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The impact of the Sustainable Development Goals on a network of 276 international organizations

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ABSTRACT

Global sustainability governance is marked by a highly fragmented system of distinct clusters of international organizations, along with states and other actors. Enhancing inter-organizational coordination and cooperation is thus often recognized as an important reform challenge in global sustainability governance. The 17 Sustainable Development Goals, agreed by the United Nations in 2015, thus explicitly aim at advancing policy coherence and institutional integration among the myriad international institutions. Yet, have these goals been effective in this regard? We assess here the impact of the Sustainable Development Goals on the network structure of 276 international organizations in the period 2012–2019, that is, four years before and four years after the launch of the Sustainable Development Goals. The network structure was approximated by analyzing data from the websites of these 276 international organizations that were joined by more than 1.5 million hyperlinks, which we collected using a custom-made web crawler. Our findings are contrary to what is widely expected from the Sustainable Development Goals: we find that fragmentation has in fact increased after the Sustainable Development Goals came into effect. In addition, silos are increasing around the 17 SDGs as well as around the social, economic, and environmental dimensions of sustainable development.

1. Introduction

The need for better policy coherence in global sustainability governance is undisputed. Hundreds of international organizations active in this field are only sparsely connected (Beckfield, 2010; Greenhill and Lupu, 2017) and often compete for scarce resources while prioritizing their own mandates (Abbott et al., 2016; Biermann et al., 2009; Zelli and van Asselt, 2013). Global sustainability governance as a system of international institutions and organizations remains fragmented (Biermann et al., 2009; Biermann and Kim, 2020; Najam et al., 2004; Young, 2011; Zelli and van Asselt, 2013). Most scholars thus agree on the need for enhanced international cooperation to better address the interconnected global governance challenges such as health, trade, and the environment (Biermann and Kim, 2020; Hanf and Scharpf, 1978). There is also no lack of policy proposals and reform ideas, for instance for clustering institutions (Moltke, 2005), managing regime interplay (Oberthür and Stokke, 2011; Stokke, 2020), embracing complexity (Duit et al., 2010), or centralizing global sustainability governance through strong coordinating authorities (Biermann, 2000; Kim et al., 2020).

The agreement in 2015 of 17 widely accepted Sustainable Development Goals (SDGs) is part of this reform discourse to foster governance integration (Vijge et al., 2020). The conceptual idea is that a defined set of overarching global goals will provide a unifying force in global sustainability governance (Biermann et al., 2017; Biermann and Kanie, 2017; Kanie et al., 2019; Kim, 2016; Underdal and Kim, 2017; Vijge et al., 2020; Young et al., 2017). Global goals such as the SDGs are believed to create a common vision and incentive for more cooperation among international organizations and institutions and hence improve policy coherence (Haas and Stevens, 2017). More detailed debates focus on specific design features and enabling conditions of goals, asking among others whether there should be one overarching goal steering all others; how different goals are best organized in a broader framework; and what the optimal number of global goals is (Nilsson and Costanza, 2015). In short, numerous theorists and practitioners expect the SDGs to

Abbreviations: SDG, Sustainable Development Goal; UN, United Nations.

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have a measurable impact on reducing the degree of institutional fragmentation and breaking down deeply entrenched policy silos (Haas and Stevens, 2017).

Empirically, however, we know very little about the steering effects of the SDGs (Biermann et al., 2017; Fukuda-Parr, 2014). There is insufficient research on whether the global goals have integrated international institutions and organizations, and if so, whether this occurred uniformly or with varying effects on different institutions and organizations in a way that merely rearranges the patchwork of institutions. To add here theoretically guided empirical insights is the key contribution of our paper. We study whether and how the 17 SDGs had any impact on the degree and pattern of global governance fragmentation.

We focus on the network of international organizations as the unit of analysis and assess whether and how this network has converged or diverged since the SDGs came into effect on January 1, 2016. Several earlier studies have used network analysis to study whether international organizations self-organize into networks and how network structures change over time (Atouba and Shumate, 2010; Beckfield, 2010, 2008; Gomez and Parigi, 2015; Greenhill and Lupu, 2017; Kim and Barnett, 2000), some with a focus on the changing degree of fragmentation (Beckfield, 2010, 2008; Greenhill and Lupu, 2017; Kim, 2013). We differ from these earlier studies in both theory and method.

Regarding our theoretical contribution, our study is novel by focusing on the specific steering effects of the SDGs on the system of international organizations. We show how the SDGs have failed to reduce fragmentation so far, but rather have increased siloization among international organizations. Global goals thus appear to steer the cooperation behavior of international organizations towards more policy domain-specific cooperation, though this effect differs across groups of international organizations.

Methodologically, we introduce a novel dynamic network model that we detail further below. We retrieved and analyzed archival data of over 3,000,000 website pages of 276 international organizations that were joined by over 1,500,000 hyperlinks. The archival internet data covered a period of eight years between 2012 and 2019, that is, four years before and four years after the SDGs came into effect. We retrieved these data from the Internet Archive, an open-access data source, using a web crawler that we custom-built. We made three assessments of this network model on three levels: we studied whether fragmentation has increased or decreased over time, first, in the entire network of international organizations (macrolevel); second, among international organizations that work on the three different social, economic and environmental dimensions of sustainable development (mesolevel); and third, among international organizations that focus their work on the 17 different policy areas represented by the SDGs (microlevel). We completed our assessment by analyzing which types of international organizations give rise to the changes in the fragmentation patterns we observe. We discern between international organizations that belong to the UN system against those that do not; those with a regional scope against those with a global geographical scope; and between those working on the economic, social, or environmental dimension of sustainable development.

We proceed as follows. Drawing on the literature on goal setting, orchestration, and polycentricity in global governance, we first formulate three propositions that could explain how the SDGs might affect the degree and pattern of governance fragmentation. We then describe how we built our novel network model consisting of international organizations using the archival websites and hyperlinks that we extracted, and how we operationalized fragmentation in network terms. We then report two central findings and explore possible explanations for the observed changes in the degree and pattern of fragmentation of the international organizations network after the adoption of the SDGs.

2. Research framework and design

While there is no consensus on a definition, governance fragmentation as a concept revolves around whether and how international institutions, including international organizations, interact or cooperate. Depending on the cooperation, a system can be more or less fragmented (Biermann et al., 2020). While there is no ideal type or level of fragmentation, most scholars agree that the system of international organizations remains too fragmented, and that better cooperation is needed (Biermann et al., 2009; Biermann and Kim, 2020; Hanf and Scharpf, 1978; Najam et al., 2004; Young, 2011; Zelli and van Asselt, 2013). Yet how better cooperation can be achieved, and how to assess any changes in fragmentation, are both long-standing points of debate (Visseren-Hamakers, 2015).

