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# IEAs and compliance: Do treaty linkages play a role?

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## **Abstract**

International environmental agreements (IEAs) address cross-border public goods, therefore they are faced with free-riding problems. Generally, the incentives of states to comply with such treaties are low as the benefits of compliance do not always outweigh the cost. Previous literature has pointed towards the importance of the treaty design characteristics in motivating compliance and deterring free-riding. The aim of this paper is to investigate the association of using of those mechanisms -treaty linkages- and the compliance with IEAs. By using data on 92 IEAs from the international regime database (IRD), the paper finds that the number of reinforcing links per treaty has a positive and significant association with better compliance. Counter to existing literature, trade links, however, do not exhibit a significant association with better compliance.

Keywords: International Environmental agreements, Treaty linkages, Compliance, Public goods

JEL classification: H41, K33, O19, Q50, Q56

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# 1 Introduction

International environmental agreements (IEAs) address the provision of cross border environmental goods, which are mostly public goods that require collective action of the parties involved (Mitchell, 2003). Due to the nature of the goods supplied by IEAs, they face free-rider problems. Incentives to free-ride in such cooperation are high, due to the lack external enforcement mechanisms (Ederington, 2002; McKibben and Western, 2014; Pham Do and Dinar, 2014) and the asymmetry in the distribution of benefits and costs across time and states (Carraro and Siniscalco, 1997; Aakvik and Tjøtta, 2011). Therefore, incentives for parties to cooperate with these agreements are low and the benefit of free riding may seem attractive for individual states. However, for IEAs to achieve their targets in supplying the environmental goods without running into a problem of “tragedy of the commons”,<sup>1</sup> cooperation between all parties is necessary and compliance with treaty terms need to be supported with sufficient incentives (Ederington, 2002; McKibben and Western, 2014; Pham Do and Dinar, 2014). So the objective when forming the IEAs is to restructure the underlying incentives so that it pays off for the individual states to comply.

Looking in detail in the literature on environmental governance, much research has shown that different terms and design elements affect state behavior in terms of participation and afterwards compliance (Raustiala, 2000; Barrett and Stavins, 2003; von Stein, 2008; Faure and Lefevere, 2012). Mechanisms such as sanctions, capacity building and monitoring are an example of such design characteristics. The focus in this paper is on one of the design characteristics, namely treaty linkages. By treaty linkages, I refer to linking treaties that do not belong to the same treaty regime or institution.

Theoretical literature suggests that linking treaties that address different issues would open new areas for cooperation and can be used as external enforcement tool in issue areas that have cross-border effects (Limão, 2005; Pham Do and Dinar, 2014; Ert et al.,

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<sup>1</sup>A situation that occurs when individuals acting in their own self-interest (rather than in the interest of the group) would exploit/over-use a shared resource to the extent that this resource becomes unavailable to a part of or the whole group.

2019). Linkages would broaden the basket of benefits against the costs and thus reduce the asymmetry that affects the emergence of a stable cooperation (Carraro and Siniscalco, 1997). Specifically, linkages with trade agreements, like using trade restrictions in case of non compliance, is expected to increase the compliance rates as the costs for violations are then higher than the benefit of non-compliance (Barrett and Stavins, 2003). Thus, issue linkage may increase the incentives to comply and overcome free riding (Kemfert, 2004). The aim of this paper is to investigate two hypotheses: first whether in fact treaty linkages are associated with better compliance rates. Second, whether linkage with trade agreements in specific is positively associated with better compliance.

The interaction of treaty linkages and compliance has been addressed empirically in several areas that are characterized by enforcement problems. However, to the extent of my knowledge it has not been tackled empirically in the context of IEAs. So the aim of this paper is to examine empirically into the role of treaty linkages in enhancing compliance with IEAs.

The International Regime Database (IRD) is used, which includes 23 international environmental regimes and a total of 92 treaties (Breitmeier et al., 1996). Using the data on treaty level characteristics from the IRD database, the main variable of interest is regime interactions. In a first step, the interactions between IEAs and other international agreements are examined, in particular whether they reinforce or conflict with each other. In a second step a tentative empirical analysis sheds light on the relationship between treaty linkages and the compliance rate with the treaty.

To examine the association between treaty links and compliance, an OLS regression is run. To proxy compliance, 2 variables from the IRD database are used: goal fulfillment and behavior conformity. I control for the treaty design characteristics as well as whether the good is public or not, the number of participants and the ratio of high income countries in each treaty. The standard errors are clustered on the regimes as each group of treaties belong to the same regime. Results show that while the total number of linkages (reinforcing and conflicting) is not significantly associated with compliance, however, the

number of reinforcing links is significant and positively associated with goal fulfillment but not with behavior conformity.<sup>2</sup> Trade linkages, counter to existing literature, do not show any significant association with either the measures of compliance.

The paper is organized as follows: the next section provides background on IEAs and compliance of parties within. The third section gives an overview of linkages and why they can be used to incentivize compliance. The fourth section presents the data used and in the fifth section the analysis and the results as well as robustness checks are presented. The sixth section concludes.

## 2 Background

### 2.1 International Environmental Agreements

IEAs are legally binding arrangements between several states to address cross-border environmental issues (Mitchell, 2003). These environmental issues usually involve a public good (PG) or a common pool resource (CPR): both of them present a non-excludable good<sup>3</sup> and the aim of IEAs is to set a framework or standards so as to regulate the use of such goods. Over the past 4 to 5 decades, these agreements have gained prominence as a tool to address the international problem of negative externalities that impact the environment (Vollenweider, 2013). More than 460 agreements have been signed since the 1970s aiming at protecting the environment (Barrett, 1994; Mitchell, 2003; Vollenweider, 2013). These agreements are voluntary by nature; so countries are free to enter and are allowed to withdraw at any point of time (Barrett, 1994; Ringquist and Kostadinova,

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<sup>2</sup>The two main dependant variables are positively though weakly correlated, therefore in some cases there can be weak goal fulfillment and high behavior conformity or vice versa. While unintuitive, there can be cases where following the prescribed behaviour in the treaty does not lead to the complete fulfillment of the treaty goals (for example: the Kyoto Protocol(KP)). The opposite is also true, in some cases the goals are fulfilled even when the behavior of parties does not prescribe fully to that mentioned in the treaty text (for example: the International Tropical Timber Agreement (ITTA)).

<sup>3</sup>By definition CPR and PG are non-excludable in consumption, but they differ in the rivalry in consumption. While PG can be consumed without reducing the availability to others, CPR consumption decreases the resource. Therefore, PGs have free-rider problems (lack of contributions), whereas CPRs have “tragedy of the commons problem” (overuse).

2005) and one of the goals of designing these treaties is to guarantee compliance with the terms and standards described in the agreement (Libecap, 2014).

The lack of external enforcement mechanisms in IEAs reduces the cost of free-riding, as there is no credible punishment. This lack of enforcement undermines the cooperation and leads to “tragedy of the commons” even when cooperation would be the optimal solution (Ederington, 2002; McKibben and Western, 2014; Pham Do and Dinar, 2014). And while the global environment would benefit from the compliance with IEAs as it will lead to collective gains from cooperation (Ringquist and Kostadinova, 2005), the incentives of states to defect is in some cases is greater than the incentive to comply.

Second, the asymmetry in the distribution of benefits and costs across time and states, reduces the incentive to comply with the treaty. States may be able to enjoy the benefits of the agreement (use of public good) without bearing the costs or in other cases, the benefits may be uncertain but the costs are high on the short term. Therefore, the incentive to free-ride in IEAs are high due to the provision of public goods and spillover effects, which undermine cooperation (Carraro and Siniscalco, 1997; Aakvik and Tjøtta, 2011).<sup>4</sup>

Hence, these agreements need to be self-enforcing and attractive so that countries are incentivized to participate rather than free-ride (Barrett, 1994; Ederington, 2002; Limão, 2005). Designing an international agreement that would be attractive enough to attract multiple heterogeneous actors with different preferences and conditions is definitely not a simple task. The heterogeneity of countries involved in IEAs makes the negotiation process and reaching an agreement difficult especially when the costs and benefits are not evenly distributed across these states (Mitchell, 2003; Aakvik and Tjøtta, 2011; Libecap, 2014).

