. We hope that our study can also be useful in understanding collective action to successfully adapt to an ongoing global pandemic and other grand challenges that society is currently facing or

will need to urgently address in the future through a careful consideration of the ties that bind global governance.

## Acknowledgments

We thank Professor Martin Everett for the excellent editorial guidance and the two anonymous reviewers for the highly constructive and developmental comments. Earlier versions of this article have benefited from the presentations at the 2021 Academy of Management Annual Meeting, 2021 Academy of International Business Annual Conference, 2021 International Studies Association Annual Convention, and research seminars held at the Department of Business-Universitat Autònoma de Barcelona and Department of Business Economics-Universitat de les Illes Balears. This work was supported by the grant PID2020–115982RB-C21, funded by the Spanish Ministry of Science and Innovation ([MICIN/AEI/10.13039/501100011033](https://doi.org/10.13039/501100011033)).

## Dataset

Federo, R. & Bustamante X. (2022). Global Interorganizational Network Dataset from GDELT. (<https://www.bustawin.com/interorg-network-dataset/>).

## Appendix A. Sample Goldstein scale coding for interorganizational dyads

Goldstein scale	Event category code	Nature of the sentiment	Illustrative sample dyad
+ 10	Provide support	Cooperative	The United Nations extended aids to the African Union peace mission to Somalia.
+ 5	Promise material support	Cooperative	Verizon pledged to sign contract to Samsung to build its 5 G network.
+ 1	Meet with or send note	Cooperative	The International Monetary Fund held meetings with the World Bank to discuss how to address the pandemic.
-0.2	Comment on situation	Conflictive	Embraer mentioned in a commentary about Boeing's intention to establish a collaboration to share supplier savings.
-5.6	Act to punish or deprive	Conflictive	The EU cut off aids to Oxfam's project in Kenya.
-10	Attack, clash, or assault	Conflictive	The European Union sanctioned Syngenta (an agricultural-product manufacturing company) by banning its pesticides that affect bees.

## Appendix B. Sample sub-groups of the global interorganizational network

<b>Automobile companies</b> <ul style="list-style-type: none"> <li>• Arctic Cat</li> <li>• Cummins Inc.</li> <li>• Honda</li> <li>• Hyundai</li> <li>• Toyota</li> </ul>	<b>Aviation</b> <ul style="list-style-type: none"> <li>• Boeing</li> <li>• Embraer</li> <li>• Rolls Royce</li> <li>• RyanAir</li> <li>• Skywest Inc.</li> <li>• Spirit Aerosystems</li> </ul>	<b>Pharmaceuticals</b> <ul style="list-style-type: none"> <li>• AstraZeneca</li> <li>• GlaxoSmithKline</li> <li>• Novartis</li> <li>• Novo Nordisk</li> <li>• Pfizer</li> <li>• Teva Pharmaceutical</li> </ul>
<b>Energy-related corporations</b> <ul style="list-style-type: none"> <li>• Anadarko Petroleum</li> <li>• BHP Billiton</li> <li>• Chevron</li> <li>• Exxon</li> <li>• Occidental Petroleum</li> <li>• Suncor Energy</li> <li>• Texaco</li> </ul>	<b>Development-oriented IGOs</b> <ul style="list-style-type: none"> <li>• African Development Bank</li> <li>• Asian Development Bank</li> <li>• European Bank for Reconstruction and Development</li> <li>• International Monetary Fund</li> <li>• Islamic Development Bank</li> <li>• World Bank</li> </ul>	<b>Social-cause NGOs</b> <ul style="list-style-type: none"> <li>• Amnesty International</li> <li>• Committee of Journalists</li> <li>• International Federation for Human Rights</li> <li>• Human Rights Watch</li> <li>• Reporters without Borders</li> <li>• Transparency International</li> </ul>
<b>Technology firms</b> <ul style="list-style-type: none"> <li>• Alcatel Lucent</li> <li>• Apple Inc.</li> <li>• China Mobile</li> <li>• Cisco Systems</li> <li>• Comcast</li> <li>• Google</li> </ul>	<ul style="list-style-type: none"> <li>• Hewlett Packard</li> <li>• Hitachi</li> <li>• Logitech</li> <li>• Microsoft</li> <li>• Netflix</li> <li>• Nvidia</li> </ul>	<b>Financial institutions</b> <ul style="list-style-type: none"> <li>• Banco Santander</li> <li>• Bank of America</li> <li>• Barclays PLC</li> <li>• Blackrock</li> <li>• BNP Paribas</li> <li>• BT Group</li> </ul>
		<ul style="list-style-type: none"> <li>• Credit Suisse</li> <li>• Deutsche Bank</li> <li>• Goldman Sachs</li> <li>• HSBC Holdings</li> <li>• Morgan Stanley</li> <li>• Signature Bank</li> </ul>



