

# The Interaction of International Institutions from a Social Network Perspective

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Previous studies increasingly acknowledge that international institutions do not exist in isolation, but regularly interact with each other. This interplay might induce influence, affecting institutions' development and performance. The following research adds to this debate by systematically analyzing the quantitative evidence on how institutional interaction drives institutional design from a network perspective. Using cross-sectional data on international environmental agreements in 1952–2000, the authors find support for their theoretical argument that regimes' similarity in design as captured by their degree of legalization strongly depends on institutions' interaction. However, while “soft law” disseminates between regimes that are well connected through direct or indirect links, this does not apply to “hard law.” The authors explain this divergence with states' concerns about binding-law commitments and sovereignty costs associated with the latter. This research may have important implications for studies of international institutions and of social networks in general.

**Keywords:** Global Environmental Governance · Institutional Interaction · International Institutions · Legalization · Social Network Analysis

International institutions do not exist in isolation from each other, but are instead situated in a broader network of regimes, in which they can be the source or the target of influences that affect an institution's development or effectiveness.<sup>1</sup> The existent literature increasingly acknowledges this phenomenon of “institutional interaction,” and primarily focuses on how possible influences travel between regimes and whether these influences actually affect the performance of institutions (Oberthür and Gehring 2006; Gehring and Oberthür 2009; see also Stokke 2001; Young 2002; Oberthür and Stokke 2011). The principle claim is that information on working procedures, regulations, or performance in general can spread through common linkages and ties between a source and a target institution. Ultimately, this influences the performance of the latter regime, while it is usually an empirical question whether this leads to synergetic effects of rather hampers effectiveness.

Indisputably, this literature furthered our understanding of international institutions and their effectiveness within global governance substantially. That being said, the nearly exclusive focus on the impact of institutional interplay on regimes' performance occurred at the expense of accounting for another important facet in this context: the previous work does not explicitly examine whether or how *regimes' design* is affected by institutional interaction. We believe that this constitutes a crucial gap in the literature at least due to two reasons. First, Miles et al. (2002), among others, demonstrate that institutional design strongly influences the performance of regimes. If subscribing to this claim, an important aspect of institutional effectiveness, i.e., a factor that functions as an intervening variable, remains uncovered if institutional interaction does indeed affect treaty

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<sup>1</sup> In the remainder of this article, we use the terms “(international) institution,” “regime,” and “treaty” interchangeably.

design. Second, and derived from the first point, it seems likely that those factors leading to specific design characteristics also influence institutions' performance. Both stages are therefore intertwined and ignoring one of them might bias the results of those studies examining the effectiveness of international institutions. Consequently, if institutional interaction drives both the design and the effectiveness of international regimes, the previous literature with its sole focus on effectiveness may have exaggerated or underestimated its findings.<sup>2</sup> We seek to contribute to this debate by systematically analyzing how the interaction between international institutions affects their design and, in particular, their degree of design similarity.

In the remainder of this paper, we understand treaty design, both theoretically and empirically, either in the form of "soft law" or "hard law" (Abbott et al. 2000; Abbott and Snidal 2000). This distinction is based upon the three dimensions of legalization, i.e., obligation, precision, and delegation (Abbott et al. 2000; Abbott and Snidal 2000). At one extreme, there are treaties that feature obligatory regulations, precise orders for action, and mechanisms that delegate power to some third party. Other institutions may lack one, two, or all of these three features. Scholars frequently characterize the first case as hard law, while the second is referred to as soft law. In light of this distinction, already note here that states generally face a tradeoff when deciding between the implementation of either soft or hard law (Downs et al. 1998; Bernauer et al. 2012; Spilker and Koubi 2012). On one hand, a soft-law design is likely to allow for flexibility and to impose less sovereignty costs on (potential) member states (see also Slaughter 2004). Having said that, the most crucial weakness of soft law seems to be that it cannot be enforced or does not provide clear and quantifiable targets, which can imply that these treaties are not necessarily effective in solving an underlying problem. On the other hand, hard law imposes obligatory and precise commitments. In theory, this could make institutions potentially better suited to solve the underlying problem, although hard law should be less attractive in the first place because of the high sovereignty costs it inflicts upon (potential) member states (see also Slaughter 2004; Skjærseth et al. 2006).

We intend to combine this literature with the work on institutional interaction for developing our theoretical expectations. As a first innovation, we study institutional interaction from a social network perspective (see Wasserman and Faust 1997; Ward 2006; Dorussen and Ward 2008; Hafner-Burton et al. 2009). Based upon this approach, we might expect that two institutions, which are well connected through direct or indirect ties, are more likely to display similarity in their design characteristics. However, we argue that this relationship strongly depends on the type of institutional design in place. In other words, we contend that regime interaction as conceptualized via ties and linkages should only induce design similarity between two institutions that are well

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<sup>2</sup> Skjærseth et al. (2006) is the only exception in this regard. We elaborate in detail below how we build upon and intend to extend this study.

connected if we study soft law. Conversely, institutional interplay is unlikely to lead to design convergence in the case of hard law even if two regimes are well connected with each other. As we elaborate below, we believe that this is because of states' concerns about obligatory commitments and sovereignty costs.

The article proceeds as follows. The next section summarizes the existent literature on institutional interaction, which allows us to outline more thoroughly the research gap we seek to address. Due to our approach, which highlights that information about design characteristics might flow through ties connecting regimes in the global network of international treaties, we also introduce and discuss the core concepts of social network analysis. Afterwards, we combine institutional interaction, network analysis, and treaty design in the form of either hard or soft law, and hypothesize that the impact of institutional interaction should also depend on the form of the design in question. The succeeding sections present our research design, the empirical analysis, as well as our results.<sup>3</sup> Here, as a further innovation, our analysis using social network measures examines 195 international environmental treaties in 1952–2000 with quantitative methods. Much of the existing work on institutional interaction relies on qualitative case studies.<sup>4</sup> While these studies provide fascinating insights and were able to uncover crucial mechanisms at work, they may be limited in scope and generalizability. Thus, we believe that our research relying on quantitative methods has important implications for studies of institutional interaction and of social networks in general. We finish the article with a comprehensive discussion of our findings, and suggest implications for future studies and policymakers.

### **On the Interaction of International Institutions: Literature Review**

International institutions are not created from scratch. When establishing (or re-designing) a regime, states may rely on existing institutions from the same or even other issue areas as “blueprints” (Stokke 2001; Oberthür and Gehring 2006; Gehring and Oberthür 2009; Oberthür and Stokke 2011; Hofmann 2010). Formally, Gehring and Oberthür (2009: 127) define this process of one institution influencing another regime as institutional interaction or interplay, i.e., a mechanism by which “one institution (the source institution) affects the development or performance of another institution (the target institution)” (see also Stokke 2001; Oberthür and Gehring 2006; 2011; Oberthür and Stokke 2011). This mechanism involves both the macro and the micro level: factors at the macro level, i.e., the design of the source institution as in this study, influence actors at the micro level. In our

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<sup>3</sup> We also conducted a series of robustness checks. These can be found in the appendix.

<sup>4</sup> For recent overviews, see Oberthür and Stokke (2011) or Oberthür and Gehring (2011).

case, these actors are the states that may be members of both the target and the source institution.<sup>5</sup> The behavior, perceptions, and preferences of those actors are thus affected by the design of the source institution, which, in turn, affect the macro level again, although it is the design of the target institution now that is being influenced. Figure 1 summarizes this process.