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<sup>4</sup>Managing commons across state borders may be difficult to overcome due to problems with coordination. For example, a given government may find it difficult to contribute to the managing of commons without credible contributions from other governments.

## 2.2 Theory

States are considered to be rational actors that aim at maximizing their net benefits, so they may find it more beneficial to free-ride and thus none of the individual parties would want to comply with the treaty. Nonetheless, it is in all states benefits to comply as this leads to the maximum benefit (gains from cooperation).

Thus, to achieve collective cooperation it is in all states benefits to incentivize compliance and/or punish free rider. So the objective when forming the IEAs is to restructure the underlying incentives so that it pays off for the individual states to comply. Some discussion to address this point has referred to the use of internal treaty characteristics (without external bodies for enforcement) to make the treaty attractive enough for the rational states to join and comply with the treaty terms; a self-enforcing treaty. In self enforcing treaties the supposed net benefit from cooperation is higher than non-cooperation. From this perspective, the internal design characteristics of the treaty are the determining factors for states to change uncooperative behavior (Koremenos et al., 2001). While in theory such self-enforcing contracts are possible, these models can become unstable when the number of participants is large, no matter if modelled as stage game or an infinite repeated game (renegotiation proof) (Barrett, 1994; Carraro and Siniscalco, 1997).

Within the rational design literature on treaties, some mechanisms are discussed to address free-riding such as sanctions, monitoring, and capacity building. Cooperation in the supply of a global public good can only be sustained when the threat of non-compliance is credible (Barrett, 1998). Sanctions are one of the most common tools, however, their use in the international public law in general is controversial in terms of how effective they are in deterring non-compliance.

According to Faure and Lefevre (2012) the use of instruments to deter non-compliance is more effective than the use of sanctions; given the assumption that states some time do not comply due to incapacity rather than on purpose. This may explain why in IEAs their use was shown to be limited (Koremenos, 2013).

The provision for monitoring mechanisms for instance or self reporting is expected



to enhance the compliance of the states with the treaty. Monitoring is expected to have a higher effect than self reporting as states can always mis-report their real emissions. Monitoring, however, is expected to increase states' compliance based on the idea that monitoring would help detect any violations early on (Raustiala, 2000), which should make states more wary of violations especially when violation of the rule would be costly in terms of either reputation or sanctions (Guzman, 2002; Vezirgiannidou, 2009; Koremenos, 2013). By far, capacity building provisions have gained the most approval in terms of their effectiveness in enhancing compliance of non-compliant states. Non-compliance in this case is mainly a result of incapacity of the state, where the state can not afford or is not able to reduce its emissions on its own rather than purposeful non-compliance (Chayes et al., 1995; Raustiala, 2000; Vezirgiannidou, 2009).

Carraro and Siniscalco (1997) suggest that treaty linkages may be a useful tool to address free-riding. They suggest that linkages with other treaties may reduce the asymmetry that affects the emergence of stable cooperation; by broadening the basket of benefits against the costs. They also suggest that it may increase the size of a stable coalition. This idea of policy linkages and coordination has also been suggested in the legal literature. Based on Trachtman (2011), treaties do not exist on their own, that is, they are embedded into the broader international legal system. One assumption that is underlying most international cooperation games is that they are self-contained. However, casual observation of international relations and international law suggests that there are many linkages (Haas, 1980). States can bind a particular game to other games in a "supergame." Therefore, modelling compliance with IEAs only based on on internal treaty design may be only one side of the story. While internal treaty design characteristics are important for compliance, the external relationships of IEAs with other public international law regimes are also likely to play a role. The focus in this paper is on the role of linkages in incentivizing/enhancing compliance with IEAs. So far, there is little economic work that determines the effect of links on compliance (Maggi, 2016).

One way to incentivize compliance is through linkages, as linking with other treaties

may have some merits as a deterrent of free-riding. By linking to other treaties, the incentive to comply increases; either by increasing the cost of non-compliance (such as in the case of Montreal Protocol through the threat of trade restrictions) or by increasing the bundle of benefits of the treaty. Linkage is useful as it acts as a external enforcement tool in issue areas that have cross-border effects, where one policy area can discipline cooperation in the other areas (Limão, 2005; Pham Do and Dinar, 2014). Thus, issue linkage may increase the incentives to comply and overcome free riding (Kemfert, 2004).

Based on the theory of exchange, issue linkages may be able to promote a larger number of mutually beneficial agreements as it can assist in overcoming the distributional issues and re-balance the asymmetrical benefits distribution,<sup>5</sup> especially in cases where monetary side payments are not a feasible alternative (Tollison and Willett, 1979; Charnovitz, 1998; Ederington, 2002). In such cases linking one policy to another<sup>6</sup> would offset the imbalance in the distribution of benefits and thus incentivize cooperation of a larger group of countries in both policy areas (Tollison and Willett, 1979; Limão, 2005; Pham Do and Dinar, 2014). This way a more stable and symmetric coalition may be obtained/achieved (Kemfert, 2004). In fact, Carraro and Siniscalco (1997) argue that linkage of environmental negotiation to economic issues -in specific- may reduce asymmetries. By linking two or more issues, the potential benefits from the linked agreement for each country are higher and it may be possible to obtain an agreement that is profitable to all countries. Additionally, linkages provide a greater degree of support for the issues linked compared to non-linkage (McKibben and Western, 2014), in cases where the issues linked are substitutes, linkage may be useful for sustaining policy cooperation, because under linkage the threat of simultaneous punishment in both linked areas is stronger and the benefit of simultaneous defection from both policies is less valuable (Ederington, 2002).

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<sup>5</sup>Benefits are highly skewed to one or some countries and where the monetary side payments are not feasible and linkage in this can be regarded as in-kind side payment (Limão, 2005; Pham Do and Dinar, 2014).

<sup>6</sup>Provided that the other issue areas offers benefits to other countries not benefiting from the first policy.

Another reason why linkage may be successful in promoting compliance is that linking to other issue areas lengthens the shadow of the future and introduces more venues for reciprocity and cross-retaliation; across time and agreements (McKibben and Western, 2014), thus increasing the credibility of the threat of punishments to potential free-rider/non-compliers (Ederington, 2002).<sup>7</sup> This is due to the fact that states would interact with each other not only in the supply of the public good but in other areas as well, overtime and repeated interactions,<sup>8</sup> the probability of retaliation or punishment is high (Ederington, 2002; McKibben and Western, 2014). Barrett (1998) shows that by linking to trade, the threat of sanction is credible and a cooperation may be sustainable.

Linkage however is controversial when it comes to its effectiveness in promoting compliance. For one it complicates and may slow down the negotiation process or lead to deviations from the main goals of a treaty (Ert et al., 2019). This is especially obvious when it comes to linkages with trade; as they are considered in some cases to be substitutes and that achieving both goals through one treaty is no more than an illusion (Charnovitz, 1998; Bodansky et al., 2016). In addition to negotiations difficulties, linkage introduces some level of inclarity or confusion in the objectives of a treaty (Bodansky et al., 2016).

Linking with other economic agreements and in specific with trade regimes is one of the most commonly researched linkages (Barrett, 1997; Charnovitz, 1998; Copeland, 2000; Alvarez, 2002; Ederington, 2002; Kemfert, 2004; Limão, 2005; Aggarwal, 2013). As it is expected to increase cooperation in regimes addressing public goods, where the benefits of free riding are expected to be offset by the gains from a club good (Kemfert, 2004) and has been shown that the threat of trade sanctions is successful in deterring free-riding in IEAs (Barrett, 1998). And linking with trade regimes does have its merits, for one institutions such as the WTO are quasi-autonomous, centralized and tend to stick to/adhere to group goals, it also has shown to be self enforcing. Therefore linking IEAs

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<sup>7</sup>However, stronger punishment does not necessitate a more efficient outcome.

