

Clubs of Clubs: Fragmentation in the Network of Intergovernmental Organizations

RESEARCH NOTE

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Has international cooperation become fragmented in recent decades? We focus on a specific form of potential fragmentation in the international system: the extent to which the network of intergovernmental organizations (IGOs) consists of distinct clusters of closely cooperating states. IR scholars—including those with an interest in the causes and consequences of membership in IGOs—pay relatively little attention to the structure of the larger IGO network. At the same time, scholars concerned with fragmentation often assume that it has increased without clear measures of this phenomenon. We use the network analytic technique of modularity maximization to show that throughout the post–World War II period, the structure of the IGO network can generally be divided into distinct groups of states on the basis of their shared IGO memberships. Yet we also show that temporal trends indicate that the IGO network has become less fragmented in recent decades, suggesting that cooperation via these organizations has become more global and less regional. Our findings indicate that, at least as far as cooperation through formal organizations is concerned, fragmentation has decreased in recent decades.

Introduction

As the number of intergovernmental organizations (IGOs) continues to expand, states embed themselves within an increasingly dense and complex institutional network. Scholars of international relations argue that membership in these institutions can influence important outcomes such as conflict, regime change, crisis bargaining, economic policy, and human rights (Finnemore 1993; Martin and Simmons 1998; Leeds 1999; Pevehouse 2002; Kelley 2004; Gheciu 2005; Dai 2005, 2007; Bearce and Bondanella 2007; Fang 2008, 2010; Dorussen and Ward 2008; Cao 2009; Avant, Finnemore, and Sell 2010; Donno 2010; Greenhill 2010, 2015; Spilker 2012; Johns 2012; Johnson 2013, 2014). Yet IR scholars have paid surprisingly little attention to analyzing the structure of this complex network of relationships and, more specifically, to the question of whether it gives rise to a more tightly integrated world or whether it serves to consolidate existing regional blocs.

Meanwhile, scholars working in a diverse set of literatures and research traditions show increasing concern about the extent of fragmentation in the international system, especially with respect to international cooperation

(see Hafner 2003; Weiss and Wilkinson 2014). Instead of creating centralized organizations, states sometimes choose to create complex regimes of smaller organizations, resulting in possible incoherence and overlap between governing institutions (Biermann et al. 2009; Keohane and Victor 2011). The multiplicity of international adjudicatory bodies may result in the inconsistent application and creation of legal rules (Raustiala 2013). A highly fragmented international system may be dividing itself into internally cooperative groups of states (Rosenau 1995). Of particular relevance to this paper, Beckfield (2008, 2010) argues that the international system is fragmented in the sense that the IGO network has become increasingly decentralized.

In this paper, we aim to build on these two literatures and contribute to our understanding of the fragmentation of the international system by analyzing the structure of the IGO network.¹ A fragmented system means different things to different scholars of the international system, whether it is one that features incoherence in international law, or a system in which states choose to create formal or informal institutions with limited scope, or a fractionalized system in which groups of states cluster into cooperative subsystems (Adler and Barnett 1998; Goh 2007/2008). We define fragmentation as the extent to which a system can be divided into distinct clusters, and we restrict our analysis to the question of fragmentation

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¹Throughout this article we use the term “IGO network” to refer to the set of relationships that form among states as a result of their membership in IGOs. Our paper builds on a growing literature that uses network analytic tools in the study of international relations (for example Carpenter 2011; Dorff and Ward 2013; Carpenter et al. 2014; Lupu and Poast 2016; Larson 2016; Chyzh 2016).

in the IGO network. Our concept of fragmentation is analogous to the use of the term “polarization” in much of the international security literature: “the degree of polarization of the group is the degree to which antipathetic, non-overlapping subgroups are formed” (Hart 1974, 232; see also Wallace 1973; Bueno de Mesquita 1978; Maoz 2006).

Why do we need to improve our understanding of fragmentation in the IGO network? We see at least two reasons. First, those who study the fragmentation of international cooperation more broadly (including IGOs, treaties, and other institutions) have long debated its effects, with some arguing that it reduces opportunities for issue linkage (Haas 1980), fosters cooperation by allowing states to reach agreements more easily (Bodansky 2002; Victor 2007), “jeopardizes the credibility, reliability, and, consequently, the authority of international law” (Hafner 2003, 856), and unevenly benefits powerful states (Benvenisti and Downs 2009). Yet much of this literature takes increasing fragmentation for granted.² We aim to contribute to this literature by measuring fragmentation over time in the IGO network, an important component of the broader network of international cooperation. Second, others who measure fragmentation using approaches similar to ours find that it has significant effects. Recent research shows that a fragmented international system, in terms of IGO ties, regime type, and trade, is more prone to interstate conflict (Cranmer, Menninga, and Mucha 2015). Maoz (2006) finds that fragmentation in the alliance network correlates with a larger probability of systemic conflict, but fragmentation in terms of trade is associated with a smaller probability of systemic conflict.

We use the network analytic technique of modularity maximization (described below) to measure the extent to which the IGO network consists of distinct IGO clusters. An IGO cluster is a group of states that share broadly similar patterns of IGO membership, constituting portions of the IGO network in which interactions among the states can be thought to be especially profound.³ As Wallace (1973, 580) notes when conducting a similar analysis of alliance ties, “the tightness of the bond between two nations is a function not only of the direct bond between the pair, but also of the number of other nations with which they are mutually linked.” In a highly fragmented international system, the IGO network would consist of clusters of states that cooperate closely with each other through IGOs, but where relatively little cooperation takes place across the cluster boundaries. A less fragmented system, on the other hand, would be one in which the pattern of cooperation is more evenly spread throughout the system. This type of system would be consistent with the more globally integrated institutional structure that world society theorists envisage (Beckfield 2010). In our own related work, we have found that states that belong to the same IGO cluster are less likely to enter into conflict with each other, independently of the extent to which they belong to the same individual IGOs (Lupu and Greenhill 2016).

We find that the degree of fragmentation in the IGO network has *not* increased. In fact, according to some of

our analyses, fragmentation has actually *decreased* in recent decades. Rather than suggesting a world in which the states of the Global South are increasingly left behind by increases in institutional cooperation in the North, our results imply that the extent to which cooperation through formal institutions is fragmented has not increased since World War II. This finding suggests that the fragmentation of international cooperation may not be as ubiquitous as scholars often assume it to be. It further suggests that, if and to the extent that fragmentation in a broader sense has increased, this has occurred via forms of cooperation other than formal IGOs, including informal institutions, ad hoc cooperation, and the fragmentation of norms.

The remainder of this article proceeds as follows. The next section briefly describes key existing arguments regarding fragmentation and the IGO network. We then explain our data and research design, as well as how we conceptualize and operationalize fragmentation. In the next section we explain our results, beginning with a descriptive analysis of the IGO clusters and continuing with a dynamic analysis of fragmentation. The final section concludes by presenting the implications of our findings.

Fragmentation and the IGO Network

Has the international system become more or less fragmented in terms of formal cooperation through IGOs? Those who take a more optimistic view argue that the proliferation of IGOs helps bring states closer together. Liberals view IGOs as promoting peace between states, which in turn encourages further integration. Sociological institutionalists view IGOs as contributing toward the development of a single “world society” or “world culture” that can cause states to adopt policies and organizational forms that are surprisingly similar to one another (Finnemore 1996; Meyer et al. 1997; Boli and Thomas 1999). On the other hand, a large body of scholarship draws attention to the often uneven nature of the institutionalization of international cooperation. Scholars analyze the extent to which the international system increasingly features regime complexity, overlapping institutions, and institutional density. Many identify fragmentation in terms of the formal organizations, informal coalitions, rules, adjudication, authority, and norms that govern international relations (Rosenau 1995; Keohane and Victor 2011; Raustiala 2013; Finnemore 2014).

What drives patterns in which states join IGOs? Some scholars find that, in general, richer, more democratic states belong to more IGOs than their poorer, less democratic counterparts (Jacobson, Reisinger, and Mathers 1986; Shanks, Jacobson, and Kaplan 1996; Beckfield 2003). For instance, in 2005 the United States belonged to ninety different IGOs, whereas Burundi—the poorest country that year on the basis of its per capita GDP—belonged to only forty seven IGOs. Significant inequalities exist among states’ levels of engagement with the world of IGOs, but these inequalities are perhaps less pronounced than one might expect (Beckfield 2003). The memberships of many IGOs include nearly every sovereign state. Thus, even very poor states are unlikely to become completely disconnected from efforts at international cooperation at the global level.