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Figure 1 about here

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In their pioneering work, Gehring and Oberthür (2009; see also Oberthür and Gehring 2006) list several causal mechanisms through which institutional interplay can occur. Next to interaction through commitment, behavioral interaction, and impact–level interaction, the potentially most relevant mechanism for our study works through what Gehring and Oberthür (2009, 132f) call “cognitive interaction.” Cognitive interaction essentially mirrors institutional learning (Gehring and Oberthür 2009, 132), since members of one regime use their experience with and knowledge about one institution’s development or performance for affecting another institution. In the words of Gehring and Oberthür (2009, 133), for example, “the members of an institution may discover, and decide to adopt, an institutional innovation introduced within another institution.” We briefly list here the steps according to which cognitive interaction evolves, but we refer the reader to Oberthür and Gehring (2006, 35ff; 2011, 35ff; see also Gehring and Oberthür 2009, 132f) for a detailed discussion of this mechanism of institutional interaction: first, the source institution generates new information, e.g., an institutional arrangement that seeks to address and solve a particular regulatory problem; second, the member states of the source institution and, more precisely, their behavior, perceptions, and preferences are affected by this change and feed the information into the decision–making process of the target institution; third, this information then changes the preferences of the (relevant) member states of the target institution before, fourthly, this modification influences the negotiation process and the output of the target institution.

Gehring and Oberthür (2009, 134) illustrate this via the compliance system in the Montreal Protocol on Substances that Deplete the Ozone Layer and the Kyoto Protocol to the United Nations Framework Convention on Climate Change. When negotiating the latter, those states that were already involved in the former may have learned from their positive experiences with the Montreal Protocol’s compliance procedure. In turn, the Kyoto Protocol’s obligations essentially implement the exact same institutional design (see also Oberthür 2001, 360f). Note, however, that this examination of the impact of institutional interaction on regime design seems to

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<sup>5</sup> Gehring and Oberthür (2009; see also Oberthür and Gehring 2006) also allow for the possibility that non-governmental organizations function as actors and influence a target institution. Especially due to our operationalization of the network measures below, however, we exclusively focus on state actors.

constitute an exception rather than the rule in this literature. In fact, the vast majority of studies exclusively analyzes if and how institutional interaction affects the performance of a target regime (Brosig 2011; Grilo 2011; Hofmann 2010; Jinnah 2010; Stokke 2001; see also Skjærseth et al. 2006). While our research certainly builds upon the theoretical insights from this earlier work, particularly with regard to the cognitive interaction mechanism, we are actually interested in a different aspect of institutional interaction, i.e., how it influences the design of international institutions or, specifically, their degree of design similarity.

With the exception of Skjærseth et al. (2006), we are not aware of any other study that explicitly analyzes how institutional interaction can result in regime design convergence or divergence. By examining three case studies, these scholars theoretically focus on the dissemination of soft law and hard law (Abbott et al. 2000; Abbott and Snidal 2000) through institutional interaction. The authors show that soft-law and hard-law institutions dealing with the same issue area can interact in a way that leads soft-law regimes to adapt more hard-law characteristics and vice versa (Skjærseth et al. 2006). Against this background, Skjærseth et al. (2006) truly intend to address those shortcomings we listed in the introduction above. That being said, although we rely to some extent on Skjærseth et al. (2006) for developing our argument, our study differs from these authors in important ways. First, Skjærseth et al. (2006) differentiate between soft law and hard law solely according to the obligation criterion. However, especially the work by Abbott et al. (2000; see also Abbott and Snidal 2000) emphasizes that both hard and soft law require more nuanced concepts than simply obligation. This rationale eventually led to the three dimensions of legalization, i.e., obligation, precision and delegation. Accordingly, our study seeks to directly capture all three dimensions simultaneously – not only when theoretically discussing regimes' design similarity in the form of legalization, but also when testing our theory empirically.

Second, Skjærseth et al.'s (2006) examination of soft and hard law as the interaction between non-obligatory and obligatory agreements, and how this affects institutions' performance, is conducted via what the literature coined "vertical interaction", i.e., the interplay between institutions at different levels of organization (Young 2002; see also Oberthür and Gehring 2006; Gehring and Oberthür 2009; Stokke 2001). This particular type may make use of any of the four previously introduced mechanisms and, in fact, we believe that it constitutes an important facet within the context of institutional interplay. Nevertheless, it seems to overlook the concept of horizontal interaction, i.e., institutional interaction at similar levels of organization, which is likely to be an equally important type (Young 2002; Oberthür and Gehring 2006; Gehring and Oberthür 2009; Stokke 2001). Thus, we focus on horizontal interaction by studying how different international treaties at the same, i.e., global level affect each other.

Third, as indicated, Skjærseth et al. (2006) employ a qualitative case–study design for the empirical test of their theory. We appreciate this strategy and, in fact, are convinced that the insights on the causal mechanisms of institutional interaction gained by the three cases of marine pollution, transboundary air pollution, and fisheries subsidy control fruitfully complement our study. Yet, the scope of these authors’ analysis may be limited and we are uncertain about the generalizability of their results. In order to address this, we depart from mere descriptive analyses by using a sample that covers all multilateral environmental treaties, thereby ensuring that our study is likely to have a much wider empirical scope than previous work.

### **Information Flows through Networks:**

#### **Social Network Analysis as a Tool for the Study of Institutional Interaction?**

Before developing our argument on institutional design and the interaction of regimes, we require an approach that might facilitate our understanding of how precisely influences flow between these institutions. Particularly the concept of cognitive interaction we outlined in the previous section provides a starting point here (Gehring and Oberthür 2009; Oberthür and Gehring 2006; 2011), since it built the foundation for multiple avenues of research in this regard. In the following, we introduce “social network analysis” to the study of institutional interaction and combine it with the previous literature on cognitive interaction (see Jinnah 2011, 3; Brosig 2011, 158; Selin and VanDeveer 2003). This approach has rarely been employed so far, which may come across surprising given the similarities in the treatment of interactions and the conceptual or methodological potential it does indeed offer.

In more detail, social network analysis deals with actors’ interactions by examining nodes, i.e., countries, institutions, individuals, etc., that are connected through and can mutually depend on each other via ties or linkages. Thus, a network is defined by a finite set of nodes, i.e., actors, and by the links, i.e., relationships, that tie two or more actors to each other (Granovetter 1985; Wassermann and Faust 1997; Borgatti et al. 2009; Hafner–Burton et al. 2009; Maoz 2010; Ward et al. 2011). These ties between nodes build a structure through which resources such as information can flow (Dorussen and Ward 2008; Hafner–Burton et al. 2009). Most network studies in international relations employ countries as nodes and analyze, for example, how ties through the network of memberships in intergovernmental organizations or trade affect outcomes such as conflict, convergence in policy outcomes, or pollution control (e.g., Cao 2009; Cao and Prakash 2010; Dorussen and Ward 2008; Hafner–Burton and Montgomery 2009). In contrast, and as specified in depth below, our study focuses on international institutions as nodes, while the mutual membership of a country in any of the regimes can be considered a link between those institutions (see also Gehring and Oberthür 2009, 139; Hofmann 2011,

103). More mutual members signify stronger ties that can transport resources such as information more efficiently between institutions. This treatment of institutional interaction comes closest to what Figure 1 depicts.

Against this background, regimes may share direct links, i.e., connections that link two institutions directly. International institutions may also share indirect links, i.e., ties to one or more than one intermediary that connect two international institutions. Direct and indirect links therefore tie a regime to other regimes and determine the density, i.e., the cohesiveness of a social network as measured by the number and strength of links (Wasserman and Faust 1997, 314f). A network may have many and strong links or edges between its nodes or not. In the former case, the density of the network is high and there are multiple, well established channels of resource flows. For example, a regime may then be better able to communicate and exchange information with a dyadic counterpart (Dorussen and Ward 2008, 192f).

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Figure 2 about here

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For the purpose of illustration, Figure 2 shows the entire network of international environmental institutions in 2000 as represented in our data, while Figure 3 focuses on a more constrained set by summarizing the network in 1953.<sup>6</sup> The width of the edges is proportional to regimes' shared country memberships: more numerous ties are represented by denser and stronger links; also, regimes having similar direct links are closely grouped. This is reflected in the clear cluster in the middle of Figure 2 and in the relatively remote positions of other institutions that are not well linked to the rest of the network. Furthermore, although most regimes are connected through direct links in 2000 or in 1953, others are not. Thus, as Figures 2 and 3 demonstrate, while many regimes have (strong) direct edges, other institutions have no or only weak direct connections with each other. For instance, the European Commission for the Control of the Foot-and-Mouth Disease is connected through much weaker links in 1953 than, e.g., the International Plant Protection Convention. The former regime has also no direct link with the latter, i.e., there is no single state that is a member in both organizations. The European Commission for the Control of the Foot-and-Mouth Disease, however, is connected to the European and Mediterranean Plant Protection Organization, which, in turn, has a direct link to the International Plant Protection Convention. Hence, these two institutions actually share an indirect link to one another via the European and Mediterranean Plant Protection Organization as an intermediary. Primarily valuable from a methodological lens, but also crucial for the theoretical argument of our study, social network analysis offers the

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<sup>6</sup> We describe these data in more detail in the research design.

possibility to analyze direct flows of information and these longer chains involving (more than) one intermediary.