<sup>8</sup>In the sense that the defection in one of the provisions of one of the linked treaties could be retaliated against over time and through the other agreements.

-that suffer from high incentives to free ride- with trade may be an effective means in promoting effective cooperation and compliance between states (Alvarez, 2002).

However, there are several arguments against the usefulness of using trade regimes in achieving compliant outcomes in the IEAs. From a practicality point of view, trade policy may not be the best instrument to achieve social objectives, they are at the end focusing on achieving trade goals. Especially, since trade and non trade issues are more likely than not to be substitutes when it comes to enforcement or at the very least asymmetric; linking to non-trade issues may lead to lower cooperation in trade policy, which would be ineffective. Also, WTO and similar regimes are not equipped to decide on environmental issues; this is beyond their scope and could end up leading either undermining the environmental goals or trade goals or an inefficient outcome for both issue areas (Charnovitz, 1998; Limão, 2005; Bodansky et al., 2016).

## 2.3 Hypotheses

In general, the interaction of treaty linkages and compliance has been addressed empirically in several areas that are characterized by enforcement problems. Hafner-Burton (2005) addressed the linkage between trade and human-rights policies, where she examined whether introducing human-rights clauses in preferential trade agreements (PTAs) improves state compliance with human rights, compared with unlinked human-rights agreements. Results show that PTAs with hard human rights standards tend to lead to better human rights practices. Additionally, the question of whether issue linkage improves compliance has also been examined in the context of security agreements by (Leeds and Savun, 2007; Poast, 2012). Leeds and Savun (2007) find that security alliances are less likely to be opportunistically terminated when they include economic provisions. Also, Poast (2012) finds that buffer states in alliances with trade provisions experience fewer violations of their territorial integrity than buffer states in other alliance arrangements.

An empirical examination of the intersection of issue linkages with IEAs has so far

been missing. Existing literature on the theoretical merits of such a mechanism does exist. Linking to trade-relevant agreements in specific has been referred to in the literature as a feasible tool for some treaties (Carraro and Siniscalco, 1997; Barrett, 1998; Barrett and Stavins, 2003). It has been recently addressed in the experimental literature by Ert et al. (2019), where they study the effect of issue linkage on cooperation in bilateral conflicts in the field of transboundary water. They show that linkage positively affects mutual cooperation and negatively affects mutual defection, thus incentivizes mutual cooperation. They also show that even in the presence of asymmetric payoffs, which reduces the cooperation rates in general, cooperation rates are higher in linked games rather than isolated games.

The previous empirical literature addressing the effect of linkages on compliance, have shown that overall there is a positive association between linkages and compliant behavior with international agreements in different areas. Thus far, it has not been examined empirically in the scope of the IEAs, so the aim of this paper is to empirically investigate whether a similar association can be found in the IEAs. Based on findings from previous literature on linkages, the following hypotheses are derived:

H1a: Treaty linkages are positively associated with better compliance

H1b: Trade linkages -in specific- are positively associated with better compliance.

### 3 Data and analysis

The data used to address the above-mentioned hypotheses is on the treaty level. The International Regime Database (IRD) is used, which includes 23 international environmental regime and a total of 92 treaty. By regime they mean an international organization; take the United Nations Framework Convention for Climate Change (UNFCCC) as an example of a regime and within the UNFCCC there exists several treaties such as the Paris agreement and the Kyoto protocol. This is one of the few datasets that provides deep and theoretically enriching information on various international environmental co-

operations (Morita and Zaelke, 2005; Marcoux, 2009). The IRD provides information on the different IEAs among 4 dimensions: the regime formation, regime attributes, regime consequences and regime dynamics. The data is gathered by surveying 48 independent scholars in the field of environmental politics, where each regime has on average 2 coders; ranging from 1 to 4 per regime (Breitmeier et al., 1996; Böhmelt and Pilster, 2010).<sup>9</sup>

For each treaty the responses over the coders are aggregated, so that each treaty enters the dataset only once.

### 3.1 Explanatory variables

The main variable of interest from the IRD dataset is the regime interaction variable found in the regime attributes (refer to Appendix A.1 for exact question as in the IRD survey). This variable is derived from a question that includes 2 sub questions. In a first step, the surveyed experts are asked to name all interaction a treaty/agreement/protocol has with other treaties/agreements. In a second step, they are asked to identify whether this interaction is reinforcing, conflicting or both. From these questions, several variables of interest are derived. First, the number of treaties linked to each treaty is identified.<sup>10</sup> Second, I identify the number of reinforcing treaties in specific. Third, the treaty links are categorized in 3 main categories: trade/economic, same issue, and environmental. For the purpose of the analysis, I am interested in knowing the total number of links, the total number of reinforcing links and whether a treaty has any linkage to trade organizations (such as the WTO), table I includes summary statistics on the relevant variables (refer to table XII in Appendix A for correlations between the relevant variables).

Over the 92 treaties, there are around 315 interactions identified, 27 of the 92 treaties have no interaction identified and the remaining 65 treaties have at least one interaction identified as shown in Figure 1. While some environmental treaties (27 treaties) have

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<sup>9</sup>Given that nature of the data, there might be problems with reliability of the information due to possibility of coder’s bias. However, this problem has been addressed by the IRD team by relying on scholars who are recognized in their fields for their expertise and practical knowledge (Breitmeier et al., 2006; Böhmelt and Pilster, 2010).

<sup>10</sup>A link is identified as treaty that does not exist with in the same regime/organization.

	no. of obs.	mean	std. dev.	min	max
No. of links	95	3.31	3.95	0	15
No. of reinforcing	95	2.63	3.85	0	15
Trade link	95	0.15	0.36	0	1

Table I: Explanatory variables: Summary Statistics

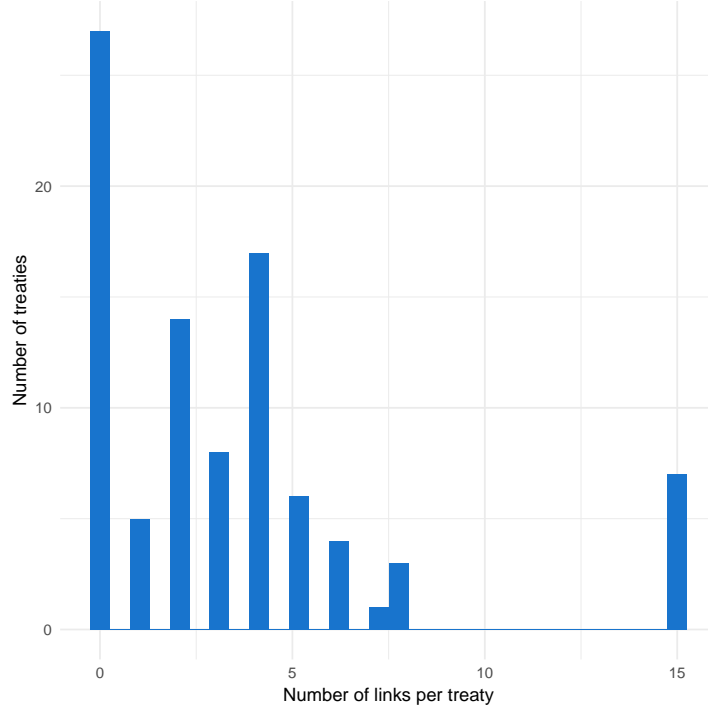


Figure 1: Number of links per treaty

no interactions with other international regimes, others have multiple interactions such that there are more interactions than environmental treaties. The data shows that 79% (250 of 315) of all interactions are reinforcing; 79% of the interacting international regimes reinforce the environmental treaty and/or vice versa. Around 15% (46 of 315) interactions are classified as both: reinforcing and conflicting by the coders. Only 6% of all interactions are considered to be conflicting (Figure 2). This shows that treaties do in fact interact with one another and they are more or less reinforcing each other.