Such observations tell us little about temporal trends in fragmentation. While some universal IGOs serve to bind (almost) all states to (almost) all others, most IGOs are narrower in membership—that is, their members consist

²For example, Biermann et al. (2009, 31) conclude their review of the literature on the effects of fragmentation by noting that “This article has focused on the issue of fragmentation, which we see as a ubiquitous structural characteristic of global governance architectures today.”

³As individual IGOs are sometimes referred to as “clubs,” IGO clusters are akin to “clubs of clubs.”

only of states that share some characteristic, such as location in the same geographical region, a common language, or a similar level of economic development. This suggests an important question: whether the rapid growth in IGOs in the post-WWII era mainly stems from the emergence of more universal IGOs or from the expansion of the more insular IGOs.

Much of the existing research on the effects of IGOs focuses on either individual organizations or the cumulative effects of membership in many organizations. Many rely upon a relatively straightforward count of the total number of IGOs to which a state belongs, or to which both members of a dyad belong (see Russett, Oneal, and Davis 1998; Frank, Hironaka, and Schofer 2000). Others use network measures to analyze how information flow or embeddedness in the IGO network can affect dyadic relations (see Ingram, Robinson, and Busch 2005; Hafner-Burton and Montgomery 2006; Dorussen and Ward 2008; Cao 2009, 2010, 2012; Torfason and Ingram 2010; Kinne 2013a,b). These studies primarily focus on using IGO network statistics as independent variables, rather than as a means to describe how the network's structure has changed over time.

In a key exception, Beckfield (2010) draws attention to structural trends in the IGO network and calls on scholars to adopt a more critical approach toward the claims of the world polity school—a school of thought that views both IGOs and international non-governmental organizations (INGOs) as promoting a universal set of norms, or what might be considered a “world culture” (Finnemore 1996; Meyer et al. 1997; Boli and Thomas 1999). Beckfield (2010) observed a steady decline in the density of the IGO network (specifically, the proportion of pairs of IGOs that have at least one member state in common), as well as a steady increase in what network analysts refer to as the “centralization” of the IGO network. He suggests that an increasingly fragmented network consisting of densely connected clusters of IGOs is taking the place of the more evenly distributed network envisioned by the world polity theorists.⁴ He also observed a steady increase over the post-WWII period in the correlation between the pattern of network ties observed in the actual network and those that we might expect to find in a hypothetical network whose structure is driven entirely by regional ties, thereby suggesting that states are organizing themselves into more tightly knit regional groupings than ever before.⁵ Reflecting on these findings, Beckfield (2010, 1052) concluded that “States are coming together. Organizations are coming apart. In sum, the world polity shows no evidence of flattening. Nor is it becoming a small world. Instead, the world polity more closely resembles ‘a world of regions’ [citations removed].”

Data and Methods

IGO Data

We begin by building the IGO network using the Correlates of War 2 International Governmental Organizations Data version 2.3 (Pevehouse, Nordstrom, and Warnke 2004). This dataset codes state membership

in IGOs based on annual editions of the Yearbook of International Organizations. Data are available in five-year intervals for the period from 1815 to 1965, and annually from 1965 to 2005. For the purposes of this analysis, we consider only states with full membership in IGOs, and exclude states with associate or observer status. The Pevehouse, Nordstrom, and Warnke (2004) dataset recognizes IGOs that meet all of the following criteria:

1. The organization must consist exclusively of states. This means that organizations that consist of non-state actors (for example international business associations or organizations composed of individual actors such as Amnesty International) are not treated as IGOs.
2. The organization must have a minimum of three states as members. Bilateral institutions are therefore excluded.
3. The organization must have a minimal level of formal institutionalization. Specifically, it needs to have a permanent staff, secretariat, and/or headquarters.
4. The organization is established by a legal treaty. Organizations that are mere offshoots of existing organizations (so-called “emanations”) are not recognized as independent IGOs.

We use these data to create a network in which states serve as nodes and shared memberships in IGOs serve as ties (“edges”). We construct an edge between every pair of states that share at least one IGO membership in common. This approach to network modeling is sometimes referred to as a one-mode network projection. When this approach is used, one should carefully assign weights to the edges based on the strength of ties (Zhou et al. 2007). For each dyad-year, we sum the number of shared IGO memberships and assign that total as the weight of the edge between those nodes for that year. Thus, for example, if States A and B belong to fifteen of the same IGOs in year T, then the edge between nodes A and B in the network for year T is 15. While this approach has some limitations that the technical literature continues to struggle with (see generally Opsahl 2013), it is consistent with most existing analyses of the IGO network (see Hafner-Burton and Montgomery 2006; Beckfield 2008; Dorussen and Ward 2008; Cao 2009, 2010, 2012; Kinne 2013a; cf. Gomez and Parigi 2015).

Temporal Trends in the IGO Network

To illustrate the growth of the IGO network, Figure 1 provides two different perspectives on the post-WWII trends in IGO memberships. The left-hand panel tracks the growth in the number of IGOs to which states belong. The heavy black line shows the trend in the median number of state IGO memberships over the period, indicating a roughly linear increase from a low of twenty six in 1945 to a high of fifty nine by 2005. To give a better sense of the overall distribution, we have included a series of lines (plotted in light gray) that show the trends in the number of IGO memberships at each decile. These lines indicate that although the gap in IGO memberships between the most- and least-connected states has increased over the period, the vast majority of states steadily joined more IGOs.

The right-hand panel of Figure 1 tracks variation in the number of member states per IGO. The heavy black line again shows the trend in the median. Interestingly, this line has remained relatively flat over the period. This is

⁴Beckfield's definition of centralization can also be conceived in terms of the extent to which the network features one central actor and many peripheral actors.

⁵In a recent study, Gomez and Parigi (2015) also examine the structure of the IGO network. Their analysis reveals mixed results, suggesting that the IGO network oscillates between periods of fragmentation and consolidation.

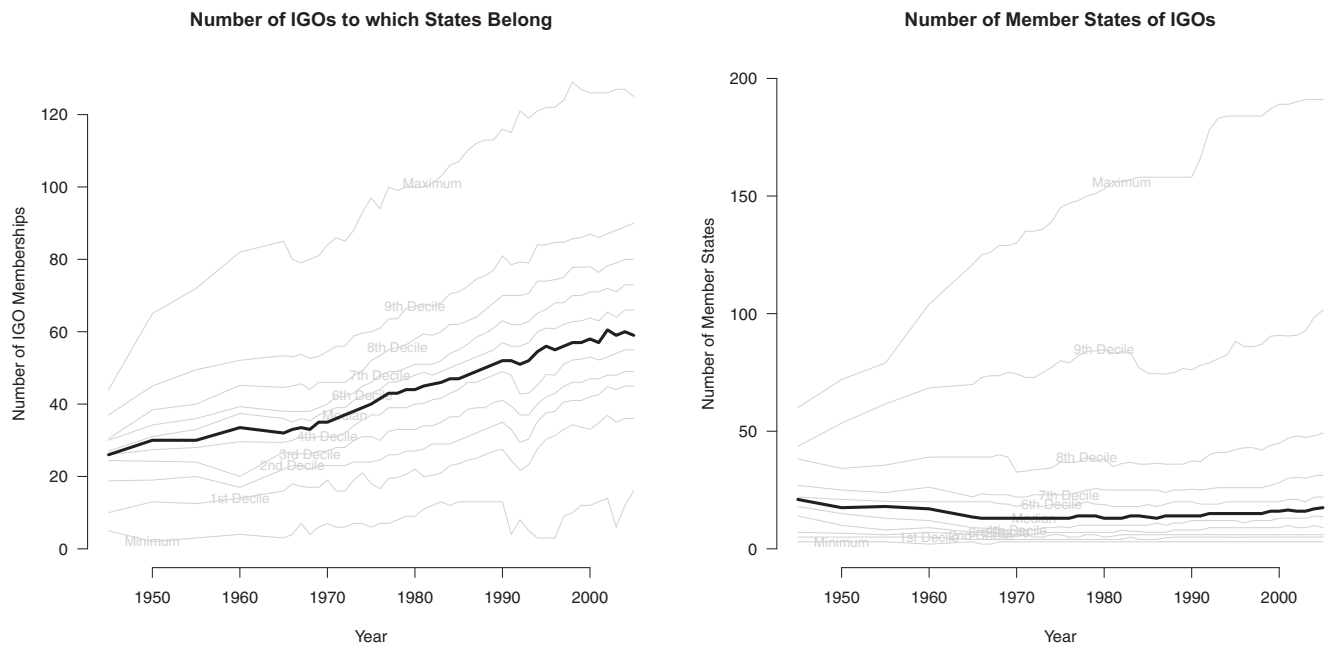


Figure 1. Trends in IGO membership, 1945–2000

especially notable in light of the fact that the total number of states in the international system has risen dramatically since 1945. Thus, although states on average belong to many more IGOs today than several decades ago, many of the IGOs they are joining have limited membership—typically around 15–20 member states. Moreover, the distribution of IGO size indicated by the decile plots is skewed to the right: while universal IGOs like the UN have increased in membership in conjunction with the growth of the number of states in the system, the size of most other IGOs has remained fairly static. For instance, despite the growth in the number of states in the system, even the IGOs at the top of the eighth decile have shown only a modest increase in size, from thirty eight member states in 1945 to forty nine members by 2005.