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Figure 3 about here

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In our context, we argue that the resources that can flow through ties pertain to information about and experiences with treaty design characteristics, in turn influencing other institutions. This essentially mirrors the logic of cognitive interaction. More specifically, direct and indirect links in social networks facilitate the transmission of information (e.g., Ward 2006). Connections that are shorter and denser convey information with lower costs, more precisely, and faster (Dorussen and Ward 2008, 197). This, *ceteris paribus*, leads to decreased uncertainty and, in our case, more knowledge about the design of institutions, its possibilities, and limitations (Pretty and Ward 2001, 209f; Hafner–Burton and Montgomery 2006; Dorussen and Ward 2008, 194f; Hafner–Burton et al. 2009, 569; Leifeld and Schneider 2012; Ward and Cao 2012). Put differently, this interaction through network ties, “which comes into existence when individuals attempt to make best use of their individual resources” (Coleman 1990, 300), is likely to influence international institutions by “shaping common beliefs” (Hafner–Burton and Montgomery 2006, 8).

It thus seems plausible that information on institutional design should spread if two institutions are strongly linked with each other. International institutions with various and strong ties to other regimes are extensively involved in relationships with each other (see Ward 2006). This makes these institutions more embedded or central in the network (Wasserman and Faust 1997, 173; Ward 2006, 151f). The centrality of regimes determines the amount of information they receive (Dorussen and Ward 2008; Hafner–Burton et al. 2009; Leifeld and Schneider 2012). If two institutions are not or only remotely linked to each other, information on institutional design should not transfer that easily. In contrast, international institutions that are more central will receive more information, which we see as important for explaining the degree of institutional similarity between two interacting institutions (see Ward 2006, 151f; Haas 1993, 187; 1997, 200; Slikker and van den Nouweland 2001, 21ff; Dorussen and Ward 2008, 195). Based upon this discussion, a first hypothesis can be formulated:

**Hypothesis 1:** The higher the degree of connectedness between two institutions, the higher the likelihood that they converge in their institutional design.



### **Soft Law, Hard Law, and Design Convergence in the Realm of Institutional Interaction**

According to the arguments outlined in the previous section, we might expect convergence in institutional design the better-connected two institutions are. Strong linkages between two regimes signify substantial information flows between these institutions, suggesting that states learn from source regime and might ultimately have common beliefs (Hafner–Burton and Montgomery 2006, 8), which make them to implement a similar design in the target treaty. The example on the Montreal Protocol and the Kyoto Protocol from above provides anecdotal evidence here. However, we contend that this convergence process not only significantly depends on the strength of connectedness between two institutions, but also on the type of institutional design. In particular, we argue that regime interaction requires strong and multiple links between institutions to work and only leads to institutional similarity or convergence in the case of soft law. In contrast, institutional interaction should not lead to design convergence in the case of hard law, even if institutions are well connected with each other.

International institutions vary considerably in their design, which we operationalize by the degree of legalization (Abbott et al. 2000). To recap, institutions can be highly legalized if they are characterized by clear obligations (i.e., an institution's rules can be enforced upon its members), are precise (i.e., rules are clearly and unambiguously defined), and delegate authority to a supranational body (i.e., a body like a secretariat that has authority to implement, interpret, and apply rules). Other regimes lack some or all of these features. By following Abbott et al. (2000), we use the term hard law for the first scenario and soft law when referring to institutions of the second category (see also Abbott and Snidal 2000; Skjærseth et al. 2006; Spilker and Koubi 2012).

Generally, hard-law treaties impose more sovereignty costs on regime members because of their binding obligations or the delegation of authority to a supranational body. Treaties with demanding obligations are more likely to require more ambitious modifications in states' behavior and strong enforcement mechanisms set further limits to their freedoms, since these mechanisms are designed for ensuring policy congruence with the obligations specified in an institutional treaty. Similarly, the delegation of authority makes it more difficult for states to interpret a respective agreement in a self-serving or biased manner. Thus, one should expect hard-law treaties to be more costly and, consequently, less attractive to (potential) member countries (Slaughter 2004; Skjærseth et al. 2006). However, since hard law is comprised of precisely stated obligations and delegates authority to implement and interpret these, it is perceived as more credible and can provoke states more effectively to reach the policy goals they agreed upon. In addition, a hard-law treaty reduces the risk of incomplete contracting by lowering the transaction costs of the law's application and by decreasing post-agreement costs such as management or enforcement. Finally, hard law may increase the reputational costs a

state will incur if it reneges on its commitments. This suggests that hard-law treaties might be able to effectively solve a problem at hand, but they are unlikely to be attractive to many (potential) members of international institutions due to the outlined sovereignty costs.

On the other hand, soft-law treaties are more flexible and usually do not constrain states' sovereignty in such a severe manner as hard law does (Slaughter 2004). Hence, soft law is regularly seen as solution for countries they can easily agree upon as it gives states the opportunity to adapt commitments to their particular needs, allowing regime members a range of discretion and flexibility in interpreting and implementing their commitments. In particular, flexibility makes it possible for states to respond to unanticipated shocks as well as to special domestic circumstances without compromising existing institutional arrangements. Furthermore, when countries' preferences are deeply divergent, a soft-law treaty can produce more opportunities for compromises (see also Skjærseth et al. 2006). A shortcoming of soft law, however, is that its rules are often vague, since no precise or quantifiable targets are set. This leads to the outcome that these kinds of treaties may not solve a problem and are often viewed as "window dressing," because they lack credibility. In addition, the adaptability of soft law can also give states the opportunity to shirk, thus leading to reduced forms of actual cooperation.

Against this background, while upholding the claim that experiences with and information on institutional design can flow between regimes that are well connected, we argue that there exists a tradeoff between soft and hard law (see also Downs et al. 1998; Bernauer et al. 2012; Spilker and Koubi 2012). On one hand, soft law may not necessarily be effective in solving an underlying problem, but it appears attractive to states due to its lower sovereignty costs. On the other hand, hard law is unlikely to be the most preferred option for states that value their autonomy and sovereignty in decision making, although it is potentially better suited to effectively address the problem an institution has been created for in the first place. In light of this rationale, when combining it with institutional interaction and information flows in networks for explaining the degree of legalization of two institutions, we must elucidate what countries value most. As emphasized, strong and various linkages between two regimes comprise information flows between these institutions, suggesting that states might learn from their experiences in the source regime and, thus, could be inclined to implement a similar design in a target treaty. However, we claim that states have a stronger incentive to preserve their sovereignty, hence promoting the dissemination of soft law in the institutional setting. Under such a setting, we might hypothesize that soft law travels through strong linkages from one institution to another, thus leading to design similarity; alternatively, two regimes are unlikely to converge in their design if one of these institutions is characterized by hard law, i.e., states will have learned from their experience with hard law and may be more eager to implement soft law instead.

More specifically, soft-law treaties, although they might fail to successfully solve a problem in question, should on average be more attractive to national governments, because of their lower contracting costs. In situations in which issues are unclear and the consequences of potential actions are uncertain, states are more hesitant getting tied into agreements that pose higher costs, threats, and constraints to their national sovereignty. As Skjærseth et al. (2006, 115) emphasize, “[i]t is easier to reach agreement on substantively ambitious soft law than on hard law.” Hence, the treaty characteristics that should seem most appealing to governments are likely to pertain to soft law. Accordingly, given that institutions do indeed share strong links with each other, we expect that institutional interaction will only lead to design convergence in the case of soft law. In contrast, for hard-law design, we should either observe no effect of institutional interaction or even a negative impact leading to design divergence. Based upon this, we formulate the following hypotheses:

**Hypothesis 2:** In the case of soft law, the higher the degree of connectedness between two institutions, the higher the likelihood that they converge in their institutional design.