The third relevant variable needed is whether the treaty has an interaction with any of the trade treaties (refer to Appendix C for details on same issue classification). Overall most of the interactions occur between treaties that address similar issues (an example for a same issue link is if two treaties address the same environmental problem such as

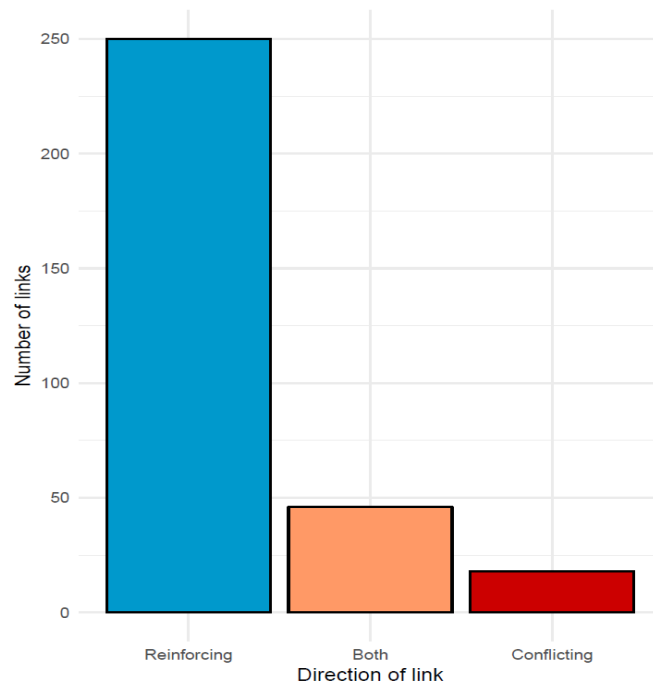


Figure 2: Number of interaction in each of the three categories

air pollution). Figure 3 shows the number of treaties that have each type of link. Overall the number of interactions with trade are limited to 15 treaties only; this means out of the 65 that do have an identified interaction, only 15 have an interaction with trade.



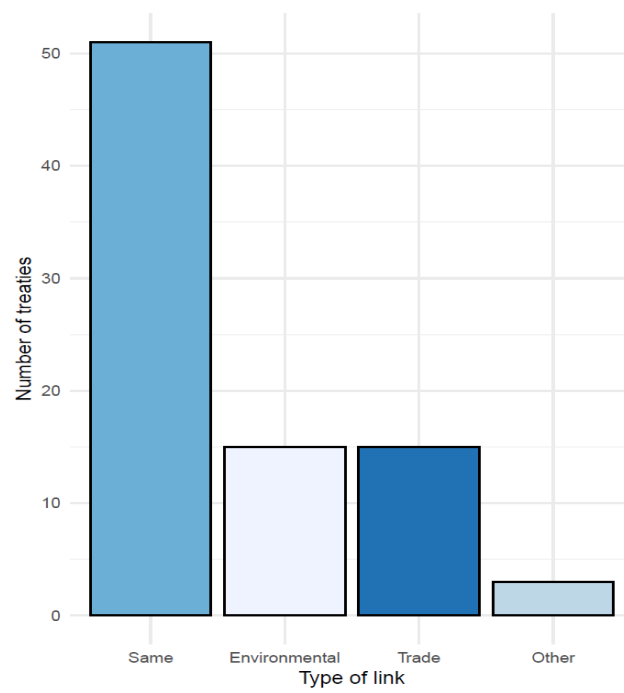


Figure 3: Number of links per category

## 3.2 Control variables

In order to empirically investigate the association between treaty linkages and compliance, some treaty design characteristics as well as characteristics of its participants that affect compliance as well must be controlled for. The IRD provides an extensive list of regime attributes and regime formation characteristics that enables us to find a measure for each of the control variables needed (refer to Appendix A.2 for the exact questions as in the IRD protocol and tables IX and XI in Appendix A for summary statistics on the relevant control variables).

The precision of the treaty -in terms of how specific the terms are in contrast to being ambiguous- is expected to be positively correlated with compliance; more precise terms are associated with higher compliance rate as with vague terms violation of treaty is not very clearly detected (Guzman, 2002; Goldsmith and Posner, 2005; Faure and Lefevre, 2012; Koremenos, 2013). The depth of the agreement is expected to be negatively associated with compliance rate; the shallower the targets the more reachable they are and also the less costly they are <sup>11</sup> and thus the higher the compliance rate (Raustiala, 2000; Guzman, 2002; Barrett and Stavins, 2003; Vezirgiannidou, 2009). Treaties with binding terms (hard law) are less attractive for parties, however, they make the detection of non-compliance easier, thus making the cost of non-compliance- such as reputation costs- higher (Raustiala, 2000; von Stein, 2008). Treaties that are characterized with high compliance costs are less attractive, and in some cases compliance rates can drop if states do not have the sufficient means to comply (Barrett and Stavins, 2003).

The use of sanctions is one of the most controversial mechanisms used for deterring non-compliance, especially when it comes to environmental issues. This may explain why they are used in much less frequency as compared to their use in trade agreements (Koremenos, 2013). On the one hand, they are expected to increase the costs of not

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<sup>11</sup>While precision and the depth of treaty targets are positively correlated ( $\sim 40\%$ ), theoretically their effect on compliance may differ due to the channels through which they work. More precise terms may be more difficult to follow, in this case precision and depth would have the same effect. However, more precise terms makes the detection of violations easier; in the sense that not complying with a specific rule would be easier to detect than not complying with an ambiguous rule.

complying with the treaties and thus lead to higher compliance rates (Raustiala, 2000; Vezirgiannidou, 2009). On the other hand Chayes et al. (1995) deem sanctions to be overall ineffective in the environmental area. According to Faure and Lefevere (2012) the use of instruments are more effective in incentives compliance compared to sanctions. For example the use of capacity building mechanisms or monitoring mechanisms are expected to be more effective in incentivizing compliance (Chayes et al., 1995; Raustiala, 2000; Vezirgiannidou, 2009). In cases where the non-compliance of a state is the result of its incapacity the use of the former mechanism is expected to increase the compliance rate (Chayes et al., 1995; Raustiala, 2000; Vezirgiannidou, 2009). In the case of monitoring mechanisms, any violation is expected to be detected earlier and thus compliance rates are expected to be higher, especially when violation is potentially costly; due to potential reputation costs or sanctions (Raustiala, 2000; Guzman, 2002; Vezirgiannidou, 2009; Koremenos, 2013).

The bigger the group of participants, the higher the incentives of hesitant states to join (Chayes et al., 1995; von Stein, 2008). However, its association with compliance is not clear and remains controversial as the larger the group of participants, the more heterogeneous their preferences are; making the negotiation of a one-goal-fits-all more difficult and thus compliance may not be in the interest of the states (Raustiala, 2000; Vezirgiannidou, 2009). States with higher income levels are expected to have higher compliance rate as they have the resources (financial and possibly technical) and the capacity to comply as compared to poorer countries. Additionally, the concern for the environment or “environmentalism” is associated more often than not with richer countries as it is thought of as a luxury (von Stein, 2008; Harris and Lee, 2017).

I also control for whether the treaty addresses a public good or not. Treaties that target the supply of a public good are expected to have higher free-rider problems and thus lower compliance rate (variables used and their expected signs in Table II).