An emerging body of literature argues that global goals such as the SDGs may help align the activities of international organizations towards more sustainable development (Bernstein, 2017; Biermann et al., 2017; Biermann and Kanie, 2017; Underdal and Kim, 2017; Young et al., 2017). Global goals are internationally agreed non-legally binding policy objectives that are time-bound, measurable and aspirational (Kim et al., 2020; Vijge et al., 2020). These goals can offer focal points for international organizations, which are often divided along issue areas or geographical lines (Greenhill and Lupu, 2017; Nilsson et al., 2009). Global goals are commonly contrasted against international rules (Kanie et al., 2019; Young, 2017), which are generally seen as being more precise and enforceable. Despite the non-legally binding nature of global goals, they are often expected to significantly influence governance at all levels of social organization (Haas and Stevens, 2017). In short, global goals may also bring international organizations together by reducing fragmentation between them.

One mechanism by which global goals could have such an impact is by functioning as “orchestrators” in dense networks of actors and institutions that help increase the coherence and consistency of fragmented global governance systems (Bernstein, 2017; Biermann et al., 2017; Biermann and Kanie, 2017; Kanie et al., 2019; Kim, 2016; Underdal and Kim, 2017; Vijge et al., 2020; Young et al., 2017). This conceptualization builds on the recent body of literature that views international organizations as orchestrators that enlist intermediaries to influence the behavior of target actors such as states (Abbott et al., 2015). In this case, shared goals are a key necessity for orchestration to take place (Abbott et al., 2012). Drawing on this idea of orchestration, recent work applied the notion of orchestration to global goals, conceptualizing global goals themselves as orchestrators. Some authors evoke here the metaphor of a musical orchestra in which international organizations are lead players while global goals are the sheet of music or the common script shared by all players (Underdal and Kim, 2017). This common script functions as a shared purpose for international organizations and may encourage decisionmakers to mutually adjust their activities to achieve the collective goals. Global goals would therefore help “orchestrate” the myriad activities of international organizations in the sustainability domain.

The effectiveness of global goals then critically depends on the extent to which international organizations accept them as steering mechanisms above their own objectives. International organizations would need to subscribe to the SDGs as universally agreed global aspirations and accept to be subject to the steering effects of the SDGs, and alter their behavior.

But do international organizations respond to the signals of the SDGs? We consider three ways in which international organizations are likely to accept the SDGs as guidance, informing our three following propositions.

(1) **Overall integration.** International organizations may consider the entire set of 17 goals as an integrative and indivisible framework and adjust their behavior accordingly. If organizations accepted the SDGs as a holistic framework, as an “integrated and indivisible” system in which all 17 goals are interconnected through multiple targets (Le Blanc,

2015), we would expect international organizations to work more towards integrated solutions that address trade-offs to realize collective outcomes, after the launch of the goals in 2015. In particular, we would expect that international organizations cooperate more with other organizations to share information, coordinate policies and make joint decisions (Biermann, 2008; Downie, 2020a, 2021; Gest and Grigorescu, 2010; Haas et al., 2013; Hall, 2015; Koops, 2017). The SDGs would convey a shared vision that facilitates cooperation (Downie, 2021; Finnemore and Jurkovich, 2020; Gray, 2008; Lipson, 2017; Lubell et al., 2017; Provan and Kenis, 2008), leading over time to a denser and more tightly knit network of international organizations (Biermann, 2017; Vijge et al., 2020). This leads us to our first proposition of possible measurable impacts that would show the steering effects of the SDGs:

Proposition 1. After adoption of the SDGs, the network of international organizations has become less fragmented.

(2) **Integration of environmental, economic, and social policies.** International organizations may associate each of the SDGs with one of the three dimensions of sustainable development, that is, environment, society, and economy. The distinction between these three dimensions of sustainable development is not made explicit in the goal framework itself but regularly done in practice (Breuer et al., 2019). No SDG, however, is framed exclusively as being social, economic, or environmental, which reflects a conscious design choice by governments (Kamau et al., 2018). During the negotiations, for example, the UN Environment Programme did not lobby for a separate set of "environmental SDGs," but rather sought to embed environmental concerns in all goals (Griggs et al., 2014; UNEP, 2013). The SDGs emphasize the interlinkages between the social, economic, and environmental dimensions and the need for international organizations working on a specific issue area to work across silos (Niestroy and Meuleman, 2016). One should hence expect as a steering effect of the SDGs that international environmental organizations, international economic organizations, and international social organizations would interact more closely and intensely in the years following the adoption of the SDGs. This leads us to our second proposition.

Proposition 2. After adoption of the SDGs, the network of international organizations has become less fragmented between the social, economic, and environmental dimensions of sustainable development.

(3) **Siloization around 17 SDGs.** International organizations may view the SDGs as 17 separate global policy objectives and then focus increasingly on one single SDG that is most linked to their own mandate, rather than on integration or a set of interrelated goals. The 17 SDGs would then lead to a steering effect that governments and UN officials have not intended: a new siloization around the 17 distinct SDGs in a system that becomes even more fragmented. Clusters of organizations would form after 2015 around issue areas as they are defined by the SDGs, such as organizational clusters around poverty (SDG 1), health (SDG 3), climate change (SDG 13), and so on (Boas et al., 2016; UN, 2015). Given that the novel boundaries between the 17 SDGs are the outcome of political negotiations involving many competing interests, we would observe a realignment of international organizations around these newly redefined 17 goals (Bernstein, 2017; Kim, 2016). The SDGs would reshape but not reduce the fragmentation of global governance (Gomez and Parigi, 2015; Nilsson et al., 2009; Pittman and Armitage, 2019; Zelli and van Asselt, 2013), and create or reorder silos instead of breaking them down (Bernstein, 2017). In global energy governance, for example, SDG 7 could then have encouraged the International Energy Agency to look inwards at the activities within their issue area rather than connecting externally with those working in other areas (Downie, 2021, 2020b).

Proposition 3. After adoption of the SDGs, the network of international organizations has become more fragmented between the 17 issue areas defined by the SDGs.

3. Data and methods

To assess structural fragmentation, our research builds on network analysis (Beckfield, 2010, 2008; Bodin and Crona, 2009; Greenhill and Lupu, 2017; Kim, 2020, 2013; Rudnick et al., 2019). Network analysis is a methodological approach that focuses on relationships between actors, and the emerging network structure formed by these actors and their relationships. The method is rooted in the assumption that actors do not merely exist in isolation, but that their positions vis-à-vis each other matter: they influence each other and their position in the network has meaning (Carrington et al., 2005; Hafner-Burton et al., 2009). Network analysis is increasingly common in global sustainability governance research to investigate institutional network structures (Bodin and Crona, 2009; Hafner-Burton et al., 2009; Kim, 2020; Maoz, 2012), including those of international organizations (Beckfield, 2008; Gest and Grigorescu, 2010; Gomez and Parigi, 2015; Greenhill and Lupu, 2017; Ingram and Torfason, 2010; Kim and Barnett, 2000; Sommerer and Tallberg, 2019), and other governance actors (Atouba and Shumate, 2015, 2010; Carpenter, 2007; Carpenter et al., 2014; Fliervoet et al., 2016; Green, 2022; Murdie, 2013; Rudnick et al., 2019; Wilson et al., 2016).