**Hypothesis 3:** In the case of hard law, the higher the degree of connectedness between two institutions, the lower the likelihood that they converge in their institutional design.

## **Research Design**

### *Data and Dependent Variables*

The foundation of our empirical analysis is a cross-sectional data set from Bernauer et al. (2012). After accounting for missing values, these data are comprised of information on design features and treaty characteristics of 195 international environmental institutions.<sup>7</sup> Most importantly, this data set provides variables that match the concept of our dependent variable: international institutions’ design and, more specifically, their degree of legalization (Abbott et al. 2000). Although our theoretical argument is likely to apply to any kind of institutional interaction, we have chosen global environmental agreements for the following reasons. First, to the best of our knowledge, this data set is the only source that offers comprehensive and reliable information on our theoretical concepts of interests. However, while these data cover all global international environmental regimes between 1952 and 2000, a potential shortcoming is their purely cross-sectional nature. This seems to be of minor importance, though. Bernauer et al. (2012) coded their data along the original institutional treaty documents, texts, charters, etc., which rarely if ever change over time. Second, by restricting the analysis to one policy area,

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<sup>7</sup> A list of all considered regimes is given in the appendix.

we are able to control for the impact of unit–heterogeneity at least to some extent and, thus, can efficiently take care of remaining heterogeneity by means of a limited set of control variables. Third, our focus is on ties between environmental regimes and how these affect institutional design. As we elaborate below in more detail, we operationalize these ties via country membership. Against this background, we need a sample of regimes that can, in principle, attract members from exactly the same population of countries in any given year. The environmental agreements in our data, despite their sometimes–limited regional scope, are potentially open to all countries in the international system and, hence, meet this criterion.

The unit of analysis in the original data is a respective institution (Bernauer et al. 2012). The literature on institutional interaction, however, departs from this by focusing on a source and a target institution in its analyses. The literature points to this distinction particularly in order to isolate each interaction for a careful and thorough analysis in qualitative studies (Oberthür and Gehring 2006; Gehring and Oberthür 2009). Despite our quantitative setup, we follow this treatment by taking the directed dyad as our unit of analysis. Hence, our data entail one case for any possible dyadic combination of one regime with another. Moreover, since regime design features rarely if ever change over time, the possibility that we observe interaction between all those directed dyads in which the source institution has been established after the target institution is excluded *ex ante*. We therefore drop these cases and only include those directed dyads in our data, in which the source institution has been established before or in the year the target institution has been founded.<sup>8</sup> In order to control for any persistent underlying propensities of institutional dyads to implement soft or hard law, we cluster the standard errors on a respective dyad. The final sample consists of 17,980 observations.

In consistence with the theory, the dependent variable must capture the degree of legalization – in our case the degree of legalization similarity between two institutions in a dyad. To this end, we follow the suggested components of legalization in Abbott et al. (2000) As stated, we define legalization as a system of institutionalized rules, norms and regulations that characterize regimes along three dimensions (see also Böhmelt and Pilster 2010, 248). First, there is obligation, i.e., an institution’s degree of bondage and commitment. The rules of a regime may not necessarily be enforced in a legal sense, i.e., they may not be “subject to scrutiny under the general rules, procedures and discourse of international law” (Abbott et al. 2000, 401). On the contrary, the majority of regimes rests on principles, norms, and goals that cannot be enforced (Porter and Welsh Brown 1996, 37). Hence, we employ an item that measures whether the treaty itself establishes an enforcement mechanisms (1) or not (0). Importantly, an enforcement mechanism must be established within the context of a specific environmental treaty and not provided by a third party.

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<sup>8</sup> The establishment of an institution refers to the first year this treaty is open for ratification.

Second, there is precision, i.e., the unambiguous definition of states' required actions in certain circumstances. High levels of precision characterize institutional rules, norms, and regulations that unambiguously define the required actions of states in certain circumstances (Abbott et al. 2000, 401). Precise rules narrow the "scope for reasonable interpretation" (Abbott et al. 2000, 402), thereby introducing clarity into an institution's structure and leaving the states with precise ideas of what to do. This mechanism creates a non-contradictory framework of rules that can be carried out coherently. Our data include a dichotomous variable that scores the value of 1 if a treaty specifies quantitative targets or clear provisions without quantitative targets. Similarly, this variable receives the value of 0 if an institutional treaty only contains ambiguous specifications of what has to be achieved. For example, a treaty could demand only that better air quality should be achieved instead of providing exact specifications for how much of emissions must be reduced.

Finally, legalization entails delegation, i.e., granting authority of implementation, interpretation, rule application, and dispute resolution to one or more third parties (Abbott et al. 2000, 401ff). In that way, states lose some degree of sovereign decision making, since bodies like secretariats take over power from states at least to some extent. Following the recent literature on this (e.g., see Jinnah 2010; Conliffe 2011; Abbott et al. 2000), our data set addresses this legalization component via a variable on the existence of secretariats: an international institution has its own secretariat, it uses an existing secretariat, or, in the case of protocols, it relies on the secretariat established by the framework convention (1). Otherwise, this variable obtains the value of 0.

Due to the dyadic nature of our data, we then combine these items into two different dependent variables that capture a) the degree of dyadic soft-law similarity and b) the degree of dyadic hard-law similarity. To this end, in a first step, we create three new variables: the first of them receives the value of 1 if both institutions in a directed dyad have soft-law obligation (0 otherwise); the second of them receives the value of 1 if both institutions in a dyad have soft-law precision (0 otherwise); and the third of them receives the value of 1 if both institutions in a dyad have soft-law delegation (0 otherwise). In a second step, we create an additive variable, i.e., our final dependent variable concerning soft-law similarity is the sum of the three items from the first step and ranges in [0; 3]. This approach leads to a soft-law similarity measure for each specific dyad: while higher values signify a more similar degree of soft law between the source and the target institution, lower values represent weak or no soft-law similarities at all between these two regimes. We then repeat this procedure for hard-law similarity between two regimes in a directed dyad. The only difference is that the three newly created items from the first step above receive a value of 1 only in the case of hard-law similarity. The rationale behind this second dependent variable, which also ranges in [0; 3], is the same as for the first one: ultimately, we obtain

a dyadic measure of hard-law similarity. Higher values stand for dyadic design similarity in terms of hard law, lower values pertain to dissimilarities in hard-law design features.

*Core Explanatory Variables: Conceptualizing Institutional Ties via Network Measures*

As indicated with Figures 2 and 3 above, we operationalize the ties between institutions and, hence, institutional interaction via regimes' co-members. For reasons of consistence with the outlined source-target approach, all of the following network measures are based on states' regime memberships in the year the target institution has been created. Apart from a few exceptions, we thus calculated every network variable for every year in 1952–2000 separately and merged these items afterwards into our data. We use three different variables that seek to capture both direct and indirect connections between international environmental institutions. First, in network analysis, a variable measuring the number of co-members equals the value of the edge in the graph that directly connects two regimes. We call this item *Direct Links*, which, for example, would receive a value of 6 for the directed dyad of the International Plant Protection Convention (established 1952; source institution) and the European and Mediterranean Plant Protection Organization (established 1953; target institution), because these institutions have six member states in common in the year 1953. The rationale behind this item stems from the fact that regimes might exchange and obtain information, and consequently be influenced by links that connect them via the shortest and most efficient ties, since these transmit information with lower costs, more precisely, and faster than longer or less efficient ties (Dorussen and Ward 2008, 197).