Variable	Expected Sign
Precise	+
Depth	-
Bind	+
Scope	-
Cost	-
Difficulty	-
Sanction	+/-
Capacity building	+
Monitor	+
No. of Parties	+/-
Ratio	+
Public	-

Table II: Control variables and their expected signs

### 3.3 Dependent variable

Two variables from the IRD regime consequences questions to proxy compliance are used (refer to Appendix A.1 for exact questions as in the IRD survey). Measuring compliance is no easy task and can be described as a multi-faceted concept. So I use two variables: goal fulfilment and behavior conformity so as to reflect 2 different facets of such a concept (refer to table X in Appendix A for pairwise correlation between the variables). The main objective for having states comply with a treaty, is to achieve the goals of the treaty. Therefore, I make use of the question on goal fulfillment <sup>12</sup> in the IRD codebook. For each treaty the coders were required to state whether the goals of the treaty have been fulfilled or not. It is coded originally as a binary variable, however, once data is aggregated over coder and treaty, a continuous measure is produced that ranges between 0 and 1 (refer to figure 4 for distribution).

<sup>12</sup>The ability to fulfill treaty's goals may be due to having the means to comply rather than violation of treaty terms. For this reason the number of countries as well as the ratio of developed countries per treaty are controlled for. Developed countries are expected to have similar means in achieving the treaty goals, thus if goal fulfillment of a treaty is due to inability of parties to comply rather than violations, we would find that treaties with high share of developed countries have high fulfillment compared to those that do not. Evidence from the data shows that goal fulfillment is positively yet not highly correlated with the ratio of developed countries (34%). So, while there is correlation between ability to fulfill goals (comply) and the ratio of developed countries, it is not sufficiently high so as to eliminate the use of goal fulfillment from being an adequate proxy for compliance.

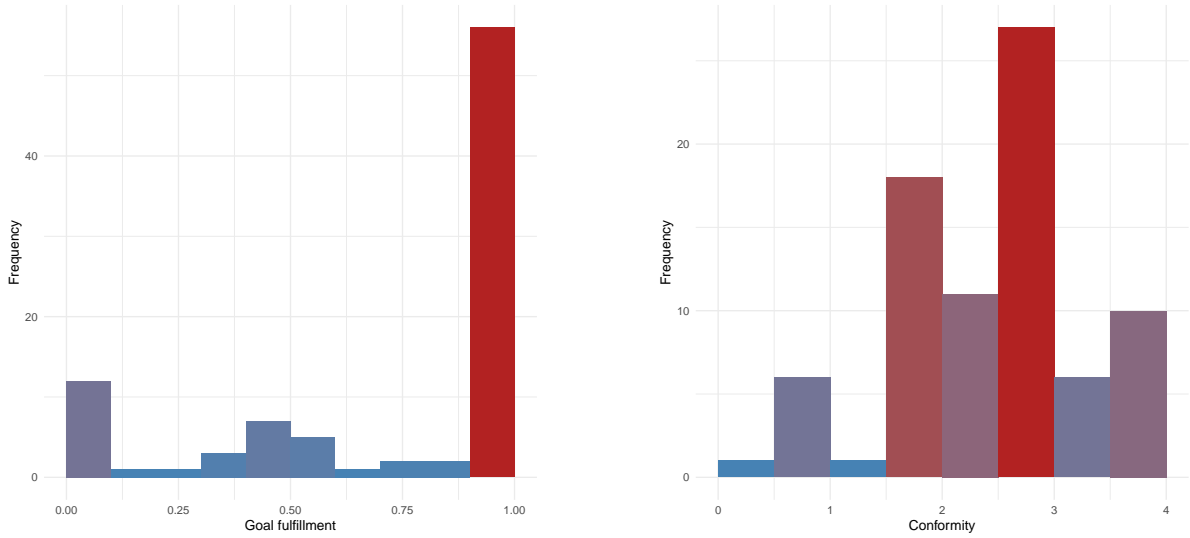


Figure 4: Distribution of responses in both dependant variables. Goal fulfillment is continuous ranging from 0 to 1, in brackets of 0.1. Conformity ranges from 0 to 4 in brackets of 0.5. The color scale illustrates the frequency of each value, ranging from blue (low frequency) to red (high frequency)

The question on behavior conformity of states as another proxy of compliance is used, but rather than look at the goal, in this case it reflects the behavior of the states. Coders were asked for every treaty to choose how much did the behavior of actors conform to the behavior described in the treaty terms on a scale from 1 to 5. Originally the variable is coded as ordinal from 1 to 5, however, once aggregated it ranges from 0 to 4 (refer to figure 4 for distribution).<sup>13</sup>

	no. of obs.	mean	std. dev.	min	max
Goal fulfillment	90	0.75	0.36	0	1
Conformity	80	2.66	0.85	0	4

Table III: Dependant variables: Summary statistics

## 4 Results

To examine the association between treaty links and goal fulfillment, an OLS regression is run. The treaty design characteristics are controlled for (referred to in 3.2). Given

<sup>13</sup>The coders were asked to code if the behavior 1= full conformation till 5=did not conform. So I adjusted the scale so that 0 refers to non conformity and 4 is full conformity. Given the aggregation, the values run from 0 to 4 in half points.

that each group of treaties belongs to the same regimes, there might be some similarities or significant elements in common. If these factors are not controlled for, the errors may not be independent or identically distributed. So the standard errors are clustered on the regimes.

	(1)	(2)	(3)
Links	0.0167 (0.0106)		
Reinforce		0.0248** (0.0110)	
Trade			-0.0457 (0.111)
constant	0.285 (0.495)	0.224 (0.495)	0.512 (0.414)
$R^2$	0.573	0.587	0.558
$N$	81	81	81
<i>controls</i>	yes	yes	yes

Standard errors in parentheses (clustered)

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

Table IV: Dependent variable: Goal Fulfillment. Table includes 3 different models, each includes one of the main explanatory variables: Number of links, Number of reinforcing links and a dummy for trade link, respectively. Tables with control variables are available in table XIII in appendix B.

In table IV the results for the goal fulfillment are presented. The variables of interest are the number of links, the number of reinforcing links and a dummy for trade link (see Appendix B for the full tables including controls). Results show that the number of links is positively associated, however, not statistically significant with the goal fulfillment. The direction of the links is controlled for in model (2) in table IV, where a variable with the number of reinforcing links only is included. The number of reinforcing links is positively associated with goal fulfillment and statistically significant. This means that while the number of total links does not seem to be significantly associated with better goal fulfillment, the number of reinforcing links is significantly associated with better goal fulfillment. Having a link with a trade agreement does not seem to have any sort of

significant association with the goal fulfillment.

In table V the results for behavior conformity are presented (see Appendix B for the full tables). As shown in the table, the number of links is positively associated with behavior conformity and statistically significant on the 10% level. When adjusting for the number of reinforcing links, the results loses significance; the number of reinforcing links is positive yet not statistically significant from zero. The number of links with a trade agreement, also, does not show any significant association with the behavior conformity.

	(1)	(2)	(3)
Links	0.0665* (0.0382)		
Reinforce		0.0591 (0.0541)	
Trade			0.399 (0.355)
constant	3.117** (0.873)	3.362*** (0.819)	3.741*** (0.876)
$R^2$	0.347	0.327	0.303
$N$	74	74	74
<i>controls</i>	yes	yes	yes
Standard errors in parentheses(clustered)			
* $p < 0.1$ , ** $p < 0.05$ , *** $p < 0.01$			

Table V: Dependent variable: Conformity. Table includes 3 different models, each includes one of the main explanatory variables: Number of links, Number of reinforcing links and number of trade links, respectively. Tables with control variables are available in table XIV in appendix B.

## 4.1 Robustness checks

### 4.1.1 Capping the number of links

Given the distribution of the number of links as shown in figure 1, number of links per treaty ranges from 1 till 8 and only few treaties seem to have 15 links. Given that this jump may lead to some bias in the results, the number of links is capped to be at the next largest number, in this case 8 links, and see if the results are some how biased by

such an outlier.

For the dependant variable goal fulfillment, the results do not differ much, the number of links is positive but not statistically significant from zero. The number of reinforcing links is positive and statistically significant at the 10% level (compared to 5% level in the main result in table IV). This robustness check shows that for the dependant variable goal fulfillment, the adjustment of the number of links does not seem to lead to very different results; in other words, the number of links does not seem to have biased the main results presented in table IV.