We modelled the network of international organizations by using their websites as nodes and the hyperlinks as proxy for cooperation ties between these international organizations. Hyperlinks are the clickable pieces of text or images on websites that lead to another piece of information on the World Wide Web, that is in our case, to the website of another international organization. Websites and hyperlinks have been used previously to map policies and institutions in the areas of health, energy, water and human security (Atouba and Shumate, 2010; Carpenter, 2007; Carpenter et al., 2014; Lang et al., 2013; McNutt and Pal, 2011; Widerberg, 2016; Yi and Scholz, 2016). Our study is the first to use hyperlinks to map and analyze the evolution of the network of international organizations over multiple years.

To map the hyperlink networks of international organizations over time, we used the Internet Archive to retrieve archived webpages of international organizations, a methodological innovation that helps address the lack of historical relational data available for global governance research. Previously used data such as co-membership (Alcacer and Ingram, 2013; Beckfield, 2010, 2008; Gomez and Parigi, 2015; Greenhill and Lupu, 2017), document citations (Kim, 2013; Kim and Morin, 2021), self-reported cooperation ties (Gallemore and Munroe, 2013; Gest and Grigorescu, 2010; Rudnick et al., 2019; Wilson et al., 2016), and official institutional ties (Sommerer and Tallberg, 2019) have been found useful in other studies. Yet they do not vary significantly over a short period of time and are generally insensitive to weak signals such as those from global goals due to high transaction costs. Furthermore, except for membership data, the availability of these types of data is limited for our research.

Therefore, the analysis of the websites of international organizations and their links is a useful alternative. In the wake of the internet revolution, 'digital diplomacy' has become increasingly important (Bjola et al., 2019; Manor, 2016; Westcott, 2008). International organizations have over the past decades strongly increased and centralized their online communication and outreach to promote their mandates and policies more effectively (Ecker-Ehrhardt, 2018a; Georgi and Schatral, 2012; Siebenhüner, 2009; Vadura, 2015). The content of websites of international organizations has become part of these extensive communication strategies, which are overseen by specialized units and with their core messages tightly controlled by senior management (Ecker-Ehrhardt, 2018b). Thus, when an international organization chooses to hyperlink to another organization's website, this is a conscious choice to associate with that organization (Maeyer, 2013). The hyperlink in essence conveys that "what this organization does is relevant to what we do." This may be for a variety of reasons, including relevant information or indicating an alliance (Park et al., 2004). Strategic reasons may also play a role, where hyperlinks may be created or

explicitly not created to increase traffic to the own website. Regardless of underlying motivations, once a hyperlink is created, visibility is given to another organization's website, reflecting trust, authority and legitimacy (Häussler et al., 2017; Maeyer, 2013; Nam et al., 2014; Park, 2003; Pilny and Shumate, 2012). While at the individual level, motivations and propensity to hyperlink may vary, the aggregate of hyperlinks reflects an underlying social structure (Halavais, 2008; Hsu and Park, 2011). This makes websites and hyperlinks useful proxies of inter-organizational relations to measure larger institutional alliances, policy coalitions and emerging policy directions of international organizations (Ecker-Ehrhardt, 2018a; Hayes and Scott, 2018; Nam et al., 2014; Pilny and Shumate, 2012; Vadura, 2015; Yi and Scholz, 2016).[1]

Website data are also available across multiple issue areas and countries. While the website texts are not always in the English language, the hyperlinks are machine-readable, allowing us to include also non-English websites in our research. In short, websites contain vital and up-to-date information about the activities of international organizations, and we hence expect to see effects of the SDGs even within the short timeframe since 2015.

We organized the collection of data in four processes (see Supplemental files figure S3).

First, we compiled and coded core data on international organizations. We collected a set of international organizations from the Correlates of War International Governmental Organizations dataset (Version 3) (Pevehouse et al., 2020; Wallace and Singer, 1970). This set includes international organizations that have at least three member states; hold regular plenary sessions at least once every ten years; and have a permanent secretariat or headquarters. We included only international organizations with member states from 2009 onward, thus disregarding organizations that have been dissolved or become inactive before that date. We also removed 37 international organizations that have no website of their own. Because the United Nations is the largest intergovernmental organization, we included its sub-units that operate with high autonomy, often with their own financial resources and leadership. These include all entities that are directly under the General Assembly and the Economic and Social Council, following here the UN System Chart 2019,[2] including thus all specialized agencies, funds and programs, research and training entities, and regional commissions. Finally, we included all organizations that have been appointed by the UN as so-called SDG "indicator custodians"[3] to disseminate knowledge and collect data on specific targets of the SDGs. In total, this led us to a set of 335 international organizations.

We classified these organizations according to three criteria. First, we classified international organizations according to which of the issue areas embedded in the 17 SDGs they primarily focus on and whether they are focusing on environmental, economic, or social policies. Coding was done separately by two researchers, and any discrepancies were discussed and resolved. Twelve organizations were discarded as they did not work on any of the issues embedded in the SDGs. Second, we coded these international organizations according to whether they are global or regional in scope. We considered an international organization as having a global scope if it had at least three member states in at least four continents each. We obtained membership data from the Correlates of War dataset and supplemented this when needed with manually obtained membership data from websites of international organizations. Third, organizations were coded as being part of the United Nations system or not. Descriptive statistics on the set of international organizations can be found in the Supplemental files table S2.

Second, we collected archived websites. We used the Internet Archive to retrieve archived websites of international organizations,[4] employing the Wayback CDX Server API.[5] For each international organization, we collected all available unique webpages of a website in each year from 2012 to 2019. A webpage of a website is analogous to a chapter in a book; for example, for the website unep.org, its webpages include *unep.org/science-data* and *unep.org/regions/Africa* and so on. The retrieved webpages for each international organization-year unit were thus our units of observation.

If fewer than three archived pages were available of a website of an international organization in a year, we considered this as missing data. This was the case for 11.3% of all international organization-year units. To prevent data loss, we imputed data where possible from the previous or next year, assuming that the website had not changed compared to the previous or next year. If this was not possible because three consecutive years were missing or if more than three years of data were missing, we deleted the international organization completely from the set. Following this approach, we deleted 47 international organizations with insufficient web presence, leading to a final set of 276 international organizations (see Supplemental files table S1).