## Appendix C. Average degree of cooperation of selected international actors

Before the pandemic		During the pandemic	
Actor	Average degree of cooperation	Actor	Average degree of cooperation
African Union	2.73	African Union	2.87
Amnesty International	0.04	Amnesty International	0.65
ASEAN	2.97	ASEAN	3.49
AstraZeneca	2.03	AstraZeneca	0.94
Boeing	2.64	Boeing	1.98
Credit Suisse	0.59	Credit Suisse	3.66
Disney	1.55	Disney	3.05
Embraer	3.47	Embraer	1.80
European Union	1.43	European Union	1.85
Google	0.60	Google	1.28
Human Rights Watch	0.24	Human Rights Watch	0.35
International Monetary Fund	2.95	International Monetary Fund	3.24
Lenovo	1.88	Lenovo	1.03
Microsoft	1.60	Microsoft	1.73
NATO	2.91	NATO	1.85
Netflix	1.58	Netflix	2.91
Nokia	2.71	Nokia	1.78
Oxfam	2.54	Oxfam	2.33
Pfizer	2.87	Pfizer	1.84
Qualcomm	1.34	Qualcomm	2.06
Red Cross	2.27	Red Cross	3.66
Samsung	2.00	Samsung	2.63
Sony	1.87	Sony	2.63
UNDP	3.51	UNDP	3.07
UNESCO	2.18	UNESCO	2.62
UNHCR	3.00	UNHCR	2.80
UNICEF	2.92	UNICEF	2.61
United Nations	2.30	United Nations	2.39
Vodafone	2.99	Vodafone	3.09
World Bank	3.21	World Bank	3.47
World Economic Forum	2.08	World Economic Forum	2.57
World Food Program	4.10	World Food Program	3.63
World Health Organization	2.46	World Health Organization	2.10
World Trade Organization	0.49	World Trade Organization	1.82

Note:

The list only includes those actors shown in Tables 5–7.