As for the dependent variable behavior conformity, the results are slightly different, while the number of adjusted links is still positively associated with the dependant variable, it loses statistical significance. The number of adjusted reinforcing links seems to non significant and have changed signs. Overall, given the lack of statistical significance and contradicting results with the main results, we can not derive any concrete conclusions with regards to the role of linkages in enhancing the behavior conformity of parties.

	(1)	(2)	(3)	(4)
	Goal	Goal	Conform	Conform
Links_adj	0.0249 (0.0174)		0.0238 (0.0613)	
Reinforce_adj		0.0376* (0.0182)		-0.0426 (0.0578)
constant	0.228 (0.449)	0.188 (0.443)	3.748*** (0.860)	4.034*** (0.846)
$R^2$	0.573	0.590	0.292	0.298
$N$	76	76	74	74
<i>controls</i>	yes	yes	yes	yes

Standard errors in parentheses(clustered)

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

Table VI: Dependent variable in column (1) and (2) is goal fulfillment. Dependent variable in column (3) and (4) is behavior Conformity. Table includes 4 different models with the adjusted number of links and adjusted number of reinforcing links as the main as explanatory variables. The first 2 columns show the results of using the explanatory variables on goal fulfillment and the 3<sup>rd</sup> and 4<sup>th</sup> show the results of using the explanatory variables on behavior conformity. Tables with control variables are available in table XVI in appendix B.



### 4.1.2 Ordered logit

A robustness check for the behavior conformity variable is run. Given that it is distributed in halves on a scale from 0 to 4 (with 8 values), an ordered logit with clustered standard errors is run. Results are in line with the those presented in the main results; the explanatory variables exhibit the same sign and none of them seem to be statistically significant.

	(1)	(2)	(3)
Links	0.165 (0.130)		
Reinforce		0.134 (0.188)	
Trade			1.540 (1.374)
constant	3.117** (0.873)	3.362*** (0.819)	3.741*** (0.876)
pseudo $R^2$	0.129	0.121	0.122
$N$	74	74	74
<i>controls</i>	yes	yes	yes
Standard errors in parentheses(clustered)			
* $p < 0.1$ , ** $p < 0.05$ , *** $p < 0.01$			

Table VII: Dependent variable: Conformity. Table includes 3 different models, each includes one of the main explanatory variables: Number of links, Number of reinforcing links and number of trade links, respectively. Tables with control variables are available in table XV in appendix B.

## 4.2 Age of a treaty and goal fulfillment

Given that the time from the start of the agreement is expected to be positively correlated with the fulfillment of treaty goals, I account for the starting year of every treaty. I include the years as a factor variable, where each value accounts for a decade (1= Treaty started before or within the 1960s, 2= Treaty started in the 1970s, 3= Treaty started in the 1980s, 4= Treaty started in the 1990s). Results show that the year variable does not have a significant association with goal fulfillment, however, the number of reinforcing

links is not statistically significant as shown in the main results in table IV.

	(1)	(2)	(3)
year_1970	0.248 (0.189)	0.205 (0.190)	0.292 (0.201)
year_1980	0.134 (0.180)	0.149 (0.186)	0.179 (0.191)
year_1990	0.142 (0.193)	0.150 (0.197)	0.185 (0.202)
Links	0.0104 (0.00899)		
Reinforce		0.0159* (0.00879)	
Trade			-0.0415 (0.102)
constant	0.0184 (0.456)	0.117 (0.464)	0.113 (0.401)
$R^2$	0.578	0.579	0.572
$N$	76	81	76
<i>controls</i>	yes	yes	yes
Standard errors in parentheses (clustered)			
* $p < 0.1$ , ** $p < 0.05$ , *** $p < 0.01$			

Table VIII: Dependent variable: Goal Fulfillment. Table includes 3 different models, each includes one of the main explanatory variables: Number of links, Number of reinforcing links and a dummy for trade link, respectively. Tables with control variables are available in table XVII in appendix B.

## 5 Conclusion

Compliance with international law is usually explained by the argument that states are rational actors that comply with the law because its terms are in their interest and when they are not, their noncompliance is expected (Goldsmith and Posner, 2005). This argument, however, over-simplifies state behavior and their incentives and is further weakened when considering voluntary treaties that address public goods where the incentives for free riding is high. IEAs are characterized with high incentives to free ride for 2 main

reasons. First, they address public goods, meaning that that compliance of one state does not guarantee that it will reap the benefits, and non-compliance does not directly mean that the country will suffer. Second, the “return on compliance” is at best probable and delayed; high costs in the present compared to potential benefits in the future.

The aim of this paper is to look into linkages in IEAs, and whether such a treaty design characteristic may incentivize better compliance with treaty terms. The paper asks whether treaty linkages are associated with better compliance and I introduce two hypotheses. Hypothesis 1a. that treaty linkage is positively associated with better compliance and hypothesis 1b. that in specific linkage with trade agreements is positively associated with better compliance in IEAs.

Results have shown that while the total number of links does not seem to be significantly associated with the goal fulfillment of a treaty, when accounting only for links that are considered to be reinforcing we observe that the number of reinforcing links is positively associated with goal fulfillment, this result holds even when adjusting the number of reinforcing links. However, the results do not show any significant association between the behavior conformity and the number of links nor the number of reinforcing links, this lack of result persists across different robustness checks. This means that with regards to one aspect of compliance, linkages are in fact positively associated with better compliance, which is in line with Hypothesis 1a presented in the paper. However, counter to what is theoretically expected, the presence of link with a trade agreement does not have a significant effect, which counters Hypothesis 1b that claims that trade linkages are positively associated with better compliance

The analysis presented in this paper suffers from some limitations. First, the number of observations is limited, which limits the generalizability of the results. Additionally, there is potential endogeneity as is common with most of international agreements; in that countries self select in the agreement and thus they agree to the linkage. Given these two caveats, the results presented in this paper and implications are limited to this data set and should be regarded with caution. Nevertheless, it is a starting point in addressing

the question of the effects of linkages on compliance empirically.

# Appendix

## A Additional information on Variables

### A.1 Questions in the IRD protocol

#### A.1.1 Regime Interactions with other institutions

213A Identify other regimes with which this regime interacts. Indicate whether the interaction is mutually reinforcing or conflicting.

Sub-question # 1: Identify other regimes with which this regime interacts.

Sub-question # 2: For each regime listed under *REGIME\_INTERACTION*, indicate whether the interaction is mutually reinforcing or conflicting.

1 = Interaction is reinforcing

2 = Interaction is conflicting

3 = Interaction is reinforcing and conflicting

4 = Don't know

#### A.1.2 Dependant variable: Goal Fulfillment

303F Taken together, did the behavioral changes lead to the fulfillment of the stated and/or unstated goals of the regime? What causal impact did the regime have in producing these changes?

If the regime has stated goals, indicate whether the behavioral changes led to the fulfillment of the stated goals of the regime. Provide codes for each stated goal mentioned under *STATED\_GOALS*.

0 = Not applicable (No goals)

1 = No (Goal not fulfilled)

2 = Yes (Goal fulfilled)

3 = Don't know

### **A.1.3 Dependent variable: Conformity**

303A Does the behavior of important actors generally conform with the provisions of the regime? Did the regime exert a causal influence on these developments?

1 = Behavior exceeds regime requirements: The actor conforms with the regime's rules almost all the time and even exceeds them to a degree that is considered significant or important by regime members

2 = Behavior meets regime requirements: The actor conforms with the regime's rules almost all the time but does not significantly exceed the regime requirements

3 = Behavior conforms with some requirements but not all: The actor only conforms with some of the regime rules.