Third, we extracted hyperlinks. For these 276 international organizations, we downloaded all available webpages, over three million in total (on average 1,375 per international organization per year) from the Internet Archive. We used Amazon Web Services cloud-computing for fast retrieval. After the download, we extracted hyperlinks from the HTML pages.[6] This resulted in over 1.5 million hyperlinks between the 276 international organizations in the set, for all years.

Fourth, we created and analyzed the networks. We counted for every pair of international organizations (IO) *i* and *j* in year *t*, IO_i-IO_j-t, that is, how many hyperlinks exist that go from the organization creating the hyperlink, IO_i, to the organization receiving the hyperlink, IO_j, in year *t*. Since the number of archived web pages per international organization per year differs, we divided the count of hyperlinks by the total number of webpages collected for the international organization creating the hyperlink, IO_i in year *t*. This results in a *relative hyperlink strength* for each pair of IO_i-IO_j in year *t*. To reduce noise in the data, we consider anything less than one hyperlink from IO_i to IO_j per 1,000 webpages of IO_i's website as an irrelevant connection. Consequently, we considered all ties with relative hyperlink strength < 0.001 as non-existing. The remaining ties with relative hyperlink strength ≥ 0.001 are considered existing ties. As the network measures used in our model require unweighted networks, we removed the tie weights, thus resulting in unweighted, directed yearly networks from 2012 to 2019 for the 276 international organizations.

3.1. Operationalization of fragmentation

We then used these networks to examine our three propositions. We used the following model.

For proposition 1—that the network of international organizations has become less fragmented after the adoption of the SDGs—we used a set of six network measures to quantify fragmentation (Kim, 2020): density, fraction of isolates, fraction of the giant component, average path length, modularity, and centralization (see table S3 and figure S4 in the Supplemental files for a summary and visual explanation of network

[1] Two concrete examples of hyperlinks reflecting inter-organizational relations among international organizations are given in Supplemental files figure S1 and S2.

[2] Document 19–00073, published July 2019, accessed on February 25, 2020, via *https://www.un.org/en/pdfs/18-00159e_un_system_chart_17x11_4c_en_web.pdf*.

[3] Obtained from 'Tier Classification for Global SDG Indicators ", version of 11 December 2019. This was the latest available list at the time of data collection. The list was obtained on February 25, 2020, via *https://unstats.un.org/sdgs/iaeg-sdgs/tier-classification/*.

[4] https://archive.org/. The Internet Archive is the most comprehensive and most globally oriented archive of websites.

[5] GitHub repository for the Wayback CDX Server API at *https://github.com/internetarchive/wayback/tree/master/wayback-cdx-server*.

[6] For instructions and code, see GitHub repository: *https://github.com/UtrechtUniversity/Global-Goals*.

parts and measures). For modularity, we used Louvain modularity in particular (Blondel et al., 2008). For centralization, we used indegree centrality (Atouba and Shumate, 2010; Green, 2013; Shumate, 2012). Given that the network measures differ in their units, ranges of values and directionality in relation to fragmentation (Kim, 2020), all network measures were normalized using min–max scaling. A normalized value of 1 indicates highest fragmentation compared to other years, and a value of 0 indicates lowest fragmentation compared to other years.

We then studied propositions 2 and 3, that is, that the network of international organizations has become less fragmented between the social, economic, and environmental dimensions of sustainable development after the adoption of the SDGs; and that after the adoption of the SDGs the network of international organizations has become more fragmented between the 17 issue areas defined by the SDGs. Here we assessed whether ties occur mainly between international organizations that work in the same area or the same sustainability dimension. In other words, we looked at *intra* and *inter cluster ties* (Greenhill and Lupu, 2017; Krackhardt and Stern, 1988). For sake of clarity, we refer to intra cluster ties as ties within an issue area or as ties within a sustainability dimension, respectively, and we refer to inter cluster ties as ties across issue areas or across dimensions. For each tie IO_i-IO_j, we considered whether IO_i and IO_j work in the same of the 17 issue areas, according to the manual coding performed. If this was the case, we considered the tie between them as being within an issue area. In the same way, we assessed whether ties are within a dimension or across the three dimensions of sustainable development, that is, within or across the economic, social, and environmental dimensions. Note that if a tie is within an issue area, it is always also by definition within a dimension, but not the other way around. Once we classified each tie, we assessed for each yearly network what percentage of all existing ties in the network is within an issue area or within a sustainability dimension. The remaining percentage of ties is across an issue area or sustainability dimension. As described, a hyperlink represents a conscious choice by one international organization to associate with another (Maeyer, 2013). Creating a hyperlink within or across an issue area or dimension thus reflects a choice to associate more with international organizations working on the same issue area or dimension, or more with those working in a different issue area or dimension. The change over time in percentage of ties within an issue area or dimension thus reflects the propensity of the network as a whole towards fragmentation or integration.

The focus of our study is on change in whole network structural properties over time. The unit of analysis is thus the entire network of international organizations, observed over eight years. De facto we have a sample size of one, consisting of 276 international organizations that interact. Given the sample size of one, we cannot infer whether any effects are statistically significant. While we acknowledge this is a shortcoming of this study, there is simply only one network of interacting international organizations in the world. As such, we can rely only on whole network descriptive statistics to make inferences, which is a common approach in longitudinal network studies in this field (Beckfield, 2010; Carrington et al., 2005; Greenhill and Lupu, 2017).

4. Results

We now report the results of our network analysis, following the three propositions that we developed above.

4.1. *The fragmentation among international organizations has not decreased after the SDGs were implemented (Proposition 1).*

We found no evidence in support of proposition 1, that is, that the network of international organizations overall would become less fragmented after the adoption of the SDGs. Fragmentation has not decreased after 2015. The level of fragmentation overall takes on a V-shaped curve (Fig. 1). From 2012 to 2016, fragmentation decreased and reached its lowest value in 2016, but then increased again from 2017 onwards.

A closer look at each of the network measures of fragmentation, as given in Table 1, allows for a more detailed analysis of this finding.

The overall tendency of international organizations to cooperate with each other (reflected by density) indicates that international organizations were less likely to cooperate in 2018 and 2019 than they were in any of the years before. This signals an increase in fragmentation.