## References

- Abbott, K.W., 2012. Engaging the public and the private in global sustainability governance. *Int. Aff.* 88 (3), 543–564.
- Amason, A.C., 1996. Distinguishing the effects of functional and dysfunctional conflict on strategic decision making: resolving a paradox for top management teams. *Acad. Manag. J.* 39 (1), 123–148.
- Atouba, Y., Shumate, M., 2010. Interorganizational networking patterns among development organizations. *J. Commun.* 60 (2), 293–317.
- Atouba, Y.C., Shumate, M., 2015. International nonprofit collaboration: examining the role of homophily. *Nonprofit Volunt. Sect. Q.* 44 (3), 587–608.
- Berchtold, C., Vollmer, M., Sendrowski, P., Neisser, F., Müller, L., Grigoleit, S., 2020. Barriers and facilitators in interorganizational disaster response: Identifying examples across Europe. *Int. J. Disaster Risk Sci.* 11 (1), 46–58.
- Besiou, M., Hunter, M.L., Van Wassenhove, L.N., 2013. A web of watchdogs: stakeholder media networks and agenda-setting in response to corporate initiatives. *J. Bus. Ethics* 118 (4), 709–729.
- Boda, Z., Néray, B., 2015. Inter-ethnic friendship and negative ties in secondary school. *Soc. Netw.* 43, 57–72.
- Bodas-Sagi, D.J., Labeaga, J.M., 2016. Using GDELT data to evaluate the confidence on the spanish government energy policy. *Int. J. Interact. Multimed. Artif. Intell.* 3 (6), 38–43.
- Bonacich, P., 1987. Power and centrality: a family of measures. *Am. J. Sociol.* 92 (5), 1170–1182.
- Borgatti, S.P., 2005. Centrality and network flow. *Soc. Netw.* 27 (1), 55–71.
- Borgatti, S.P., Everett, M.G., 2000. Models of core/periphery structures. *Soc. Netw.* 21 (4), 375–395.
- Borgatti, S.P., Halgin, D.S., 2011. On network theory. *Organ. Sci.* 22 (5), 1168–1181.
- Borgatti, S.P., Jones, C., Everett, M.G., 1998. Network measures of social capital. *Connections* 21 (2), 27–36.
- Brown, L.D., Kalegaonkar, A., 2002. Support organizations and the evolution of the NGO sector. *Nonprofit Volunt. Sect. Q.* 31 (2), 231–258.
- Carroll, C.E., McCombs, M., 2003. Agenda-setting effects of business news on the public's images and opinions about major corporations. *Corp. Reput. Rev.* 6 (1), 36–46.
- Collberg, C., Kobourov, S., Nagra, J., Pitts, J., Wampler, K., 2003. A system for graph-based visualization of the evolution of software. In: *Proceedings of the 2003 ACM Symposium on Software visualization*. (pp. 77–ff).
- Collet, F., Hedström, P., 2013. Old friends and new acquaintances: tie formation mechanisms in an interorganizational network generated by employee mobility. *Soc. Netw.* 35 (3), 288–299.
- Crocker, C.A., Hampson, F.O., Aall, P., 2011. Collective conflict management: a new formula for global peace and security cooperation? *Int. Aff.* 87 (1), 39–58.
- Crowe, J.A., 2007. In search of a happy medium: how the structure of interorganizational networks influence community economic development strategies. *Soc. Netw.* 29 (4), 469–488.
- Das, S.R., Chen, M.Y., 2007. Yahoo! for amazon: sentiment extraction from small talk on the web. *Manag. Sci.* 53 (9), 1375–1388.
- Diani, Mario, McAdam, Doug, 2003. *Social Movements and Networks: Relational Approaches to Collective Action*. Oxford University Press.
- Doh, J.P., Tashman, P., Benischke, M.H., 2019. Adapting to grand environmental challenges through collective entrepreneurship. *Acad. Manag. Perspect.* 33 (4), 450–468.
- Dumbill, E., 2012. *Planning for big data*. Newton, MA: O'Reilly Media.
- Etter, M., Colleoni, E., Illia, L., Meggiorin, K., D'Eugenio, A., 2018. Measuring organizational legitimacy in social media: assessing citizens' judgments with sentiment analysis. *Bus. Soc.* 57 (1), 60–97.
- Everett, M.G., Borgatti, S.P., 2014. Networks containing negative ties. *Soc. Netw.* 38, 111–120.
- R. Federo X. Bustamante *Global Interorganizational Network Dataset from GDELT 2022*. <https://www.bustawin.com/interorg-network-dataset/>.
- Federo, R., Saz-Carranza, A., 2018. A configurational analysis of board involvement in intergovernmental organizations. *Corp. Gov. Int. Rev.* 26 (6), 414–428.
- Federo, R., Saz-Carranza, A., Esteve, M., 2020. *Management and Governance of Intergovernmental Organizations*. Cambridge University Press, Cambridge.
- Freeman, L.C., 1978. Centrality in social networks conceptual clarification. *Soc. Netw.* 1 (3), 215–239.
- Fruchterman, T.M., Reingold, E.M., 1991. Graph drawing by force-directed placement. *Softw. Pract. Exp.* 21 (11), 1129–1164.
- George, G., Howard-Grenville, J., Joshi, A., Tihanyi, L., 2016. Understanding and tackling societal grand challenges through management research. *Acad. Manag. J.* 59 (6), 1880–1895.
- Gest, N., Grigorescu, A., 2010. Interactions among intergovernmental organizations in the anti-corruption realm. *Rev. Int. Organ.* 5 (1), 53–72.