Taken together, these graphs demonstrate that while virtually all states belong to significantly more IGOs than they did in earlier decades, these ties do not necessarily reflect a deeper integration with the rest of the world. Instead, the data may be indicating that rapid growth in IGOs facilitates close attachments between groups of states. Consider again the case of Burundi. In 1965, three years after gaining independence from Belgium, Burundi belonged to fifteen different IGOs, only one of which was a regional organization. With the exception of the Non-Aligned Movement, all of the remaining IGOs to which Burundi belonged in 1965 were universal organizations. By 2005, however, Burundi belonged to forty seven IGOs, of which 13 (28 percent) were regional and at least another four were restricted to certain types of states (for example the French-speaking Organisation Internationale de la Francophonie).

Fragmentation and Modularity

This section expands on our definition of fragmentation in the IGO network. As stated above, we define fragmentation as the extent to which a system can be divided into distinct clusters. This concept is distinct from a focus on the *number* of clusters in the system. By our definition, a system can be less or more fragmented and have many

clusters or few clusters. To make the distinction between fragmentation and the number of clusters clearer, consider the analogy to the current state of American congressional politics. Most observers consider Congress to have become increasingly polarized in the sense that the extent to which Democratic and Republican legislators vote similarly has decreased (McCarty, Poole, and Rosenthal 2006). At the same time, the number of clusters has not changed—it consists almost exclusively of the Democratic and Republican parties. In other words, the system has become more fragmented while the number of clusters has not changed.

The stylized IGO networks depicted in Figure 2 can serve to further illustrate this. Each node in these networks represents a state, while a line between two nodes indicates that the two nodes belong to the same IGO. Nodes are colored and numbered based on the cluster to which they belong. The network on the top left includes only two distinct clusters. It is also highly fragmented in the sense that, on average, the members of each cluster have very little interaction with members of the other cluster. The network immediately below it also consists of only two distinct clusters, but differs from the first in the sense that there is a higher degree of interaction among the members of the two clusters. By our definition, the bottom left network is less fragmented than the top left network. The network in the top right panel is, like the top left, highly fragmented, but consists of five distinct clusters rather than two. The network in the bottom right also consists of five distinct clusters, but is less fragmented than the network in the top right panel.

We operationalize our concept of fragmentation using the network analytic concept of modularity, which measures the extent to which clusters are separate from each other in a network. This measure has recently been applied in several areas of political science research, including studies of the global trade network (Lupu and Traag 2013) and judicial citation networks (Lupu and Voeten 2012). The concept of modularity can be more formally described by the equation

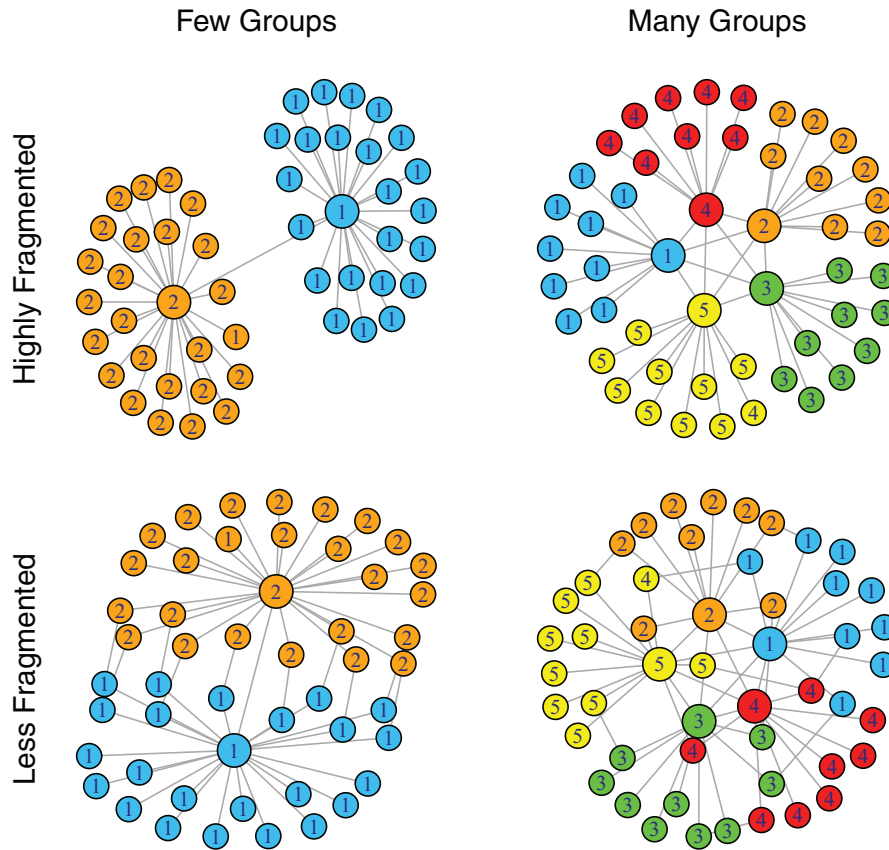


Figure 2. A comparison of stylized IGO networks in terms of fragmentation and the number of groups

$$Q = \sum_i (e_{ii} - b_i^2)$$

where e_{ii} refers to the proportion of edges that both originate and end in cluster i . The parameter b is defined as $\sum_j e_{ij}$, where e_{ij} refers to the proportion of edges that originate in cluster i but end in cluster j . As the structure of a network becomes more fragmented, the proportion of edges e_{ii} that span two nodes within a single cluster increases relative to the proportion of edges e_{ij} that span nodes that lie within different clusters, therefore leading to an increase in the modularity score Q .

To estimate the modularity of the IGO network, we follow Lupu and Traag (2013) and many other network analyses by using the algorithm described by Blondel et al. (2008). The algorithm starts with a state in which each node is a sole member of a cluster—in other words, where the number of clusters is equal to the total number of nodes in the network. In random order, it then joins these clusters in pairs, choosing the pairs that increase modularity the most. This continues until the algorithm can no longer join pairs of clusters in a way that further increases modularity.⁶ We do not specify, *ex ante*, the number of clusters in the international system; instead, the results indicate the number of clusters, the distribution of states into those clusters, and the modularity of the network. We apply this algorithm to the IGO network for each year in the series 1950–2005. For each year, we

generate a modularity score and a set of IGO clusters with constituent states.

Results

This section presents the results of our analysis. We begin with a descriptive analysis of the clusters and then go on to examine temporal trends in the degree of fragmentation using a number of different indicators. Our results suggest that although the network appears to be clustered along regional lines, the degree of fragmentation is declining.

IGO Clusters

After using the optimization algorithm described above, we find that in each year the network can be meaningfully partitioned into either three or four distinct IGO clusters.⁷ Each of these clusters therefore represents a group of states with relatively many shared IGO ties to each other and relatively few shared IGO ties to other states. Figures 3 show the IGO clusters at six different years.⁸

Clearly, the IGO clusters roughly map on to geographic regions. For instance, most Latin American states remain within a single IGO cluster throughout the period, as do most African states. On the one hand, this might seem to be an intuitive finding; after all, many IGOs have emerged out of the need to facilitate trade among neighboring states, and geographically proximate states often share

⁶The Supplementary Information provides a more detailed explanation, including a comparison to other modularity maximization algorithms. Please see the supplementary materials.

⁷The algorithm is not constrained in terms of the number of clusters it can identify within a network.

⁸We constructed these maps using the CShapes Package in R (Weidmann, Kuse, and Gleditsch 2010).