Connection in the network as a whole (reflected by the fraction of the giant component and the fraction of isolates) shows that there is consistently one large group (the giant component) that includes at least 88% of international organizations in every year. The rest of the international organizations are mainly isolates. Overall, therefore, the

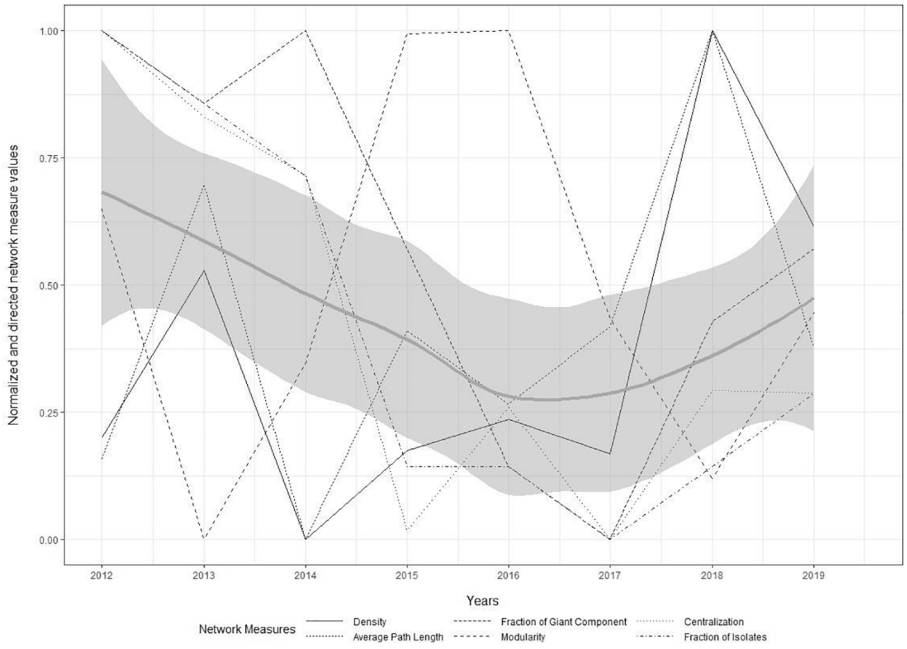

Fig. 1. Network fragmentation 2012–2019. Normalized network measures assessing fragmentation in the network of international organizations from 2012 to 2019. A value of 1 indicates higher fragmentation and 0 indicates lower fragmentation. The grey area indicates the smoothed average of all normalized network measures.

Table 1
Network measures per year. Centralization is based on in-degree; modularity is the Louvain modularity on the undirected network.

Measure	2012	2013	2014	2015	2016	2017	2018	2019
Nodes	276	276	276	276	276	276	276	276
Ties	1891	1827	1930	1896	1884	1897	1735	1810
Density	2.49%	2.41%	2.54%	2.50%	2.48%	2.50%	2.29%	2.38%
Fraction of giant component	88.4%	88.8%	88.4%	89.5%	90.6%	90.9%	89.9%	89.5%
Fraction isolates	10.9%	10.5%	10.1%	8.7%	8.7%	8.3%	8.7%	9.1%
Average path length	3.20	3.45	3.13	3.32	3.25	3.32	3.59	3.30
Centralization	0.384	0.396	0.404	0.452	0.436	0.454	0.433	0.434
Modularity	0.265	0.248	0.257	0.273	0.274	0.259	0.251	0.260

network of international organizations has consisted throughout of one large cluster, indicating a well-connected network, see Fig. 2. In 2018 and 2019, the giant component is slightly smaller compared to previous year, indicating that some international organizations "break off" from the group and become isolates. This signals increasing fragmentation in 2018 and 2019.

We also analyzed the internal structure of the giant component. With regards to centralization, we see the highest values in 2015, 2016 and 2017. In those years, the network was most starshaped. This indicates that in those years, a small number of international organizations acted as central hubs for cooperation, corresponding to the decrease in fragmentation. In the two years after, 2018 and 2019, centralization decreases, indicating that there are to a lesser extent such central international organizations. This corresponds to the increased fragmentation in 2018 and 2019 that we just reported.

The average path length, which indicates the average number of "steps" it takes for any international organization to reach another, had been the lowest in 2012 and 2014, indicating low fragmentation in those years—that is, the years *before* the SDGs were launched. In 2018, the average path length was highest, which indicates higher fragmentation. While these minimum and maximum values appear to follow the same V-shape in fragmentation as the other measures, the average path length shows more variance, so it must be interpreted cautiously.

As for modularity, we found that overall modularity is low, which indicates relatively low fragmentation *within* the giant component. This aligns with the visual representation of the network (Fig. 2) showing one big cluster of international organizations, with few communities to be identified. Modularity is lowest in 2013, indicating that communities in the giant component were even less pronounced in 2013 compared to the other years. However, in none of the years it was possible to identify clear communities within the giant component with visual inspection, hence the overall low modularity values.

In sum, several network measures point towards a decrease in fragmentation from 2012 to 2016 and an increase in 2017 to 2019. While fragmentation first decreased after adoption of the SDGs in 2015, it again increases thereafter. There is no stable long-term trend towards integration after 2015, so we found no evidence supporting proposition 1. In short, despite their strong language of advancing policy coherence and institutional integration, *the launch of the SDGs does not correlate with reduced fragmentation in the system of international organizations*.

4.2. Siloization in three dimensions of sustainable development (economic, social, environmental) and within the 17 issue areas of the SDGs is increasing (Propositions 2 and 3)

We found that siloization among international organizations has increased over time, in two directions.

First, siloization within the three dimensions of sustainable development (economic, social, environmental) is increasing: international organizations tend to cooperate more with international organizations that work on the same dimension (Proposition 2). We found that the percentage of ties within a sustainability dimension is increasing over time, signifying that international organizations are clustering around economic, social, and environmental issues (Fig. 3). This provides evidence against proposition 2; that after adoption of the SDGs the network of international organizations would become less fragmented between the social, economic, and environmental dimensions of sustainable development.

Second, international organizations cooperate more with organizations that work in the same SDG issue area (Proposition 3). We found that the percentage of ties within an issue area has increased over time (Fig. 4). Thus, out of all cooperation occurring between international organizations, increasingly more occurs between organizations that work in the same issue area around one SDG. In other words, international organizations are clustering around the 17 issue areas, resulting in a network that is increasingly fragmented between these 17 areas. This supports proposition 3 *that the network of international organizations has become more fragmented between the 17 issue areas covered by the 2030 Agenda after the adoption of the SDGs*.

The increase of ties both within an issue area and within a sustainability dimension indicates a process of "siloization" (Bernstein, 2017). This siloization seems to proceed quite steadily over time, with no clear change when the SDGs were implemented. The SDGs appear to neither reduce the silos nor to exacerbate them.

Our analysis has revealed further information on the directions of siloization.

We found that international organizations that focus on economic, social or environmental policies display different tendencies toward inter-organizational cooperation and siloization. Social international organizations are least likely to cooperate with others outside their social dimension; the social dimension is hence most siloized. Environmental international organizations, conversely, are most inclined to cooperate with others outside their dimension, yet this inclination has diminished over time, especially in 2019 (Fig. 5). For all three types of international organizations, either working on the economic, social, or environmental dimension, ties within that dimension have increased after the adoption of the SDGs. All types of international organizations have thus become more inclined to cooperate with others in their own dimension rather than with international organizations in other dimensions.