- Goldstein, J.S., 1992. A conflict-cooperation scale for WEIS events data. *J. Confl. Resolut.* 36 (2), 369–385.
- Gupta, D., Koontz, T.M., 2019. Working together? Synergies in government and NGO roles for community forestry in the Indian Himalayas. *World Dev.* 114, 326–340.
- Hagberg, A., Swart, P., Chult, D.S. 2008. Exploring network structure, dynamics, and function using NetworkX (No. LA-UR-08-05495; LA-UR-08-5495). Los Alamos National Lab. (LANL), Los Alamos, NM (United States).
- Hitt, M.A., Holmes Jr., R.M., Arregle, J.L., 2021. The (COVID-19) pandemic and the new world (dis) order. *J. World Bus.* 56 (4), 101210.
- Jehn, K.A., 1995. A multimethod examination of the benefits and detriments of intragroup conflict. *Adm. Sci. Q.* 40 (2), 256–282.
- Jones, C., Hesterly, W.S., Borgatti, S.P., 1997. A general theory of network governance: exchange conditions and social mechanisms. *Acad. Manag. Rev.* 22 (4), 911–945.
- Kamada, T., Kawai, S., 1989. An algorithm for drawing general undirected graphs. *Inf. Process. Lett.* 31 (1), 7–15.
- Kapucu, N., Beaudet, S., 2020. Network governance for collective action in implementing united nations sustainable development goals. *Adm. Sci.* 10 (4), 1–21.
- Kapucu, N., Hu, Q., 2020. Network Governance: Concepts, Theories, and Applications. Routledge.
- Kim, J.H., Marks, F., Clemens, J.D., 2021. Looking beyond COVID-19 vaccine phase 3 trials. *Nat. Med.* 27 (2), 205–211.
- Kim, R.E., 2020. Is global governance fragmented, polycentric, or complex? The state of the art of the network approach. *Int. Stud. Rev.* 22 (4), 903–931.
- Kojaku, S., Masuda, N., 2018. Core-periphery structure requires something else in the network. *N. J. Phys.* 20 (4), 043012.
- Lawton, T.C., Dorobantu, S., Rajwani, T.S., Sun, P., 2020. The implications of COVID-19 for nonmarket strategy research. *J. Manag. Stud.* 57 (8), 1732–1736.
- Lazarus, J.V., Ratzan, S.C., Palayew, A., Gostin, L.O., Larson, H.J., Rabin, K., Kimball, S., El-Mohandes, A., 2021. A global survey of potential acceptance of a COVID-19 vaccine. *Nat. Med.* 27 (2), 225–228.
- Lecy, J.D., Schmitz, H.P., Swedlund, H., 2012. Non-governmental and not-for-profit organizational effectiveness: a modern synthesis. *Volunt.: Int. J. Volunt. Nonprofit Organ.* 23 (2), 434–457.
- Lee, T.H., Riffe, D., 2019. Business news framing of corporate social responsibility in the United States and the United Kingdom: Insights from the implicit and explicit CSR framework. *Bus. Soc.* 58 (4), 683–711.
- Leetaru, K., Schrodt, P.A., 2013. Gdelt: Global data on events, location, and tone, 1979–2012. *ISA Annu. Conv.* 2 (4), 1–49 (Citeseer).
- Levin, N., Ali, S., Crandall, D., 2018. Utilizing remote sensing and big data to quantify conflict intensity: the Arab spring as a case study. *Appl. Geogr.* 94, 1–17.
- McAfee, A., Brynjolfsson, E., 2012. Big data: the management revolution. *Harv. Bus. Rev.* 90 (10), 60–66.
- McDonnell, M.H., King, B., 2013. Keeping up appearances: reputational threat and impression management after social movement boycotts. *Adm. Sci. Q.* 58 (3), 387–419.
- McPherson, M., Smith-Lovin, L., Cook, J.M., 2001. Birds of a feather: homophily in social networks. *Annu. Rev. Sociol.* 27 (1), 415–444.
- Moshtari, M., Gonçalves, P., 2017. Factors influencing interorganizational collaboration within a disaster relief context. *VOLUNTAS: Int. J. Volunt. Nonprofit Organ.* 28 (4), 1673–1694.
- Murdie, A., 2014. Scrambling for contact: The determinants of inter-NGO cooperation in non-western countries. *Rev. Int. Organ.* 9 (3), 309–331.
- Olsen, A.O., Sofka, W., Grimpe, C., 2016. Coordinated exploration for grand challenges: the role of advocacy groups in search consortia. *Acad. Manag. J.* 59 (6), 2232–2255.
- Ostrom, E., 2000. Collective action and the evolution of social norms. *J. Econ. Perspect.* 14 (3), 137–158.
- Ostrom, E., Ahn, T.K., 2009. The meaning of social capital and its link to collective action. In: Svendsen, G.T., Svendsen, G.H. (Eds.), *Handbook of Social Capital: The Troika of Sociology, Political Science and Economics*. Edward Elgar Publishing, U.K, pp. 17–35.