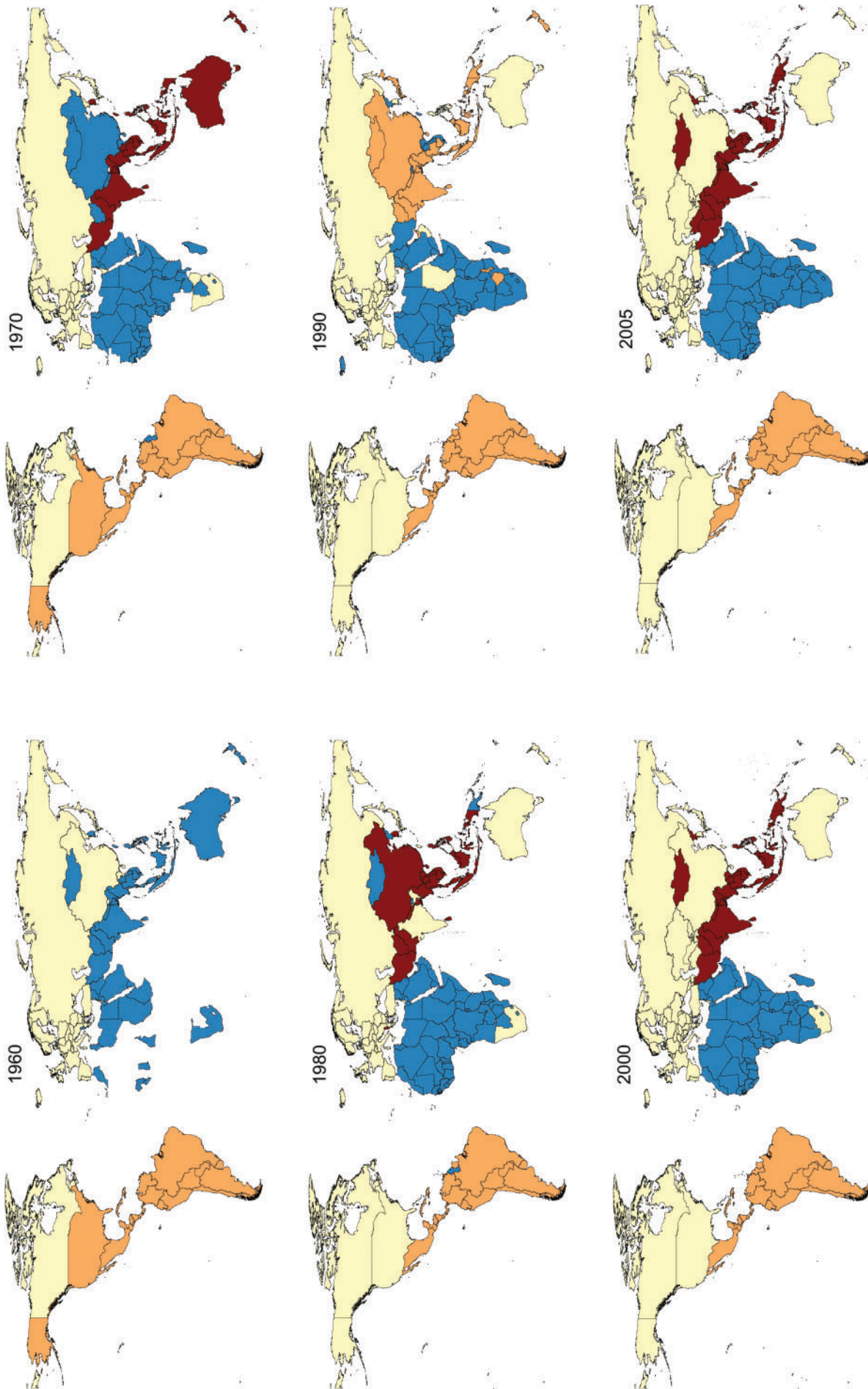


Figure 3. Maps of IGO clusters in 1960, 1970, 1980, 1990, 2000, and 2005

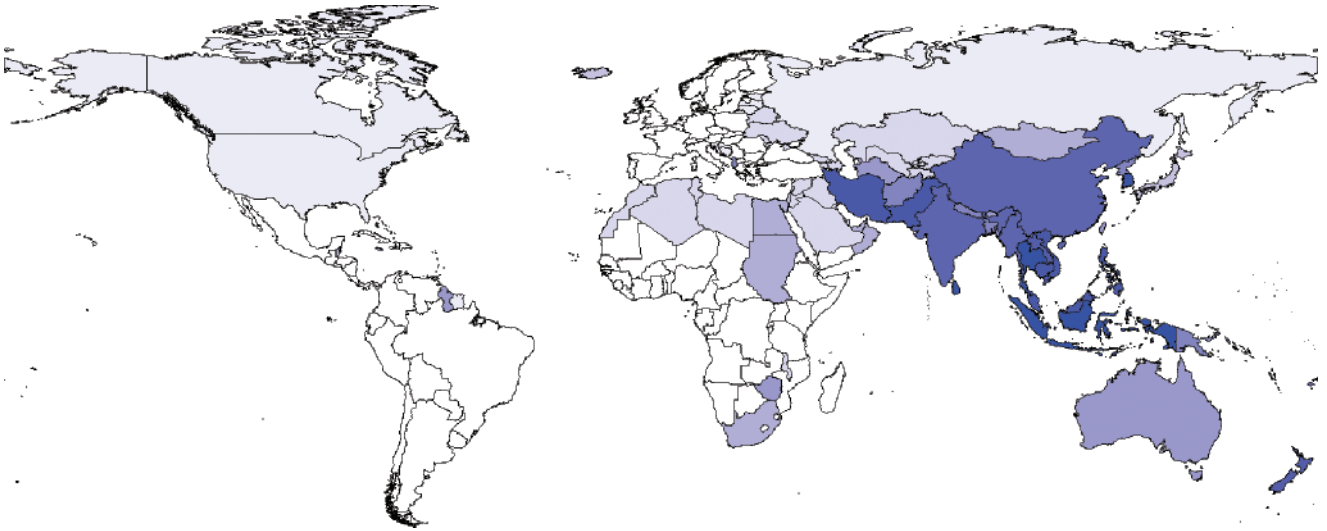


Figure 4. Stability of cluster membership over the 1950–2005 period. Darker shades indicate more frequent transitions.

certain characteristics that simultaneously increase the demand for cooperation and make cooperation easier to achieve. Moreover, as the neo-functionalists predict, once states start to cooperate in one issue area (like trade), demands for cooperation in other issue areas (for example legal integration) will likely arise (see for example Cichowski 2004). As a result, we can expect to find a high degree of path dependence whereby early attempts at institution building, if successful, lead to a flourishing of IGOs among a particular group of states. The dense network of IGOs that have developed in post-WWII Europe provides perhaps the clearest example of this.

On the other hand, finding such a strong degree of regionalism in the IGO network is more noteworthy. Transportation and telecommunication costs have fallen so significantly that geographical distance is now a much less significant barrier to international interactions than it was in recent decades. Moreover, many of the problems that states now face—for example climate change—are truly global in scope. By relying on the same functionalist logic that predicts high levels of regional cooperation, we can expect that these issues will promote the development of more global institutions to deal with them. As Beckfield (2010) notes, world polity theory predicts the development of norms and institutions at the global, rather than the regional, level. It is, after all, a theory of a *world* polity that involves the development of a *world* culture (Boli and Thomas 1999).

Interestingly, the European IGO cluster has expanded over time to include Russia, Japan, the United States, and more recently, China.⁹ As of recent years, it is perhaps more appropriate to think of this as a European/Northern cluster, rather than a European one. It may be puzzling to note in our maps that during many of the Cold War years, many European members of the North Atlantic Treaty Organization (NATO) and the Warsaw Pact belonged to the same IGO cluster. This is because,

⁹Russia, Japan, the United States, and China were in this cluster as of 1955, 1960, 1970, and 1981, respectively. All of these states remained within the European/Northern cluster for the remainder of the period, with the exception of Japan and China, both of which were in a different IGO cluster in 1990. The temporary changes in the structure of the IGO network in 1990 are likely the result of systemic changes surrounding the collapse of the Soviet Union.

during the Cold War, while the Warsaw Pact states tended to belong to relatively few IGOs, the IGOs to which they did belong tended to include many NATO members.¹⁰

Another interesting feature of the maps presented in Figures 3 is the absence of a distinct cluster of Asian states for much of the period under examination. Instead, most Asian states have a pattern of IGO membership that aligns most closely with one of the other regions at each point in time. For instance, in 1960 much of Asia was in the same cluster as the independent African states, whereas by 1970 some Asian states were in a separate South Asian cluster, while others remained in the African cluster. In 1990, much of Asia was in the Latin American cluster. What this means is that many Asian states, most prominently India and the People's Republic of China, have been near the borders of IGO clusters in the network. This is because these states tend to work through IGOs with states in various clusters at less unequal rates than, for example, states in Latin America, which tend to work through IGOs much more so with other states in the same cluster.