4 = Behavior conforms some (but not all) of the time and/or to some degree but not completely: The actor conforms with the regime's rules most of the time but deviates occasionally in such a way that is considered significant or important by regime members and/or conforms only to some degree in a way that is considered significant or important by regime members.

5 = Behavior does not conform at all: The actor does not conform with the regime's rules to any significant or important degree.

6 = Don't know

## A.2 Measurement of control variables

Variables are aggregated over treaty and averaged over coder so the scale in some cases is different from that specified in the IRD protocol. For some variables the scale is reversed so that all variables are in the same direction. In the cases of where the coder chooses “Don’t know” the variable takes a missing value (NA). For more information on the variables refer to Breitmeier et al. (1996)

Variable (IRD code)	Question in IRD/Variable clarification
<b>Depth (RA15)</b>  Variable ranging from 1 to 5, where 1 is very shallow and 5 very deep.	205G Is the regime shallow or deep as measured by the density and specificity of its rules? <ul style="list-style-type: none"> <li>• 1 = Very shallow: Compared to the density of rules considered necessary for managing the problems in the issue area, the regime comprises only a very limited number of rules, and/or established rules are rather weak compared to the specificity of the rules considered necessary for managing the problems in the issue area</li> <li>• 2 = Shallow: Between 1 and 3 on the scale.</li> <li>• 3 = Medium: Compared to the density of rules considered necessary for managing the problems in the issue area, the regime comprises a sizable number of rules to manage the problem and/or established rules have developed some strength compared to the specificity of the rules considered necessary for managing the problems in the issue area.</li> <li>• 4 = Deep: Between 3 and 5 on the scale.</li> <li>• 5 = Very deep: Compared to the density of rules considered necessary for managing the problems in the issue area, the regime comprises a very comprehensive set of rules and/or established rules are rather strong compared to the specificity of the rules considered necessary for managing the problems in the issue area</li> <li>• 6 = Don’t know</li> </ul>
<b>Precise (RA12)</b>  Variable ranging from 1 to 5, where 1 is ambiguous and 5 is precise (scale provided in IRD is reversed).	205D Are the regime’s substantive rules generally precise and easy to interpret in the sense that they call for well-defined actions, or are they ambiguous and indeterminate? <ul style="list-style-type: none"> <li>• 1 = Precise and easy to interpret</li> <li>• 2 = Between 1 and 3 on the scale.</li> <li>• 3 = Medium</li> <li>• 4 = Between 3 and 5 on the scale.</li> <li>• 5 = Ambiguous and indeterminate</li> <li>• 6 = Don’t know</li> </ul>

<p><b>Scope (RA14)</b></p> <p>Variable ranging from 1 to 5, where 1 is very narrow and 5 is broad</p>	<p>205F Is the regime narrow or broad as measured by the functional scope of its rules?</p> <ul style="list-style-type: none"> <li>• 1 = Very narrow: The regime has a very limited functional scope compared to the specific issues considered necessary for inclusion in the regime and covers only a limited number of important issues. For instance, only a very small number of issues are regulated compared to a large number considered necessary for inclusion in the regime</li> <li>• 2 = Narrow: Between 1 and 3 on the scale.</li> <li>• 3 = Medium: The regime covers some important issues compared to the range of issues considered necessary for inclusion in the regime. For instance, several issues considered necessary for inclusion in the regime are regulated</li> <li>• 4 = Broad: Between 3 and 5 on the scale.</li> <li>• 5 = Very broad: The regime has a very comprehensive functional scope and covers all important issues considered necessary for inclusion in the regime</li> <li>• 6 = Don't know</li> </ul>
<p><b>Bind (RA11)</b></p> <p>Variable ranging from 0 to 1, where 0 indicates soft law/not legally binding and 1 indicates hard law/legally binding (scale is reversed and adjusted to range from 0 to 1 instead of 1 to 2)</p>	<p>205C Are the regime's substantive rules legally binding on the members, or do they have the character of soft law (e.g., ministerial declarations, codes of conduct)? For each rule listed under RULES, code whether it is legally binding on the members, or whether it has the character of soft law</p> <ul style="list-style-type: none"> <li>• 1 = Rule is legally binding.</li> <li>• 2 = Rule is soft law/not legally binding.</li> <li>• 3 = Don't know</li> </ul>



<p><b>Cost (RF13)</b></p> <p>Originally dummy variable, indicating the treaty is costly, 0 otherwise. Due to aggregation and averaging over coder it takes 3 values: 0 no costs, 0.5 costly according to one coder, 1 costly</p>	<p>101M What were the most important difficulties in implementing the proposed solutions? Treaties that are coded as 2 or 3 or 6 are considered costly.</p> <ul style="list-style-type: none"> <li>• 1 = Great interference in social life</li> <li>• <b>2 = High public sector costs</b></li> <li>• <b>3 = High private sector costs</b></li> <li>• 4 = Low domestic capacities</li> <li>• 5 = Resistance from negatively affected interest-groups</li> <li>• <b>6 = High political costs for single national governments</b></li> <li>• 7 = High public resistance in the mass media against proposed solutions</li> <li>• 8 = Resistance from government agencies and administrations</li> <li>• 9 = Proposed solutions contradicted with traditional domestic policies and or regulations</li> <li>• 10 = Less or no experience with implementation of proposed solutions</li> <li>• 11 = Don't know</li> </ul>
<p><b>Difficulty (RF12)</b></p> <p>Variable ranging from 1 to 5 (in 0.5), where 1 s very easy to implement and 5 very difficult (scale provided in IRD is reversed).</p>	<p>101L Did the proposed solutions appear to be difficult or easy to implement?</p> <ul style="list-style-type: none"> <li>• 1 = Very difficult</li> <li>• 2 = Difficult: Between 1 and 3 on the scale</li> <li>• 3 = Balanced: Some implementation problems were present, but were far less pronounced</li> <li>• 4 = Relatively easy: Between 3 and 5 on the scale</li> <li>• 5 = Easy: No implementation problems occurred</li> <li>• 6 = Don't know</li> </ul>

<p><b>Monitor (RA16)</b></p> <p>Dummy Variable taking the value of one when the treaty includes monitoring provisions</p>	<p>206A Does the regime explicitly call for the conduct of programmatic activities?</p> <ul style="list-style-type: none"> <li>• 1 = Scientific monitoring of causes and effects of the problem</li> <li>• 2 = Research about causes and effects of the problem</li> <li>• 3 = Expert advice</li> <li>• 4 = <b>Compliance monitoring</b></li> <li>• 5 = Review of implementation</li> <li>• 6 = Verification of compliance</li> <li>• 7 = Financial and technology transfer</li> <li>• 8 = Reviewing adequacy of commitments</li> <li>• 9 = Information management</li> <li>• 10 = If applicable, mention additional activities</li> <li>• 11 = Don't know</li> </ul>
<p><b>Sanctions enforced (RA47)</b></p> <p>Dummy Variable, where 1 means regime has sanctions and are enforced, 0 otherwise (in 0.5)</p> <p>The enforcement is based on Sub-question 2 (scale is reversed and adjusted so that 0 is not carried out and 1 is carried out). The variable used in analysis is a product of both</p>	<p>Sub-question # 1: What formal compliance mechanisms are provided for in the regime's constitutive provisions to achieve compliance?</p> <ul style="list-style-type: none"> <li>• 1 = No compliance mechanisms</li> <li>• 2 = Issuance of notices of violations</li> <li>• 3 = <b>Suspension of membership rights</b></li> <li>• 4 = <b>Exclusion from membership</b></li> <li>• 5 = <b>Imposition of military punishments</b></li> <li>• 6 = <b>Imposition of financial/economic punishments</b></li> <li>• 7 = Support for capacity building to enhance compliance</li> <li>• 8 = Granting of a transition period to achieve compliance</li> <li>• 9 = Dissolution of linkages</li> <li>• 10 = Identify additional compliance mechanisms, if applicable</li> <li>• 11 = Don't know</li> </ul> <p>Sub-question # 2: For each compliance mechanism listed under COMPLIANCE, indicate whether the compliance mechanism is carried out as formally provided</p> <ul style="list-style-type: none"> <li>• 1 = Compliance mechanism is carried out as formally provided for by the regime</li> <li>• 2 = Compliance mechanism is not carried out although formally provided for by the regime</li> </ul>