Second, we employ the *Maximum Flow of Information*, a variable that considers a regime's whole range and any strength of all ties to the entire network (Dorussen and Ward 2008; Ford and Fulkerson 1956; Freeman et al. 1991). Hence, in contrast to *Direct Links*, which only relies on those ties between two regimes in a dyad, the *Maximum Flow of Information* considers the entire network of a specific year to measure how an institution is linked to all other nodes in the network. More precisely, *Maximum Flow of Information* is calculated by,

$$\text{Maximum Flow of Information } (i) = \sum_{\forall i \neq j} v(i, j)$$

where  $i$  is one of the two institutions in a directed dyad,  $j$  pertains to any other regime in the whole network of a specific year, and  $v$  stands for the value, i.e., the strength of a tie linking the two regimes as measured by institutions mutual state members (Dorussen and Ward 2008, 196).<sup>9</sup> The higher the value of this monadic measure, the more possibilities for a regime to obtain information via direct and indirect linkages do exist. This

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<sup>9</sup> In order to calculate *Maximum Flow of Information* with this equation, the network must satisfy the condition  $r \leq (n-2)^{1/2}$ , where  $n$  is the number of institutions and  $r$  is the ratio of the largest edge value in a network to the smallest edge value. This is given in our setup, however.

variable essentially counts flows of information through all possible chains of intermediaries, i.e., the existent number of direct and indirect links a regime has to all other regimes in the entire system (Ford and Fulkerson 1956). For introducing the *Maximum Flow of Information* into our dyadic setup, we calculate the “weakest link” in a dyad, i.e., the ties of the institution least embedded in a dyad govern this variable (Dorussen and Ward 2008, 197).

That being said, information transmissions via our last measure can be misperceived and exerted influences are likely to be weak. The *Maximum Flow of Information* counts flows of information and influence through long chains of intermediaries, although the most empirically plausible paths in “given the possibility of such distortion are short ones” (Dorussen and Ward 2008, 197). Therefore, as a final core explanatory variable, we employ what is known as Simmelian ties in network analysis. A Simmelian tie is a reciprocally connected pair with mutual ties to third parties (Simmel 1950; and Krackhardt 1999, 186). For example, the International Plant Protection Convention and the European and Mediterranean Plant Protection Organization from Figure 3 are reciprocally tied to each other; at the same time, however, they are also reciprocally tied to the European Organization for Nuclear Research. Accordingly, our third network measure counts the number of Simmelian ties between each pair of regimes. The logic behind this variable differs from the previous two items in the following ways. First, indirect connections between two regimes via an intermediary are taken into account. Our first variable, *Direct Links*, only counts the direct connections between two international institutions. Second, with regard to the indirect connections of two regimes, the Simmelian tie variable only takes into account the shortest paths via one intermediary as these are likely to be the most efficient and effective ones for the transformation of information. Thus, it is a more nuanced measure than the *Maximum Flow of Information*.

#### *Control Variables: Underlying Problem Structure and Public Goods*

We also consider a set of control covariates that may influence the institutional design of international institutions and, therefore, the degree of institutional similarity between two treaties. The first cluster of control variables is based upon the literature on the effectiveness of international environmental regimes, which highlights the importance of an institution’s underlying problem structure (e.g., Young 1999; Mitchell 2006; and Miles et al. 2002). Miles et al. (2002; see also Böhmelt and Pilster 2010, 247), for instance, use incongruity, asymmetry, and the cumulative cleavage structure to determine the level of “malignancy,” which they combine with “uncertainty” in order to operationalize environmental problems. The authors also argue that the underlying problem of an environmental regime may influence its institutional design: depending on the problem an institution has been created for, there are likely to be different degrees of issue scope, centralization, or

flexibility (Koremenos et al. 2001; Mitchell 2006). While our data set does not include variables that measure, e.g., the level of malignancy or uncertainty of a regime's problem structure directly, it contains information on the respective issue or problem that an institution deals with. More specifically, we include dummy variables for either regime in a dyad that indicate whether a regime deals with a) matters of environmental pollution (*Pollution 1* whether the source institution in a dyad regulates a pollution issue or not and *Pollution 2* whether the target institution in a dyad regulates a pollution issue or not); b) the protection of endangered species, microorganisms, and wildlife (*Species 1* and *Species 2*); c) nuclear energy issues within the environmental sphere (*Nuclear 1* and *Nuclear 2*); and d) particular ecosystems such as desertification, barren land, or wetlands (*Habitat 1* and *Habitat 2*). We thus use these variables as proxies for the different problem structures regimes may have, since Miles et al. (2002) show that an institution's underlying problem structure does indeed vary over issues.

With regard to the second cluster of control variables, we take into account the logic that actors may find it difficult to organize themselves and, ultimately, are able to agree on an "optimal design" for dealing with an environmental problem if they face a public good (Chamberlain 1974; Olson 1965; Snidal 1996; Taylor 1987). Hence, it seems plausible that this affects the degree of legalization of regimes and, as a result, their design similarity. We consider two variables that identify whether a global public good characterizes either regime in a dyad or not (*Global Public Good 1* and *Global Public Good 2*). We further include variables in order to make the distinction between global and domestic public goods (*Domestic Public Good 1* and *Domestic Public Good 2*).<sup>10</sup> The rationale for including the latter set of variables is grounded in the idea of group size (Fearon 1998, 270; Hasenclever et al. 1997, 54; Barrett 2003; Sandler 2004, 32). Public choice theorists argue that the complexity or organizational costs for providing a public good rise with more actors participating or being potentially relevant (Buchanan and Tullock 1962; Olson 1965; Chamberlain 1974; see also Koremenos et al. 2001, 773). Domestic public goods and global public goods, respectively, are likely to address a diverse pool of relevant actors or members.

Apart from these theoretical foundations for our controls, there is also a methodological justification. Since our sample consists of environmental treaties only, we can control for the problem of unit-heterogeneity to some extent, but perhaps not completely. Our control covariates are likely to address any remaining imbalances in this regard. Table 1 summarizes the descriptive statistics of all variables we discussed.

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<sup>10</sup> The baseline category that is left out of the models pertains to those treaties that regulate mixed public goods, i.e., issues that have some regional or domestic component, but also a transnational character.



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Table 1 about here

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### **Empirical Findings**

The empirical analyses of our hypotheses are summarized in Tables 2–4. In Table 2, we employ *Soft–Law Similarity* as the dependent variable and run ordered probit models due to the ordinal scale of this item. Each model in this table uses a different network measure, thus allowing us to directly examine which factor exerts what kind of influence. Moreover, despite their different operationalizations, all network variables essentially seek to capture information flows between regimes. We thus can demonstrate that our results are robust. Table 3 follows this logic, while we substitute *Soft–Law Similarity* for *Hard–Law Similarity*. Finally, since coefficients in nonlinear models cannot be interpreted as slopes or elasticities, we calculated substantive quantities of interest in Table 4. Here, we summarize the difference in the predicted probability for the values of our respective dependent variable as one network variable changes values from its minimum to its maximum, while all others items are held constant at their medians.

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Table 2 about here

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We start with the examination of the results on *Soft–Law Similarity*. Evidently, we obtain some initial support for our first hypothesis, while the second hypothesis can be fully confirmed. As argued, the more ties between two regimes, either directly or indirectly, the more likely that these two institutions are characterized by degree similarity (first hypothesis) in the form of soft–law similarity (second hypothesis). This view is supported by the positive coefficients of *Direct Links*, *Maximum Flow of Information*, and *Simmelian Ties* in Table 2. On the contrary, the less connected two regimes in the network of international environmental institutions, the less likely it is that both are mutually characterized by soft law. Ultimately, we conclude that our argument presented in the second hypothesis holds true: a closer connection between two international institutions, either via direct or indirect links, induces a stronger degree of soft–law similarity. Note, however, that we would also need a positive impact of the network measures in the analyses of *Hard–Law Similarity* if we were to confirm the first hypothesis. Furthermore, although we explicitly do not want to exclude the possibility that soft law may also be effective in addressing environmental problems, that states learn from that, and then transfer their insights into the design of a target institution, it seems more plausible from our argumentation above and given the results

here that regimes are similar in their soft-law design due to states' concerns about sovereignty and autonomy in this context. Soft law hardly poses any challenges to states' power, and once this lesson has been learned in a source institution successfully, it is more likely that this design is transferred to a target institution if these two regimes are well connected with each other.