These maps also reveal that some states belong to the same IGO cluster for many years while others do not. To illustrate this point more clearly, Figure 4 shows the degree to which states change from one cluster to another over the period under examination (with darker shades indicating the states that have experienced more transitions between clusters). We can see from this figure that three regions have been especially stable in terms of IGO clusters (and, in turn, in terms of shared IGO membership): Europe, Latin America, and sub-Saharan Africa. Each of these groups of states constitutes the core of one IGO cluster. By contrast, as noted above, many Asian states have moved from one cluster to another many times, indicating that they lie at the borders of these clusters in the network structure.

¹⁰Examples include the European and Mediterranean Plant Protection Organization, International Atomic Energy Agency, International Civil Aviation Organization, International Centre for the Study of the Preservation and Restoration of Cultural Property, International Council for the Exploration of the Sea, and International Committee of Military Medicine and Pharmacy. In 1960 the median Warsaw-Pact/NATO dyad belonged to 18 of the same IGOs, whereas the global dyadic median was 14. By 1990, the median Warsaw-Pact/NATO dyad belonged to 42 of the same IGOs, whereas the global dyadic median was 23.

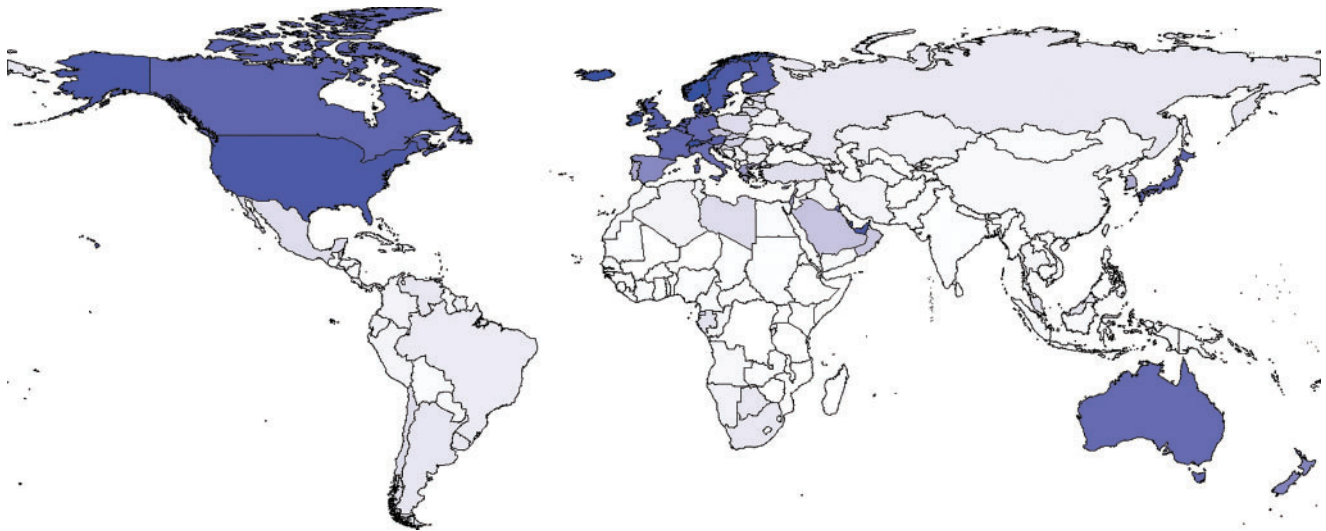


Figure 5. GDP per capita in 2005

Another feature of the dynamics of the network structure that stands out in Figure 4 is the relative instability of the Asian states' position in the global IGO network. While Japan was in the European/Northern cluster relatively early in the post-WWII period, China switched across all four clusters before finally settling into the European/Northern cluster in 1981, which indicates that for many years China's position in the network was near the borders of various clusters. Most other Asian states show a similar pattern of switching between different clusters, although, as noted above, a new cluster began to emerge in 1994 that encompassed much of South and Southeast Asia. States such as Iran, India, Thailand, and Indonesia have remained in the cluster since then.

In thinking about how the states are distributed among the clusters we identify, an interesting question to consider is whether the clusters reflect varying levels of economic development. Figure 5 provides a map of each state's GDP per capita in 2005, the last year in our time series. At first glance this might seem to provide a compelling explanation for the structure of the network, especially in light of the fact that none of the African states (with the exceptions of South Africa and Zimbabwe) were ever part of the European/Northern cluster. However, this cannot explain why the European/Northern cluster has come to absorb Russia and China, or why it took until 1971 for the United States to leave the Latin American cluster for the European/Northern one. It also does not explain why a distinct South Asian cluster began to develop in the mid-1990s. Thus, while the uneven levels of economic development around the world can to some extent account for the clustering of states within the IGO network, it provides what is still a very incomplete explanation of the network's structure (cf. Beckfield 2003).

Fragmentation or Consolidation?

The evidence we have presented so far supports the view that the IGO network is fragmented, mainly along regional lines. But is the network becoming more fragmented over time, and what might this suggest for theories of international cooperation? As noted in Section 2, Beckfield (2010) argued powerfully that the degree of

fragmentation in the world polity has been steadily rising in the post-WWII period. Analyzing the IGO clusters, however, leads us to reach a rather different conclusion. In this section we look more closely at temporal variation in the clusters and consider indicators that reflect the degree to which the IGO clusters have fragmented or consolidated. As we shall show, these indicators suggest that the degree of fragmentation of the IGO network has decreased in recent years.

Modularity (or Global Fragmentation)

The first—and most direct—measure of the degree of fragmentation in the IGO network is provided by the modularity measure discussed earlier. A higher level of modularity means that the number of IGO ties that exist among states within the IGO clusters is much larger than the number of ties that cross the boundaries between clusters. If the IGO network has become more fragmented, its modularity should have increased over time.

Figure 6 plots the IGO network's modularity over the period 1950–2005.¹¹ The graph indicates that the level of fragmentation in the IGO network has decreased over the period, and especially in the post-Cold War period.¹² What this suggests is that while we continue to identify distinct clusters of states in the network, an increasing amount of cooperation is taking place via IGOs that connect states across different clusters. In trying to express these patterns of IGO cooperation using the language of the polarization literature, we could say that the system continues to have several poles, yet these poles are becoming closer together over time.

¹¹It should be noted that the minimum possible value of modularity is -0.5 , and the maximum is 1. The modularity maximization problem is NP-hard (Brandes et al. 2008), meaning that, even with today's computing power, it is not feasible to calculate the modularity for every possible partition of a network of a significant size, thus determining with certainty which partition maximizes modularity. The advantage of our algorithmic approach is that it is computationally feasible; the disadvantage is that one cannot rule out the possibility of an undetected partition with a larger modularity. Thus, while it is not possible to conclude with certainty that the clusters we detect are the "true clusters," the trend in the clusters we detect indicates a decrease in modularity over time.

¹²There appears to be a spike in modularity in 1990, but this is likely to be due to the various institutional realignments that took place as a result of the newly independent post-Soviet republics joining IGOs.