- Ostrom, E. 2004. Understanding collective action. *International Food Policy Research Institute – 2020 Vision Focus Brief*, 2 of 16:1–2.
- Park, J., Chung, E., 2021. Learning from past pandemic governance: early response and public-private partnerships in testing of COVID-19 in South Korea. *World Dev.* 137, 105198.
- Pearce, J.L., 2003. *Globalization and NGOs: Transforming business, government, and society*. Greenwood publishing group.
- Perez, O., Cohen, R., Schreiber, N., 2019. Governance through global networks and corporate signaling. *Regul. Gov.* 13 (4), 447–469.
- Plotly Technologies Inc, 2015. Collaborative data science. Montréal, QC, (<https://plotly>).
- Pruitt, D.G., Rubin, J.Z., 1986. *Social Conflict: Escalation, Stalemate, and Settlement*. Random House, New York.
- Quinton, S., Wilson, D., 2016. Tensions and ties in social media networks: towards a model of understanding business relationship development and business performance enhancement through the use of LinkedIn. *Ind. Mark. Manag.* 54, 15–24.
- Rombach, P., Porter, M.A., Fowler, J.H., Mucha, P.J., 2017. Core-periphery structure in networks (revisited). *SIAM Rev.* 59 (3), 619–646.
- Rondinelli, D.A., London, T., 2003. How corporations and environmental groups cooperate: Assessing cross-sector alliances and collaborations. *Acad. Manag. Perspect.* 17 (1), 61–76.
- Sapat, A., Esnard, A.M., Kolpakov, A., 2019. Understanding collaboration in disaster assistance networks: organizational homophily or resource dependency? *Am. Rev. Public Adm.* 49 (8), 957–972.
- Saz-Carranza, A., Albareda, A., Federo, R., 2020. Network tasks and accountability: a configurational analysis of EU regulatory networks. *Public Adm.* 98 (2), 480–497.
- Schilke, O., Cook, K.S., 2013. A cross-level process theory of trust development in interorganizational relationships. *Strateg. Organ.* 11 (3), 281–303.
- Schilling, M.A., Phelps, C.C., 2007. Interfirm collaboration networks: the impact of large-scale network structure on firm innovation. *Manag. Sci.* 53 (7), 1113–1126.
- Schrodt, P.A., 2012. *Conflict and Mediation Event Observations Event and Actor Codebook*, Version 1.1b3. Pennsylvania State University.
- Shipilov, A., Gawer, A., 2020. Integrating research on interorganizational networks and ecosystems. *Acad. Manag. Ann.* 14 (1), 92–121.
- Siegel, D.A., 2009. Social networks and collective action. *Am. J. Political Sci.* 53 (1), 122–138.
- Smith, K.G., Carroll, S.J., Ashford, S.J., 1995. Intra-and interorganizational cooperation: toward a research agenda. *Acad. Manag. J.* 38 (1), 7–23.
- Stadtler, L., 2018. Tightrope walking: navigating competition in multi-company cross-sector social partnerships. *J. Bus. Ethics* 148 (2), 329–345.
- Sydow, J., 1998. Understanding the constitution of interorganizational trust. In: Lane, C., Bachmann, R. (Eds.), *Trust Within and between Organizations: Conceptual Issues and Empirical Applications*. Oxford University Press, Oxford, pp. 31–63.
- Sytch, M., Tatarynowicz, A., 2014. Friends and foes: the dynamics of dual social structures. *Acad. Manag. J.* 57 (2), 585–613.
- Teegen, H., Doh, J.P., Vachani, S., 2004. The importance of nongovernmental organizations (NGOs) in global governance and value creation: an international business research agenda. *J. Int. Bus. Stud.* 35 (6), 463–483.
- Tischer, D., 2020. Collecting network data from documents to reach non-participatory populations. *Soc. Netw.* In press <https://doi.org/10.1016/j.socnet.2020.09.004>.
- Vu, H.T., Do, H.V., Seo, H., Liu, Y., 2020. Who leads the conversation on climate change? A study of a global network of NGOs on twitter. *Environ. Commun.* 14 (4), 450–464.
- Ward, M.D., Beger, A., Cutler, J., Dickenson, M., Dorff, C., Radford, B., 2013. Comparing GDELT and ICEWS event data. *Analysis* 21 (1), 267–297.
- Weidmann, N.B., 2016. A closer look at reporting bias in conflict event data. *Am. J. Political Sci.* 60 (1), 206–218.
- Yonamine, J.E., 2013. *A Nuanced Study of Political Conflict Using the Global Datasets of Events Location and Tone (GDELT) Dataset* (Doctoral dissertation). Pennsylvania State University.
- Zaidi, S.A., 1999. NGO failure and the need to bring back the state. *J. Int. Dev.: J. Dev. Stud. Assoc.* 11 (2), 259–271.