In addition, we found substantial variation between international organizations that belong to the UN system and those that do not (Fig. 6). International organizations outside the UN system have a higher percentage of ties within a dimension than international organizations in the UN system. In other words, organizations that belong to the UN system are more likely than organizations outside the UN system to cooperate across the three dimensions of sustainable development. This difference has become more pronounced after the SDGs were implemented. For the UN system, the number of ties within a sustainability dimension decreases in 2012–2017, indicating more cooperation across the three dimensions and hence less fragmentation. Yet in 2018 and 2019, ties within a sustainability dimension increase sharply again, though it is still lower than before the adoption of the SDGs. For non-UN organizations, the number of ties within a dimension steadily increases and is higher after the SDGs were implemented. These results indicate that non-UN system organizations tend to cluster their cooperation around economic, social, and environmental dimensions, more so than UN system organizations do. This difference is increasing until 2018.

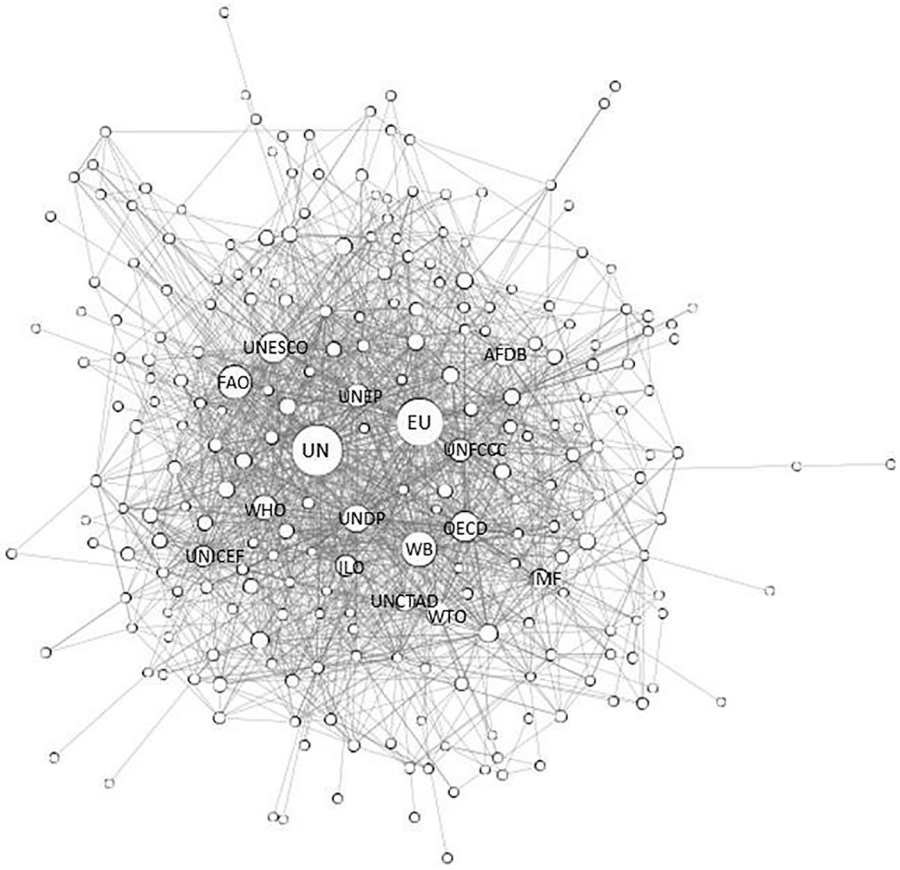

Fig. 2. Visualization of the network of international organizations in 2019. The size of the node is proportional to the indegree, i.e. the number of incoming ties to a node. Node labels are displayed for nodes with an indegree of 25 or higher. AFDB = African Development Bank; EU = European Union; FAO = UN Food and Agriculture Organization; ILO = International Labour Organization; IMF = International Monetary Fund; OECD = Organization for Economic Development and Cooperation; UN = United Nations; UNCTAD = UN Conference on Trade and Development; UNDP = UN Development Programme; UNEP = UN Environment Programme; UNESCO = UN Educational, Scientific, and Cultural Organization; UNFCCC = UN Framework Convention on Climate Change; UNICEF = UN Children's Fund; WB = World Bank; WHO = World Health Organization; WTO = World Trade Organization.

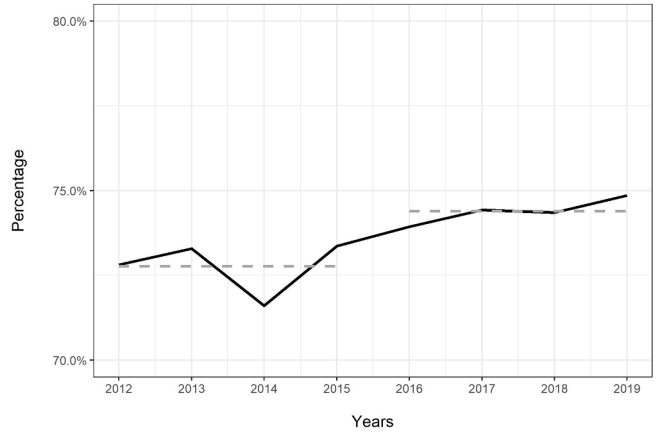

Fig. 3. Percentage of ties within a sustainability dimension. Ties occurring within a sustainability dimension, as percentage of all ties in the network, over time. The grey lines indicate average values in the years before, 2012–2015, and after, 2016–2019, the SDGs were implemented.

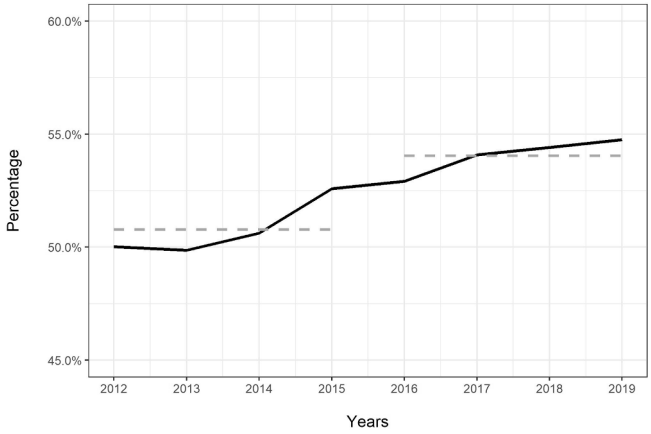

Fig. 4. Percentage of ties within one of the 17 issue areas of the SDGs. Ties occurring within an issue area, as percentage of all ties in the network, over time. The grey lines indicate average values in the years before, 2012–2015, and after, 2016–2019, the SDGs were implemented.

Finally, international organizations with a global scope are more likely to cooperate across different sustainability dimensions than international organizations with a regional scope, and this difference has increased since the adoption of the SDGs (Fig. 7). For regional international organizations, the percentage of ties within a sustainability dimension is increasing over time, indicating increasing siloization driven by the same organizations. For the global international organizations, ties within a sustainability dimension are quite stable over time, showing no clear difference before and after the adoption of the SDGs.