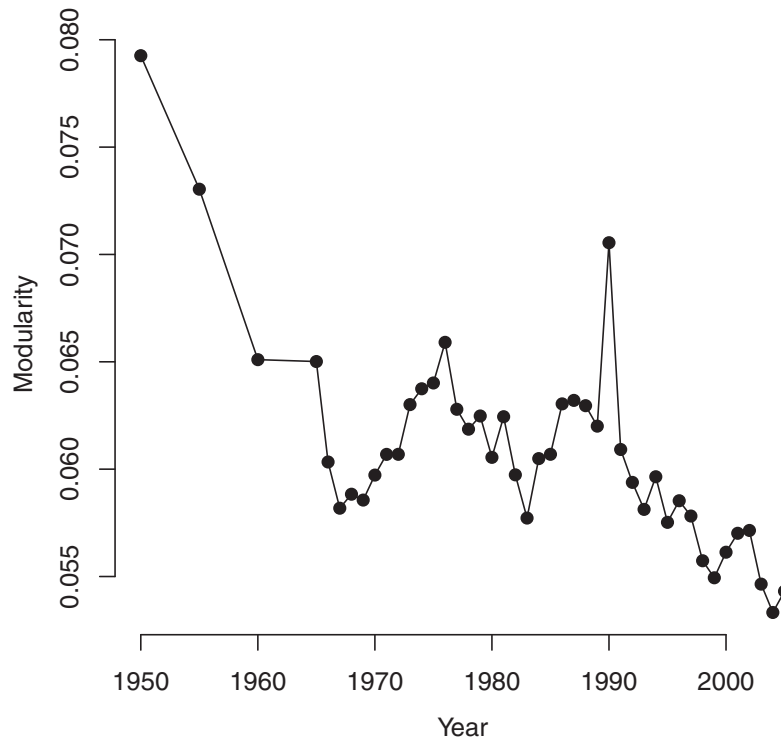


Figure 6. Trends in modularity scores, 1950–2005

To determine whether our choice of network model affects our results, we have used an alternative, bipartite model to analyze the IGO network and used an algorithm designed for bipartite networks to maximize modularity. The results of this analysis, reported in the [Supplementary Information](#), suggest that the reduction in modularity over time is robust to this alternative approach to modeling the IGO network. In addition, to test whether our result is driven by IGOs with primarily economic functions, we analyzed network models that exclude such IGOs. As the [Supplementary Information](#) shows, the decrease in the level of modularity over time is robust to this alternative specification.

Fragmentation Within and Across Clusters

A second, more fine-grained, measure of fragmentation can be obtained by looking at trends in the degree to which individual states are connected to each other. We do this by calculating two measures. First, we calculate the average number of IGO memberships each state-year shares with states in its own cluster (“intra-cluster ties”). Second, we calculate the average number of IGO memberships each state-year shares with states outside its own cluster (“inter-cluster ties”). Third, we subtract the rate of inter-cluster ties from the rate of intra-cluster ties (“tie rate difference”). We calculate these statistics for the three main clusters in the network, which we refer to as the “African,” “European/Northern,” and “Latin American” clusters.¹³ If a cluster has become increasingly insular—in other words, if IGO-based cooperation becomes increasingly concentrated within the cluster—this would be

reflected in an increasing tie rate difference. By contrast, if the states in a cluster are increasingly working through IGOs with states from other clusters, we should observe a decreasing tie rate difference. If the network as a whole is becoming more fragmented, we would consistently observe increasing tie rate differences across the clusters.

Figure 7 provides global time trends of these statistics. On the left-hand side, the solid line represents the average number of intra-cluster ties per state. The dotted line represents the average number of inter-cluster ties per state. On the right-hand side, the line represents the tie rate difference. In the European/Northern cluster, the top left plot demonstrates that states have cooperated with other members of their cluster through IGOs significantly more than with states from outside their cluster throughout the period under study. Perhaps more interestingly, the top right plot indicates that the tie rate difference increased during the 1970s, indicating that during this period the cluster members joined many of the same IGOs as each other, most of which were new European institutions. Nonetheless, as the top right plot indicates, after the end of the Cold War, the tie rate difference initially dropped but later steadily increased to its historical levels. This indicates that, while states in the European/Northern cluster continue to cooperate with each other more than they do with other states, the cluster as a whole is about as well integrated into the global IGO network now as it was in the 1950s, 1960s, and early 1970s. We observe a similar trend in the Latin American cluster in the middle two plots in Figure 7. Thus, the results with respect to these two clusters weigh against the notion that the global IGO network has become more fragmented than it was in the past.

The results differ to some extent in the African cluster. As the bottom right plot shows, throughout the Cold War, the states in this cluster formed, on average, about the

¹³These designations are based on the region in which the bulk of the countries in a cluster is located. As the maps above show, clusters often include some countries from other regions.

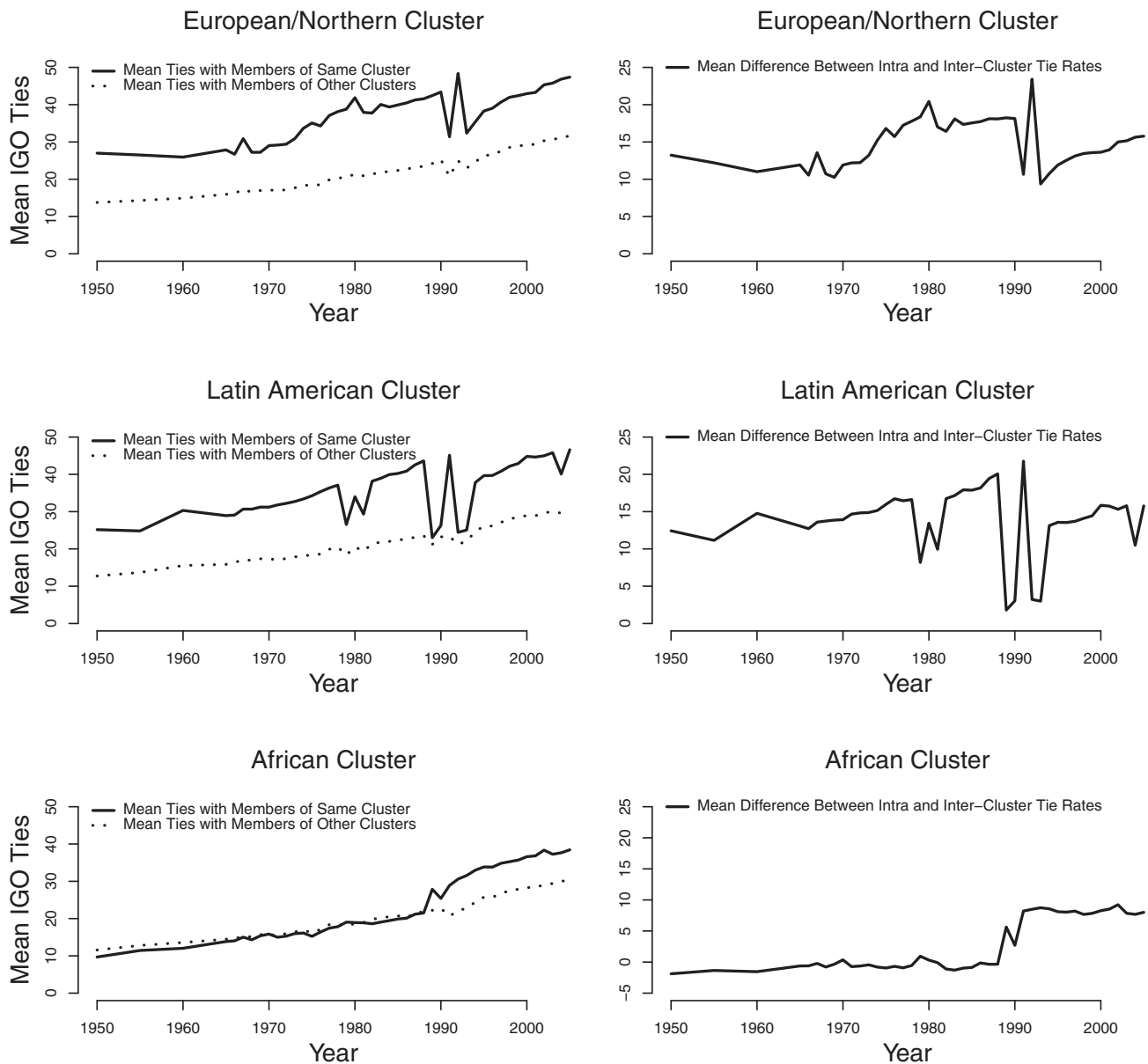


Figure 7. Trends in rates of IGO co-memberships within and across clusters, 1950–2005

same number of ties to other members of the cluster as they did to states outside the cluster. This indicates that during that period this cluster was not as well defined or internally consolidated as other clusters. In addition, states in this cluster joined fewer IGOs than other states did. In part, this may be because of political instability in the region, including the emergence of many new states. Around the end of the Cold War, however, the tie rate difference increased sharply, as shown on the bottom right. This indicates that during this period the states in the African cluster began to join more of the same IGOs with each other than with states from outside the cluster, and/or that around this period several states on the border of this cluster moved to other clusters. In other words, around the end of the Cold War the African cluster became both more internally consolidated and more distinct from the other clusters. Nonetheless, since the early 1990s, the tie rate difference has been flat with respect to the African cluster. In sum, the results with respect to the African cluster indicate an increase in fragmentation

around the end of the Cold War, but no such trend since then.