Coming to our analyses on *Hard-Law Similarity*, as proposed in the third hypothesis, we observe the directly opposite effect of either network measure as in the case of *Soft-Law Similarity*. More specifically, Tables 3 and 4 demonstrate that *Direct Links*, *Maximum Flow of Information*, and *Simmelian Ties* have negative coefficients. In fact, the less connected two regimes are in the network of international environmental institutions, the more likely it is that both are characterized by hard law. While this goes against the "naïve" expectations from our first hypothesis, it is in consistence with our rationale that led to the third hypothesis: it therefore seems that states' experiences with hard law in one institution can only travel to the target and prevent the implementation of hard law there if these two institutions are well connected with each other.

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Table 3 about here

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The substantive effects summarized in Table 4 further increase the confidence in our results. For example, when moving from the minimum toward the maximum of *Direct Ties*, the predicted probability to see full similarity in two regimes' soft law increases by 29 percent. In other words, information flows between two institutions do matter for the institutional interplay of international regimes. In the case of hard law, however, it seems that closer connections do not transfer information about the effectiveness or efficiency of hard law in one regime to another, but rather concerns about sovereignty and autonomy of states. Nevertheless, the negative effects on design similarity in the case of hard law, while being statistically significant, are generally not as substantial as the positive impact for soft law. For instance, the predicted probability of observing full similarity in the case of hard law decreases by 6 percent if we move from a scenario with the minimum of *Direct Ties* to a scenario with the maximum of this variable. Furthermore, according to Table 4, we observe that the network measures incorporating indirect links exert on average a lower effect than *Direct Ties*, which operationalizes only direct linkages between two regimes. While this means that indirect links do also transmit and convey information flows between regimes, they can only be considered as imperfect substitutes for direct ties if these do not exist or may be inactive (Dorussen and Ward 2008). Hence, direct linkages between institutions are the most efficient and effective ones.

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Table 4 about here

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With regard to the control variables, it seems that these covariates do a fairly good job in capturing influences from problem structure and good type. For example, Table 3 shows that the public–good problematic at the global level makes it generally less likely that two institutions in a dyad are similar in their hard–law design. However, the item *Domestic Public Good 2* displays a positive and highly significant coefficient, i.e., two institutions are more likely to have hard–law similarity if the target regime in the dyad under study deals with a domestic public good. Thus and in consistence with the variables concerning regimes’ problem structure, it depends on the source/target regime’s characteristics and ultimately remains an empirical question whether these covariates influence hard or soft law design in a positive or negative fashion. That being said, the signs of the coefficients generally change over Tables 2 and 3 – which is expected given that the two different dependent variables in those tables rely on opposing theoretical considerations and empirical operationalizations.

### **Conclusion**

Do institutional design characteristics flow through the network of international regimes, thus supporting the idea of institutional interaction? Our research suggests that this is indeed the case, yet only for a specific set of design characteristics. Generally, our findings based upon the social network analysis of 195 international environmental treaties strongly support the argument that institutional interplay affects the design of international institutions if these are in some way connected with each other. However, interaction only leads to a higher degree of design similarity in the case of soft law. In contrast, in the case of hard law, institutional interaction does not lead to design convergence, although – or actually because – two institutions share multiple linkages.

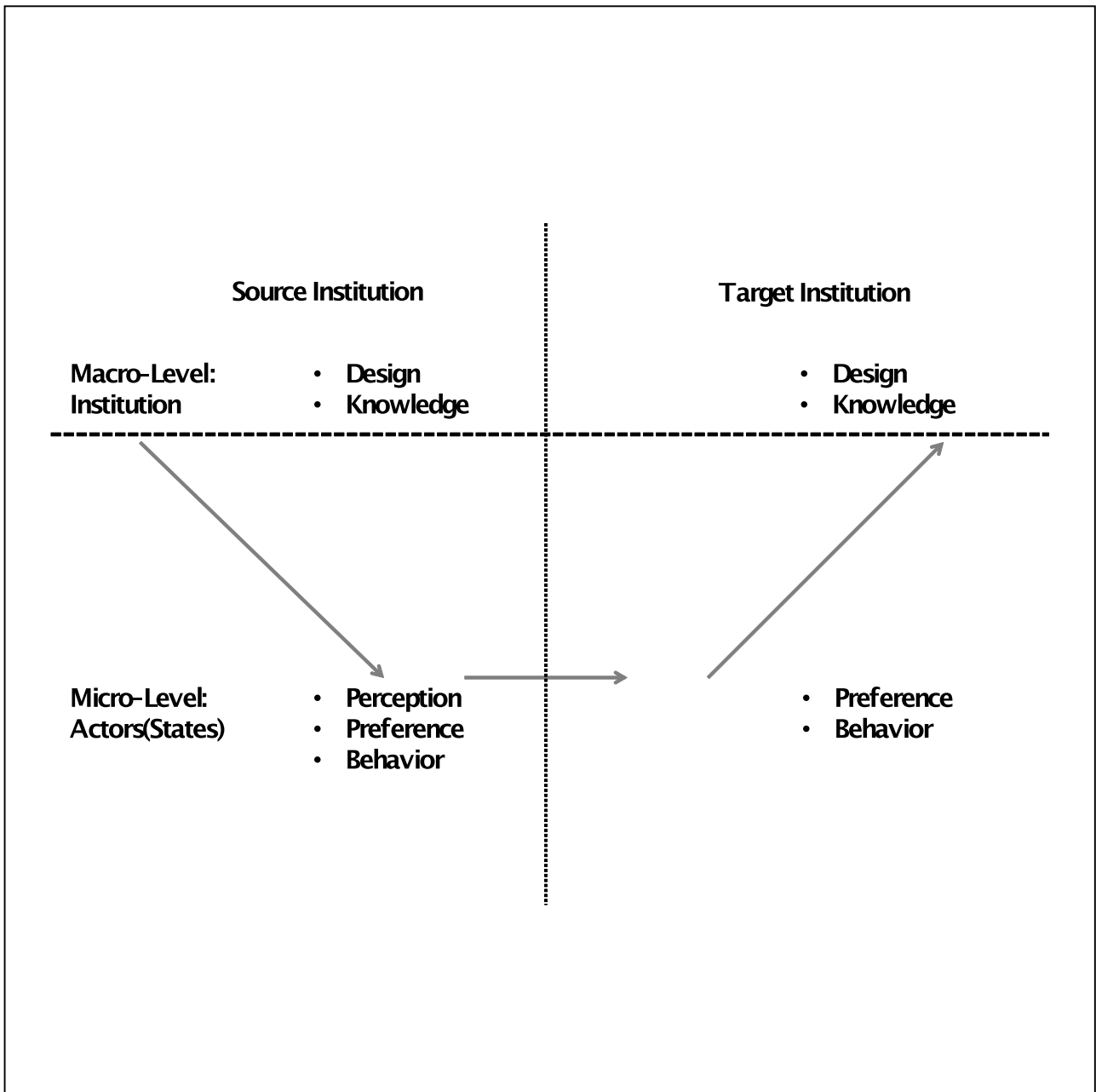
The theoretical rationale behind these results is that more connections between institutions facilitate the transmission of information and, thus, should make it more likely that their design converges, i.e., becomes more similar. States learn from their experience with regime designs and, due to the claim that stronger ties induce common norms and behavior, they might be inclined to adapt under those circumstances the same treaty characteristics that were used in an earlier regime. However, we also argued that ties or connections may not necessarily transfer information about the effectiveness or efficiency of hard law in one regime to another, but rather states’ concerns about sovereignty and autonomy. Since hard law implies more sovereignty costs for (potential) member countries, we ultimately do not observe institutional design similarity here.