5. Discussion

Our study shows that despite efforts to present the SDGs as a holistic and integrated framework, fragmentation has not decreased in the hyperlink network of international organizations since the global goals were agreed. While our results indicate a decrease in network fragmentation in 2012–2017, this increased again in 2018–2019. Furthermore, we found that siloization between issue areas has increased. International organizations increasingly focus on the network around their own issue areas and sustainability dimension rather than giving

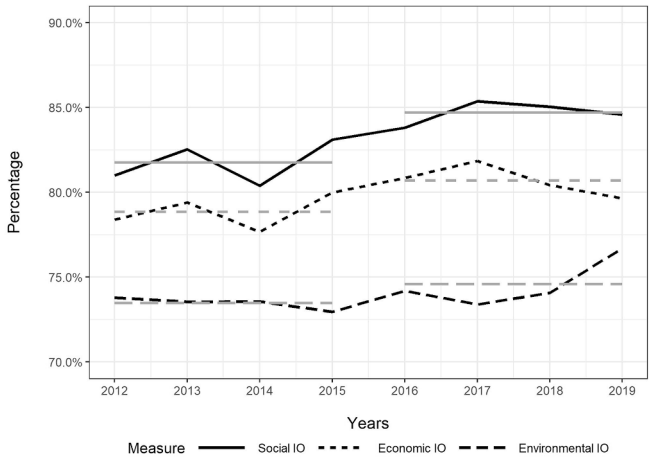

Fig. 5. Siloization: Economic, social and environmental international organizations. Ties within a dimension, for international organizations that focus on social (solid), economic (short dash), or environmental (long dash) policy, as percentage of all ties in the network. The grey lines indicate average values in the years before, 2012–2015, and after, 2016–2019, the SDGs were implemented.

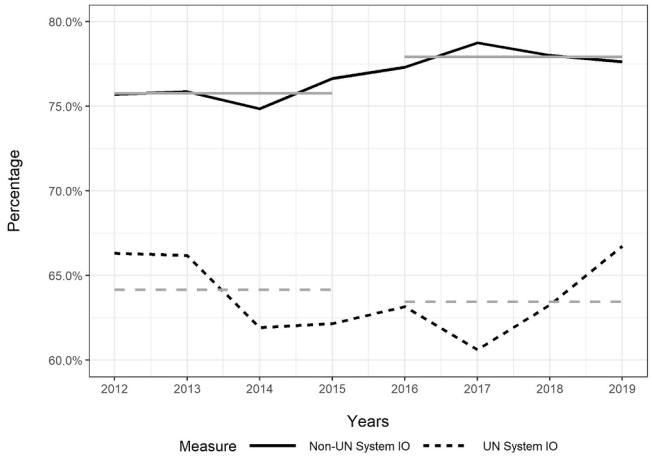

Fig. 6. Siloization: UN and non-UN system international organizations. Ties within a dimension for international organizations that belong to the UN system (dash) or do not (solid), as percentage of all ties in the network. The grey lines indicate average values in the years before, 2012–2015, and after, 2016–2019, the SDGs were implemented.

attention to international organizations outside their own area. While the overall trend of increasing siloization is clear, there are some differences between groups of international organizations. Siloization is strongest with international organizations working on the economic and social dimensions of sustainability; those with a regional scope; and those outside the UN system.

In interpreting our results, it should be noted that our study looks only at one specific measure of fragmentation, hyperlink networks. Nevertheless, we believe our findings yield several important insights for strategies of "global governance through goals." First, issue-specific global goals strengthen silos around issue areas. The SDGs are not having the effect of "breaking down silos" that they were intended to have. This is in line with expectations and findings of several scholars who warned that having separate, issue area-specific goals would lead to the reinforcement of silos (Bernstein, 2017; Gomez and Parigi, 2015; Kim, 2016; Nilsson et al., 2009; Pittman and Armitage, 2019; Underdal and Kim, 2017; Zelli and van Asselt, 2013). The same was observed with the earlier Millennium Development Goals, which encouraged

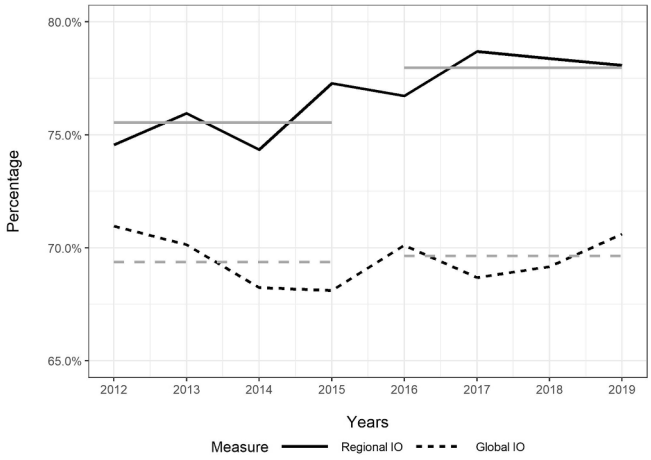

Fig. 7. Siloization: Global and regional international organizations. Ties within a dimension for international organizations that have a global (dash) or regional (solid) scope, as percentage of all ties in the network. The grey lines indicate average values in the years before (2012–2015) and after (2016–2019) the SDGs were implemented.

implementation approaches that were judged later as "vertically structured and conceptually narrow" and lacking attention for issues outside the goals (Bisbee et al., 2020; Fukuda-Parr, 2016, 2014).

Second, global goals have different effects on different types of international organizations. Our findings showed that in international organizations that are part of the UN system, cooperation within the own sustainability dimension has decreased, indicating that here, the economic, social and environmental silos are becoming less pronounced for UN system international organizations. Global goals may here bring an orchestration effect within UN system organizations, even though not showing this effect across the board.

While the latter indicates some effect of global goals, both insights together draw into question the functioning of goals as a global governance tool, at least regarding their envisaged role as orchestrators of international organizations and institutions (Bernstein, 2017). After all, the goals are intended to apply to all international organizations to increase cooperation and strike a balance between economic, social, and environmental policy objectives. If only certain groups of international organizations try to increase cooperation across issue areas and sustainability dimensions, this conflicts with the intention of the goals to address global issues in an integrated and holistic manner. In addition, that we observed effects of the SDGs mainly within the UN system may suggest that the goals tend to influence organizations that had a major role in their development, but less so other international organizations.

For the groups where no increased cooperation was observed, it remains a question why this is the case, despite the strong call in the SDGs for integration and the breaking down of silos. While more research is needed to elucidate this, the insights from our study combined with other studies provide several fruitful avenues towards an explanation.