We also examine other trends in the relationship between IGO clusters and IGO membership. Rather than focusing on mean tie rates, we now focus on comparing the total number of inter-cluster IGO ties to the total number of intra-cluster IGO ties. We calculate this by taking the sum of each state's IGO ties to all other states within its cluster and dividing that by the sum of the state's ties to all other states (both inside and outside its cluster). States with larger ratios are those whose IGO-based cooperation occurs mostly within their own cluster, while those with smaller ratios have more diffuse patterns of cooperation.

Figure 8 provides a series of plots showing these trends over time for the three main clusters. The heavy black line in each plot represents the *median* ratio among the states in the cluster in that year. To give a fuller sense of how these ratios are distributed within each cluster, we also include light gray lines representing the minimum, first

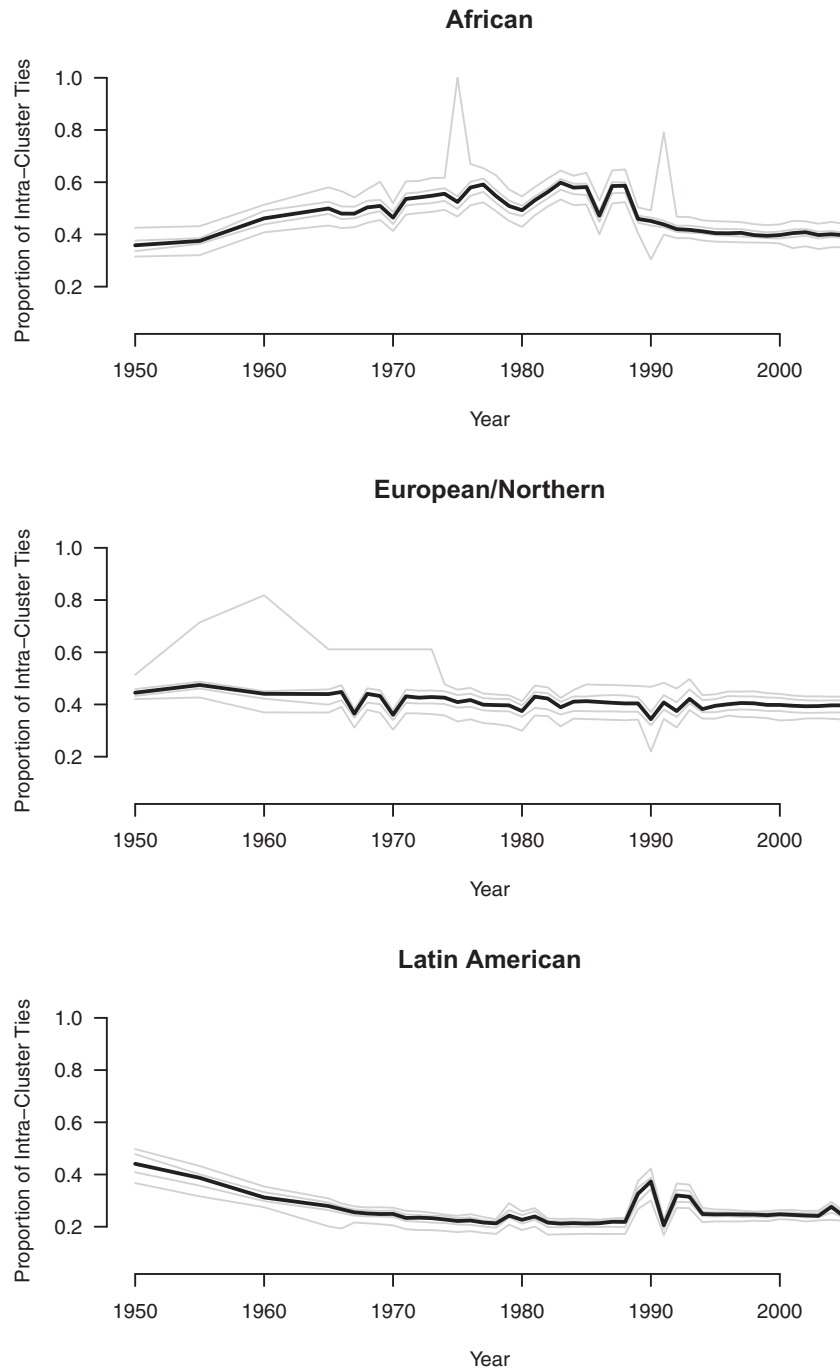


Figure 8. Trends in proportion of intra-cluster ties by IGO cluster, 1950–2005

quartile, third quartile, and maximum scores. In all three clusters, the median ratio is well below 0.5 in most years. This means that the total number of inter-cluster ties generally exceeds the total number of intra-cluster ties.

More important, however, are the changes in these ratios over time. In an increasingly fragmented network, we would expect to see increases in the proportion of total intra-cluster IGO ties. Figure 8, however, indicates a decrease in the extent of fragmentation in the IGO network, especially since the end of the Cold War. In the European/Northern cluster, the ratio of intra- to inter-cluster ties has remained fairly constant. The Latin American cluster

experienced a relative decline in intra-cluster ties during the 1950s and 1960s, but this trend leveled off, with the exception of a spike around the end of the Cold War. While the African cluster experienced a gradual relative increase in intra-cluster ties until the mid-1980s, this has since declined. In other words, the states in the African cluster are becoming (in relative terms) increasingly connected to states that lie outside their cluster. This is most notable because the members of this cluster, given their generally low levels of economic development, might be considered to be at an especially high risk of becoming disconnected from the rest of the world polity.

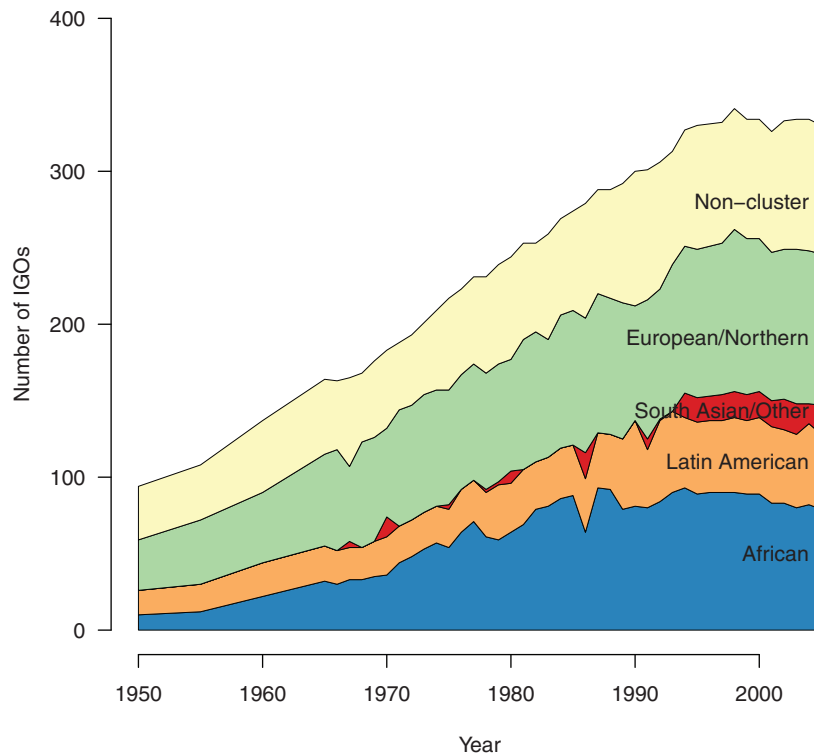


Figure 9. Cluster “affiliation” of IGOs, 1950–2005

Fragmentation Within IGOs

The third approach we take to exploring trends in fragmentation analyzes the extent to which each IGO includes member states from different IGO clusters. For each IGO in each year, we calculate the proportion of its member states that belong to each cluster. Universal IGOs tend to include states from each of the clusters. For example, in 2005 the membership of the International Civil Aviation Organization (ICAO) included sixty four states from the African cluster, 57 from the European/Northern cluster, 32 from the Latin American cluster, and thirty three from the South Asian cluster. Other IGOs consist of a more geographically concentrated group of states. For example, the African Development Bank (AfDB) is mainly composed of states that lie within the African cluster. Interestingly, the AfDB now includes several states from other clusters, reflecting the Bank’s increasing level of cooperation with states from outside its region.