While our original aim was to address a few shortcomings in the scholarly literature on institutional interplay, our research may also highlight crucial policy implications (see also Oberthür and Gehring 2011, 48f). For example, policymakers might assume that if state actors eventually agreed on hard law for the design of one regime, they might be more willing to implement it in another institution as well. This would induce that hard law could gradually flow through the entire network of institutions (Skjærseth et al. 2006), which might be desirable from a somewhat normative point of view, since hard law is generally seen as more effective than soft law (see Abbott et al. 2000). Unfortunately, however, our results can hardly be taken as evidence for this. Obviously, neither do we want to recommend breaking up the existing ties between institutions nor not establishing new linkages at all against this background – particularly since the existing research on institutional interaction convincingly points to synergetic effects in the case of regimes' performance. We do suggest, nevertheless, that policymakers should engage more strongly in managing institutional interaction (Oberthür 2009) and pay close attention to these ties when creating or re-designing institutions, because these linkages between institutions not only transfer information from one regime to another, but also can signal a lot about the underlying preferences of states. If taking into account this interaction between institutions, we gain a substantial amount of information *ex ante* about those actors that eventually make the decisions.

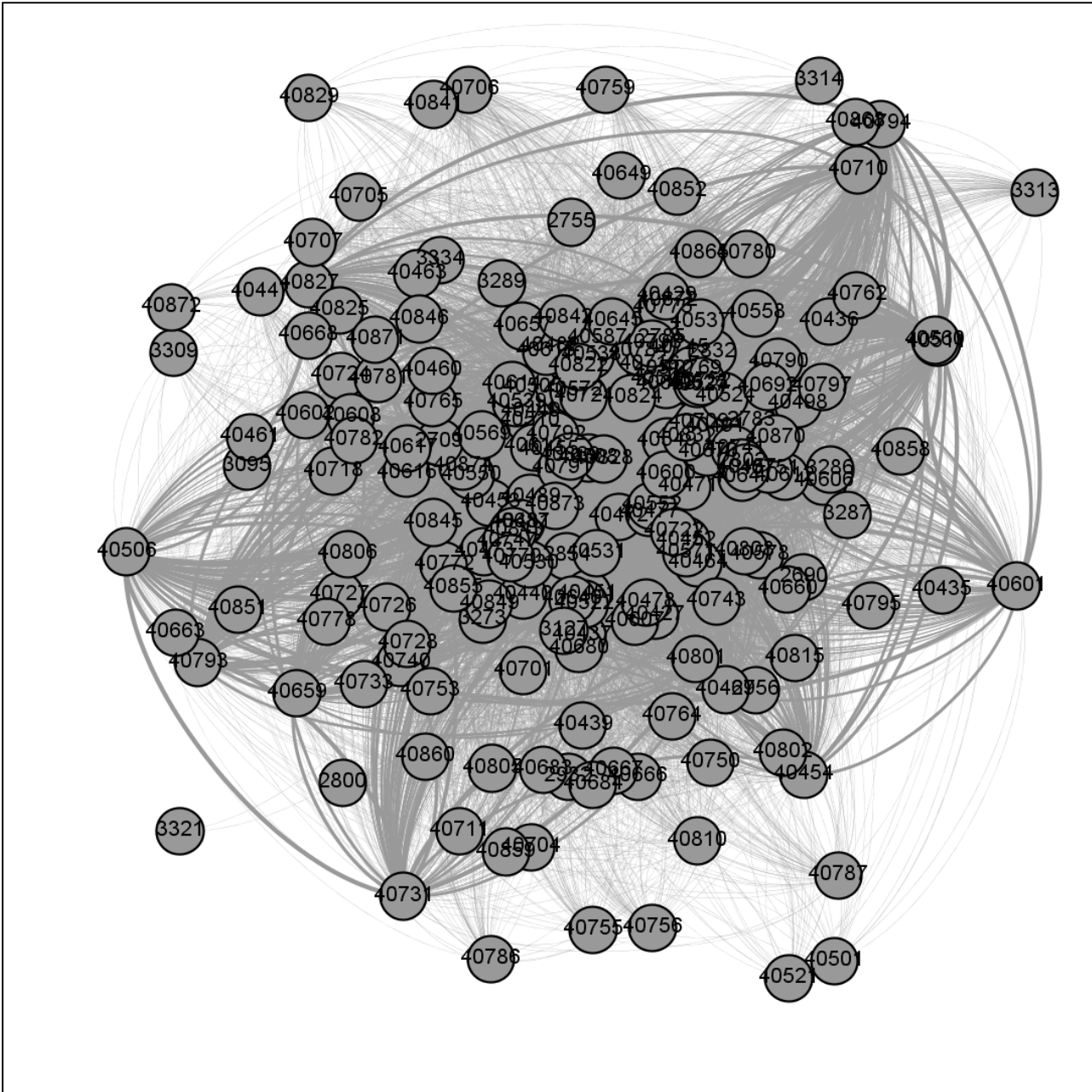
In light of this discussion, we hope that our work contributes to the existing literature in important ways. Needless to say, though, that many questions remain unanswered and various avenues for further research exist (see also Oberthür and Gehring 2011, 51f). We outline three of them. First, while our theoretical argument is of general nature, our empirical test refers to the realm of environmental politics. Future research might therefore want to examine whether our findings also hold for other issue areas such as trade or human rights. Due to the limited availability of data, this points to new data collection efforts. Second, we focused on regimes' design (similarities), while the previous literature primarily studied how institutional interplay influences regimes' performance. Our research design could be well applied to this case of effectiveness, although one would require a valid and reliable performance measure first, which can be used for a wide array of international institutions across issue areas (Miles et al. 2002). In principle, though, we see a lot of potential in using network analysis for future research, especially due to the higher degree of generalizability resulting from those approaches. Finally, our theoretical argument was built upon the notion that states value their sovereignty more than potential gains in effectiveness from hard law. In fact, this claim is in consistence with the empirical observation that only a minority of institutions can actually be characterized as hard law (Porter and Welsh Brown 1996, 37; Abbott et al. 2000; Abbott and Snidal 2000). However, some institutions do rely on obligatory norms, precise regulations, and delegation and the crucial question here is why states were actually able to agree on such an institutional

setup in the first place if it does constrain their autonomy? Arguably, trying to provide an answer on this goes beyond the scope of this paper, but a systematic study in this regard could substantially further our understanding of the mechanisms persistent in global governance and within the networks of international institutions.