One premise of this study—following the UN narrative in this field—is that international organizations subscribe to the SDGs and are willing to accept their steering effects. This premise could simply be false. It would instead be rather consistent with our data to assume that international organizations, especially those outside the UN system and those with an economic focus or regional scope, "resist" being governed by global goals because they possibly prefer to focus on their own goals and targets (Bernstein, 2017). Earlier mandates and established structures and procedures may trump the global agreement on the SDGs as a guiding principle (Bernstein, 2017; Biermann and Siebenhüner, 2009; Underdal and Kim, 2017). In this case, "business as usual" continues, and the siloization that we observed would indicate a continuation of the siloization already occurring before 2015. A promising avenue of further research, therefore, could be to investigate to what extent

international organizations subscribe and are integrating the SDGs into their work.

However, this view of "resisting goals" does not fit the evidence completely. As international organizations strive to remain valuable to their principals, they are known to react to a changing global context (Abbott et al., 2016; De Wit et al., 2020), which would include adjusting their programs and efforts to the content of global goals (Bridgewater et al., 2014). A closer inspection of our website data also showed that most international organizations, also outside the UN system, do mention the SDGs on their websites.[7] So the SDGs are considered relevant by many international organizations. Several qualitative studies also show that at least some international organizations do internalize the SDGs (Censoro et al., 2020; Downie, 2020b; Montesano et al., 2021). Thus, it seems likely that most international organizations primarily see the SDGs as separate goals rather than an integrated agenda, leading to the cherry-picking of those goals that best fit their agenda, as has been observed for other governance actors such as business sector and national governments (Allen et al., 2018; Forestier and Kim, 2020; Kornieieva, 2020; Schmidt-Traub et al., 2017). This focusing on only the "own" goals would lead to the reinforcement of silos over time (Boas et al., 2016; Stevens and Kanie, 2016), as we have observed in this study. A future avenue of research could focus on whether and why international organizations view the SDGs as separate goals rather than an integrated framework, and whether this leads to cherry-picking SDGs and to focusing cooperation efforts around certain SDGs.

Finally, research could focus on whether the siloization observed in this study results from a lack of *willingness* or lack of *ability* of international organizations to cooperate beyond their own issue area. The SDGs are internally incoherent, with some inherently conflictive targets, and many interdependencies between the targets are context-specific (Allen et al., 2019; Boas et al., 2016; Lusseau and Mancini, 2019; Nilsson et al., 2009; Underdal and Kim, 2017; Vandemoortele, 2018; Weitz et al., 2018). Thus, to truly come up with "integrated solutions" that account for interdependencies and spillovers, knowledge and resources are required to elucidate the "ripple effects" of the efforts of one organization. Many international organizations may lack the resources and ability to account for the many interdependencies between the SDGs, and engage in cooperation activities on top of that, despite a willingness to do so. Alternatively, international organizations might simply lack interest in cooperating more outside their own issue area. Calls for extensive cooperation can be perceived as threatening the autonomy of international organizations, especially so for the smaller ones with less resources and authority (Biermann, 2008; Underdal and Kim, 2017). In addition, international organizations may be reluctant to cooperate more outside their own issue area as they do not intend to tread upon other organizations' mandates. Further research in this area could, for example, focus on perceptions of the SDGs by international organizations to assess whether they are generally perceived as helpful and how the SDGs relate to the own mandate.

Methodologically, there are several limitations of this study that may be improved upon in future studies. Firstly, as described, in our longitudinal study we could not discern effects of the SDGs from effects of other global trends that may have influenced the network of international organizations, as there is no group of international organizations that is not "exposed" to the SDGs and could have served as a counterfactual. To discern the steering effects of the goals from other ongoing global changes, additional qualitative research is needed. Secondly, we applied a rather novel method, that is, the analysis of hyperlink data. While the analysis of hyperlinks in global governance is to some extent established, the use of web archives for network analysis is still in its infancy. More applications of this method are necessary, within and outside global governance, to get a clearer view of its strengths and weaknesses. In addition, while hyperlinks are a valuable proxy for cooperation and fragmentation, further studies using other quantitative and qualitative measures to assess the influence of the SDGs on fragmentation would be useful to confirm our findings. Finally, as far as we are aware, this is the first study to assess fragmentation with a consolidated set of network measures (Kim, 2020). While the measures overall point in the same direction, some were less clear than others. More refinement of a network model for measuring fragmentation may be useful.

6. Conclusion

Our study shows that since the implementation of the SDGs, fragmentation among international organizations has not decreased. Instead, siloization has increased around the 17 SDG issue areas as well as around the economic, social and environmental dimensions of sustainable development. International organizations are central to addressing the issues encompassed in the SDGs (Cormier, 2018; Sachs, 2006; Stiglitz, 2008), and the consequences of continued siloization could be severe. Working in silos may hamper the exchange of novel ideas and knowledge amongst international organizations that is required to deal with the complex and globally interconnected problems that the SDGs aim to address, and it might limit options for joint standards, policies, and transformative norm development (Bodin, 2017; Borgatti and Halgin, 2011; Burt, 2004). Moreover, such effects may trickle down to the national level because of the significant role that international organizations have in shaping domestic policies in many countries (Abbott and Bernstein, 2015; Cormier, 2018; Tosun and Peters, 2018).

While the eventual impact of the SDGs can only be assessed towards the end of their implementation period—that is, by 2030—recent data suggest that the world is not on track to achieve them. Progress on many targets has stalled or reversed (UN, 2021). In the end, the onus is on political actors at all levels to implement the goals. A reduction of fragmentation and siloization, at all levels of global sustainability governance and cutting across policy areas, is indispensable in achieving the SDGs (Biermann and Kanie, 2017; Gupta and Nilsson, 2017). Our study has shown that, so far, the opposite is happening.

CRediT authorship contribution statement

Maya Bogers: Conceptualization, Methodology, Writing – original draft, Writing – review & editing, Visualization, Formal analysis. **Frank Biermann:** Conceptualization, Supervision, Writing – review & editing, Funding acquisition. **Agni Kalfagianni:** Conceptualization, Supervision, Writing – review & editing. **Rakhyun E. Kim:** Conceptualization, Supervision, Writing – review & editing. **Jelle Treep:** Methodology, Software, Data curation. **Martine de Vos:** Methodology, Software, Data curation.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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[7] A brief text analysis of our website data reveals that in 2019, all UN international organizations and more than 60% of non-UN international organizations use the SDGs at least once on their website.

Data availability

A list of international organizations and their websites used in the analysis is in the Supplementary material, table S1. Hyperlink data was obtained through the Internet Archive's Wayback CDX Server API. Workflow to obtain this data is available at: https://github.com/UtrechtUniversity/Global-Goals. Processed hyperlink data and manually coded data for international organizations are available from the corresponding author upon request.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.gloenvcha.2022.102567.

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