We use the cluster affiliation of IGOs’ member states to identify IGOs with particular clusters. We do so in cases where at least two-thirds of an IGO’s members belong to the same cluster. (This is of course an arbitrary threshold, although we found that varying this threshold from 0.5 to 1 reveals a similar overall trend.) We refer to these as “cluster IGOs”; they are, in a sense, clubs of states that often belong to the same other clubs. We then assign the remaining IGOs (those with a more diverse membership pattern in terms of clusters) to a residual category we call “non-cluster” IGOs.

Figure 9 shows how the IGOs can be assigned to each of the clusters. In an increasingly fragmented network, the growth of the cluster IGOs would significantly exceed the growth rate of non-cluster IGOs, but we do not observe this. During the period 1950–1990, non-cluster IGOs

grew at about the same rate as cluster IGOs, except with respect to the IGOs associated with the African cluster, which did grow more rapidly. Since the early 1990s, all of the categories of IGOs are relatively flat, which means that overall the growth of cluster IGOs is not outpacing non-cluster IGOs. This weighs against the notion that the IGO network has become more fragmented.

This overall pattern is confirmed by looking at trends among individual states. In Figure 10, we show a series of similar graphs for a sample of four states. This sample was chosen by selecting the state in each of the four clusters that, on the basis of the sum of its IGO ties to all other states in the cluster in 2005, represented the most central state within its particular cluster.¹⁴ Despite their status as central members of their IGO clusters, these states nonetheless continue to be deeply integrated into the global IGO network. The three most central states in the clusters of the Global South—Senegal, Venezuela, and India—belong to more non-cluster IGOs (that is, those in which less than two-thirds of member states belong to a single cluster) than cluster IGOs. In each of these cases we can also see that the rate of growth of cluster IGOs does not exceed that of the more globally oriented IGOs. The exception is France, the most central state in the European/Northern cluster. In this case, a larger proportion (around half) of the IGOs to which it belongs are those that can be identified with its own cluster.

Conclusion

Scholars working in a variety of research traditions have argued that the post–Cold War era has witnessed significant fragmentation in international cooperation. Some

¹⁴See Opsahl, Agneessens, and Skvoretz (2010) for a discussion of different approaches to calculating degree centrality in networks with valued edges.

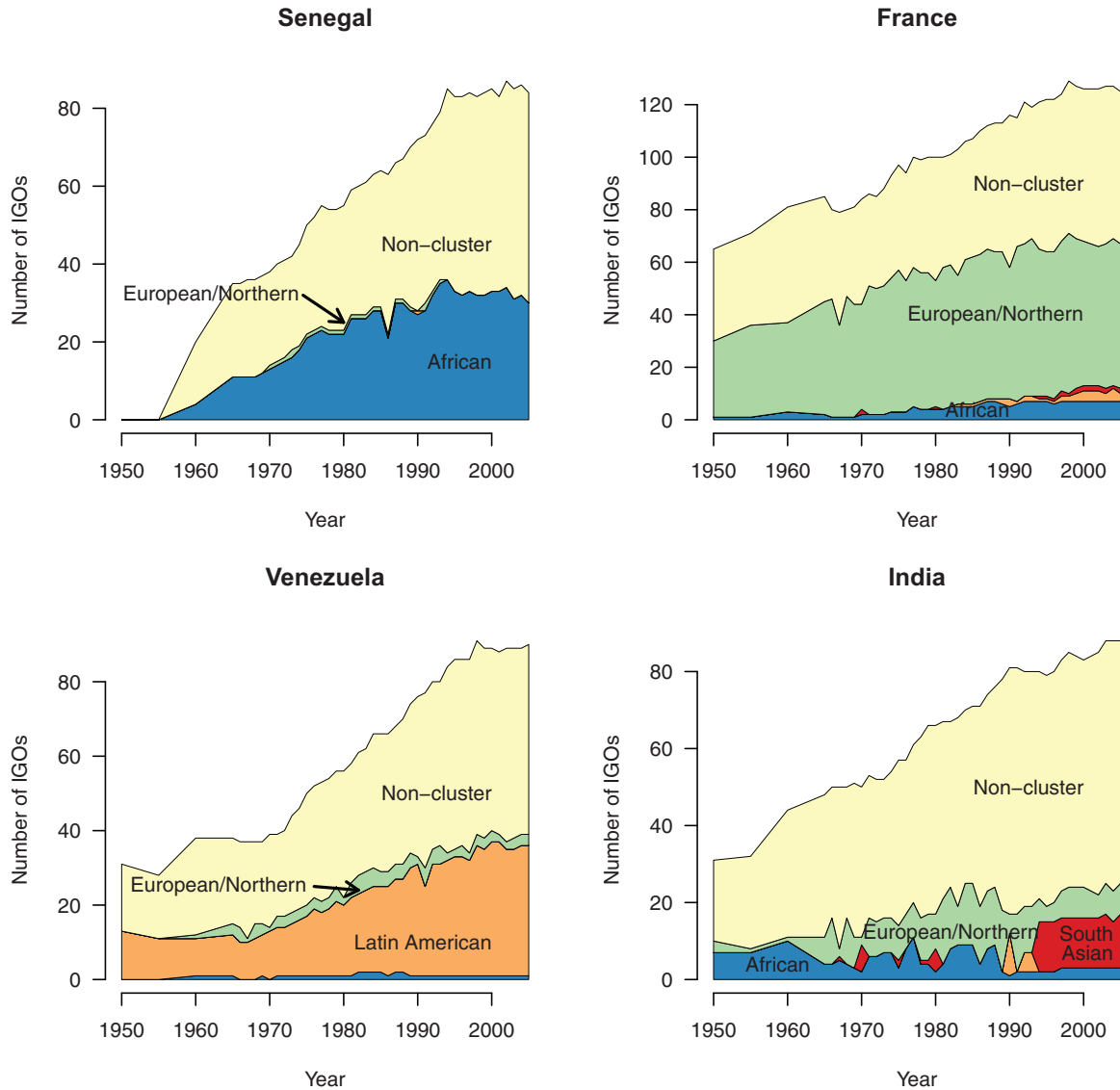


Figure 10. Cluster “affiliation” of the IGOs for selected states, 1950–2005

focus on multiple institutional forms in one issue area, while others take a broader view. In a separate literature, scholars analyze the effects of membership in individual IGOs or the cumulative effects of dyadic co-membership in IGOs, yet pay less attention to the structure of the IGO network. In this article, we built on these two literatures by measuring and analyzing fragmentation in the IGO network over time. We thus contribute to our broader understanding of fragmentation in the international system by analyzing a specific form of fragmentation: the extent to which the world consists of distinct clusters of IGO-based cooperation. Our findings also matter to debates about the impact of the proliferation of IGOs: is this leading to the development of a truly global international system, or instead serving to harden the boundaries that have existed between regions, and thereby contributing to a more fragmented international system?

We have shown that the IGO network can be consistently divided into three or four distinct clusters of states that tend to work together via IGOs. In this respect, our findings lend support to the arguments that Beckfield (2003, 2008, 2010) makes about regionalism and

inequality in the IGO network. Elsewhere, we demonstrated that shared membership in these IGO clusters can have important effects on reducing conflict between pairs of states, and that these effects exist independently of the simpler dyadic effect of shared IGO memberships (Lupu and Greenhill 2016).

Yet, at the same time, our findings suggest that fragmentation may be less pervasive than scholars of international institutions often assume. Although distinct regionally based clusters exist, the boundaries between these clusters are becoming less sharp as states are increasingly working through IGOs with states outside their own clusters. By providing an annual quantitative measure of fragmentation, our results indicate that the common assumption that fragmentation has increased throughout the arenas of international cooperation may not be accurate; the bulk of our evidence suggests that fragmentation in the IGO network has decreased.

That said, fragmentation in international cooperation—in a broader sense—remains an important concern for scholars and policymakers (Krahmann 2003; Biermann et al. 2009; Keohane and Victor 2011; Weiss

and Wilkinson 2014). Others make more expansive claims about fragmentation, often by defining this term differently or more generally. Fragmentation may be occurring in the international system, via fragmentation of norms and principles, cooperation in informal institutions, the emergence of informal regional orders, and the diffusion of rule-making authority to permanent and ad hoc adjudicators. Our findings indicate, however, that the trend toward fragmentation is not reflected in states' patterns of cooperation through formal IGOs.

Supplementary Information

Supplementary information is available at the *International Studies Quarterly* data archive.

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