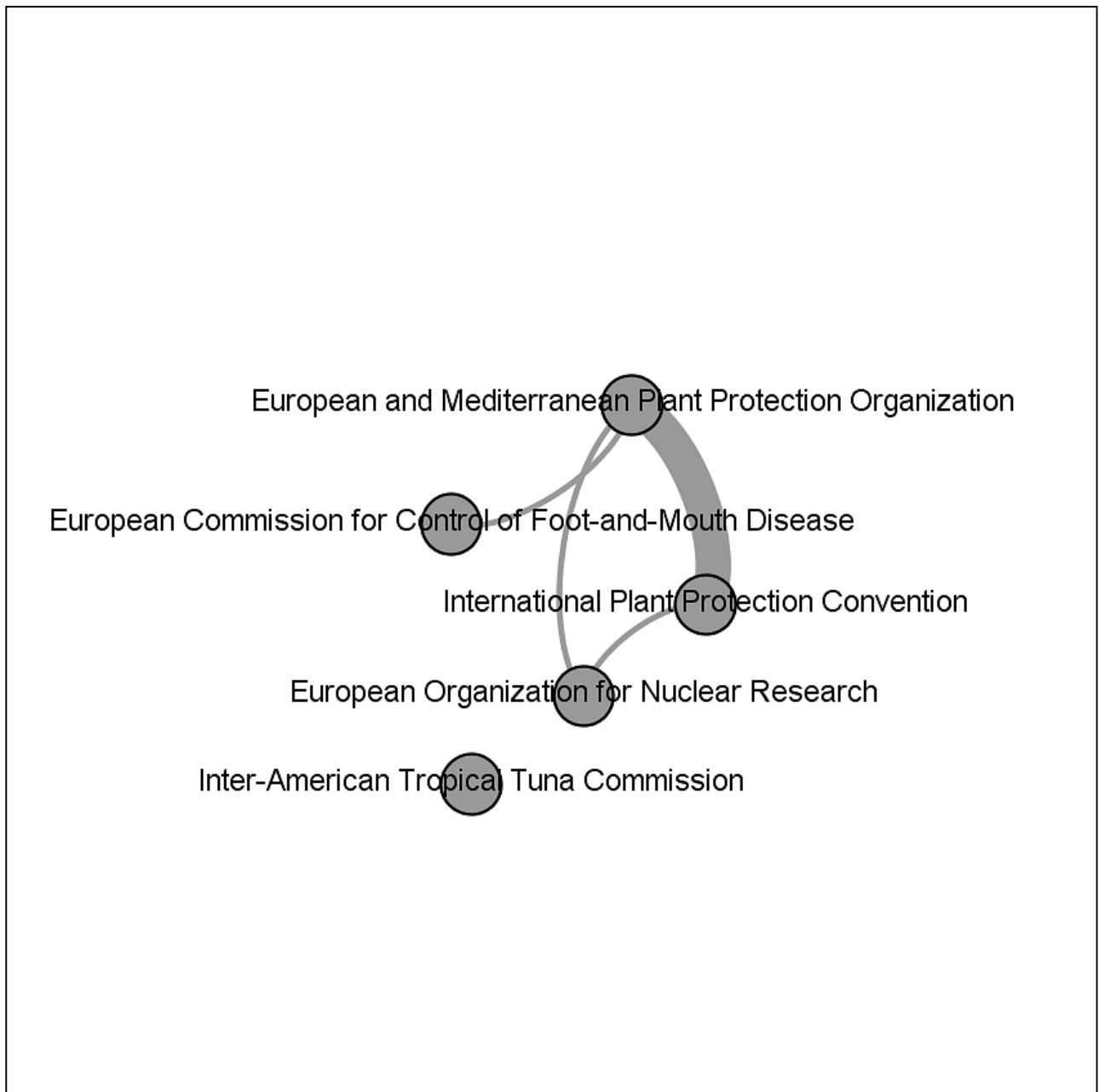
**FIGURE 1** The Mechanism of Institutional Interaction



*Note:* Adapted from Gehring and Oberthür (2009, 130).

**FIGURE 2** The Network of International Environmental Institutions, 2000

*Note:* Regime identification numbers are listed in the appendix.

**FIGURE 3** The Network of International Environmental Institutions, 1953



**TABLE 1** Descriptive Statistics

	Obs	Mean	SD	Min	Max
Hard–Law Similarity	17980	1.16	0.87	0	3
Soft–Law Similarity	17980	0.64	0.70	0	3
Direct Links	17980	0.73	1.60	0	28
Maximum Flow of Information	17980	80.38	99.22	0	1175
Simmelian Ties	17980	20.84	32.71	0	133
Global Public Good 1	17980	0.73	0.45	0	1
Global Public Good 2	17980	0.73	0.44	0	1
Domestic Public Good 1	17980	0.19	0.39	0	1
Domestic Public Good 2	17980	0.20	0.40	0	1
Pollution 1	17980	0.39	0.49	0	1
Pollution 2	17980	0.50	0.50	0	1
Species 1	17980	0.35	0.48	0	1
Species 2	17980	0.37	0.48	0	1
Nuclear 1	17980	0.17	0.38	0	1
Nuclear 2	17980	0.14	0.34	0	1
Habitat 1	17980	0.18	0.38	0	1
Habitat 2	17980	0.23	0.42	0	1

**TABLE 2** Institutional Interaction from a Network Perspective – Soft Law, 1952–2000

	Model 1	Model 2	Model 3
Direct Links	0.07*** (0.01)		
Maximum Flow of Information		0.01*** (0.00)	
Simmelian Ties			0.01*** (0.00)
Global Public Good 1	0.29*** (0.03)	0.31*** (0.03)	0.30*** (0.03)
Global Public Good 2	-0.06* (0.03)	-0.07** (0.03)	-0.08** (0.03)
Domestic Public Good 1	0.05 (0.04)	0.07** (0.04)	0.05 (0.04)
Domestic Public Good 2	-0.54*** (0.04)	-0.56*** (0.04)	-0.56*** (0.04)
Pollution 1	-0.05*** (0.02)	-0.06*** (0.02)	-0.05** (0.02)
Pollution 2	-0.49*** (0.02)	-0.49*** (0.02)	-0.49*** (0.02)
Species 1	0.17*** (0.02)	0.17*** (0.02)	0.17*** (0.02)
Species 2	-0.19*** (0.02)	-0.20*** (0.02)	-0.21*** (0.02)
Nuclear 1	0.12*** (0.03)	0.14*** (0.03)	0.12*** (0.03)
Nuclear 2	0.10*** (0.03)	0.11*** (0.03)	0.10*** (0.03)
Habitat 1	0.05** (0.02)	0.05** (0.02)	0.06** (0.02)
Habitat 2	-0.05** (0.02)	-0.05*** (0.02)	-0.05** (0.02)
Observations	17980	17980	17980
Log Pseudo Likelihood	-17160.10	-17199.00	-17129.70
$\chi^2$	1155.40***	1130.40***	1297.30***
AIC	34352.10	34430.00	34291.40

Note: Cut points not reported; robust standard errors in parentheses

\* significant at 10%; \*\* significant at 5%; \*\*\* significant at 1% (two-tailed)

**TABLE 3** Institutional Interaction from a Network Perspective – Hard Law, 1952–2000

	Model 4	Model 5	Model 6
Direct Links	–0.09*** (0.01)		
Maximum Flow of Information		–0.01*** (0.00)	
Simmelian Ties			–0.01*** (0.00)
Global Public Good 1	–0.22*** (0.03)	–0.23*** (0.03)	–0.22*** (0.03)
Global Public Good 2	–0.06** (0.03)	–0.06** (0.03)	–0.04 (0.03)
Domestic Public Good 1	0.02 (0.03)	–0.02 (0.03)	0.01 (0.03)
Domestic Public Good 2	0.37*** (0.03)	0.37*** (0.03)	0.39*** (0.03)
Pollution 1	0.07*** (0.02)	0.08*** (0.02)	0.08*** (0.02)
Pollution 2	0.23*** (0.02)	0.24*** (0.02)	0.24*** (0.02)
Species 1	–0.18*** (0.02)	–0.17*** (0.02)	–0.18*** (0.02)
Species 2	0.05** (0.02)	0.07*** (0.02)	0.06*** (0.02)
Nuclear 1	–0.50*** (0.03)	–0.52*** (0.03)	–0.51*** (0.03)
Nuclear 2	–0.28*** (0.03)	–0.28*** (0.03)	–0.28*** (0.03)
Habitat 1	–0.11*** (0.02)	–0.10*** (0.02)	–0.12*** (0.02)
Habitat 2	–0.01 (0.02)	–0.01 (0.02)	–0.01 (0.02)
Observations	17980	17980	17980
Log Pseudo Likelihood	–21675.20	–21797.80	–21672.80
$\chi^2$	1187.10***	1079.20***	1347.30***
AIC	43382.40	43627.60	43377.50

Note: Cut points not reported; robust standard errors in parentheses

\* significant at 10%; \*\* significant at 5%; \*\*\* significant at 1% (two-tailed)

**TABLE 4** Predicted Probabilities of Design Similarity

Based on Table 2				
	Soft-Law Similarity=0	Soft-Law Similarity=1	Soft-Law Similarity=2	Soft-Law Similarity=3
Direct Links	-0.47	-0.16	0.34	0.29
Maximum Flow of Information	-0.34	0.08	0.20	0.06
Simmelian Ties	-0.20	0.09	0.10	0.02
Based on Table 3				
	Hard-Law Similarity=0	Hard-Law Similarity=1	Hard-Law Similarity=2	Hard-Law Similarity=3
Direct Links	0.73	-0.37	-0.30	-0.06
Maximum Flow of Information	0.20	-0.02	-0.14	-0.04
Simmelian Ties	0.20	-0.01	-0.14	-0.05

*Note:* Change of predicted probabilities of dependent variables' categories is shown for each network measure when moving from the minimum to the maximum; all other variables held at their mean values

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