<p><b>Capacity building (RA47)</b></p> <p>Dummy Variable, where 1 means regime has capacity building mechanisms and are enforced, 0 otherwise (in 0.5)</p> <p>The enforcement is based on Sub-question 2 (scale is reversed and adjusted so that 0 is not carried out and 1 is carried out). The variable used in analysis is a product of both</p>	<p>Sub-question # 1: What formal compliance mechanisms are provided for in the regime's constitutive provisions to achieve compliance?</p> <ul style="list-style-type: none"> <li>• 1 = No compliance mechanisms</li> <li>• 2 = Issuance of notices of violations</li> <li>• 3 = Suspension of membership rights</li> <li>• 4 = Exclusion from membership</li> <li>• 5 = Imposition of military punishments</li> <li>• 6 = Imposition of financial/economic punishments</li> <li>• <b>7 = Support for capacity building to enhance compliance</b></li> <li>• 8 = Granting of a transition period to achieve compliance</li> <li>• 9 = Dissolution of linkages</li> <li>• 10 = Identify additional compliance mechanisms, if applicable</li> <li>• 11 = Don't know</li> </ul> <p>Sub-question # 2: For each compliance mechanism listed under COMPLIANCE, indicate whether the compliance mechanism is carried out as formally provided</p> <ul style="list-style-type: none"> <li>• 1 = Compliance mechanism is carried out as formally provided for by the regime</li> <li>• 2 = Compliance mechanism is not carried out although formally provided for by the regime</li> </ul>
<p><b>Public good (RF14)</b></p> <p>Dummy variable indicating that treaty addresses the provision of a collective/public good</p>	<p>101N Does the problem involve supplying a collective good, regulating the use of a common pool resource, managing a shared natural resource, or controlling transboundary externalities?</p> <ul style="list-style-type: none"> <li>• 1 = Collective (or public) good</li> <li>• 2 = Common pool resource</li> <li>• 3 = Shared natural resource</li> <li>• 4 = Common pool resource and shared natural resource</li> <li>• 5 = Transboundary externalities</li> <li>• 6 = Don't know</li> </ul>
<p><b>No. of parties</b></p> <p>Variable ranging from 2 parties to 176 parties per treaty</p>	<p>Data collected by authors from the <i>International Environment Agreements Database Projects</i> <a href="https://iea.uoregon.edu/">https://iea.uoregon.edu/</a></p>

Ratio of developed	Data collected by the authors based on
Variable ranging from 0 to 1, representing the ratio of developed countries per treaty, where 0 means no developed country is party to the treaty and 1 is all parties are considered developed countries	<ul style="list-style-type: none"> <li>Country membership and year of treaty from <a href="https://iea.uoregon.edu/">https://iea.uoregon.edu/</a></li> <li>Country classification provided by the world bank's <i>historical classification of income</i> from: <a href="https://datahelpdesk.worldbank.org/knowledgebase/articles/906519-world-bank-country-and-lending-groups">https://datahelpdesk.worldbank.org/knowledgebase/articles/906519-world-bank-country-and-lending-groups</a>. Year used for classifications are 1989 and 1998 depending on the treaty year.</li> </ul>

### A.3 Descriptive statistics

	count	mean	sd	min	max
Depth	92	2.98913	1.171967	1	5
Precise	86	3.925359	.7898784	2	5
Scope	91	3.428571	.9763066	1	5
Bind	87	.7719732	.3203482	0	1
Cost	94	.6276596	.3875493	0	1
Difficulty	89	3.580524	1.073781	1	5
Monitor	95	.5473684	.5003918	0	1
Sanctions	95	.0526316	.2244815	0	1
Capacity building	95	.2736842	.4482141	0	1
Public good	92	.423913	.4968847	0	1
No. of Parties	92	48.77174	51.92135	2	176
Ratio of developed	92	.5573526	.2659865	0	1

Table IX: Control Variables: Summary statistics

	Conformity	Goal fulfillment
Conformity	1.000	
Goal fulfillment	0.110 (0.341)	1.000

*p*-values in parentheses

<sup>c</sup>  $p < 0.10$ , <sup>b</sup>  $p < 0.05$ , <sup>a</sup>  $p < 0.01$

Table X: Pair-wise correlation between dependant variables

	Depth	Precise	Scope	Bind	Cost	Difficulty	Ratio	Public	No. of Parties
Depth	1.000								
Precise	0.405 <sup>a</sup> (0.000)	1.000							
Scope	0.236 <sup>b</sup> (0.024)	-0.188 <sup>c</sup> (0.084)	1.000						
Bind	0.089 (0.412)	0.315 <sup>a</sup> (0.003)	0.143 (0.185)	1.000					
Cost	0.139 (0.186)	-0.132 (0.225)	0.135 (0.202)	-0.047 (0.663)	1.000				
Difficulty	-0.202 <sup>c</sup> (0.058)	-0.394 <sup>a</sup> (0.000)	-0.093 (0.384)	-0.145 (0.187)	0.406 <sup>a</sup> (0.000)	1.000			
Ratio	0.130 (0.221)	0.043 (0.693)	-0.172 (0.106)	-0.104 (0.339)	0.210 <sup>b</sup> (0.044)	-0.229 <sup>b</sup> (0.033)	1.000		
Public	0.098 (0.363)	-0.295 <sup>a</sup> (0.006)	0.233 <sup>b</sup> (0.029)	0.048 (0.659)	0.376 <sup>a</sup> (0.000)	0.031 (0.780)	0.199 <sup>c</sup> (0.059)	1.000	
No. of Parties	-0.073 (0.494)	-0.112 (0.303)	0.332 <sup>a</sup> (0.001)	0.339 <sup>a</sup> (0.001)	-0.164 (0.119)	-0.090 (0.406)	-0.369 <sup>a</sup> (0.000)	-0.070 (0.511)	1.000

*p*-values in parentheses

<sup>c</sup>  $p < 0.10$ , <sup>b</sup>  $p < 0.05$ , <sup>a</sup>  $p < 0.01$

Table XI: Pair-wise correlation between control variables

	Public	Monitor	Sanction	Capacity building	Links	Links_dir	Reinforce	Conflict
Public	1.000							
Monitor	0.124 (0.240)	1.000						
Sanction	-0.206 <sup>b</sup> (0.049)	0.214 <sup>b</sup> (0.037)	1.000					
Capacity building	0.341 <sup>a</sup> (0.001)	0.131 (0.205)	0.067 (0.520)	1.000				
Links	0.403 <sup>a</sup> (0.000)	0.197 <sup>c</sup> (0.056)	-0.043 (0.680)	-0.013 (0.898)	1.000			
Links_dir	0.452 <sup>a</sup> (0.000)	0.108 (0.325)	-0.098 (0.373)	-0.107 (0.328)	0.897 <sup>a</sup> (0.000)	1.000		
Reinforce	0.427 <sup>a</sup> (0.000)	0.128 (0.218)	-0.076 (0.466)	-0.095 (0.361)	0.949 <sup>a</sup> (0.000)	0.978 <sup>a</sup> (0.000)	1.000	
Conflict	-0.274 <sup>b</sup> (0.012)	0.126 (0.250)	0.224 <sup>b</sup> (0.039)	0.034 (0.756)	0.068 (0.536)	-0.261 <sup>b</sup> (0.016)	-0.128 (0.242)	1.000

*p*-values in parentheses

<sup>c</sup>  $p < 0.10$ , <sup>b</sup>  $p < 0.05$ , <sup>a</sup>  $p < 0.01$

Table XII: Pair-wise correlation between explanatory variables and other relevant variables

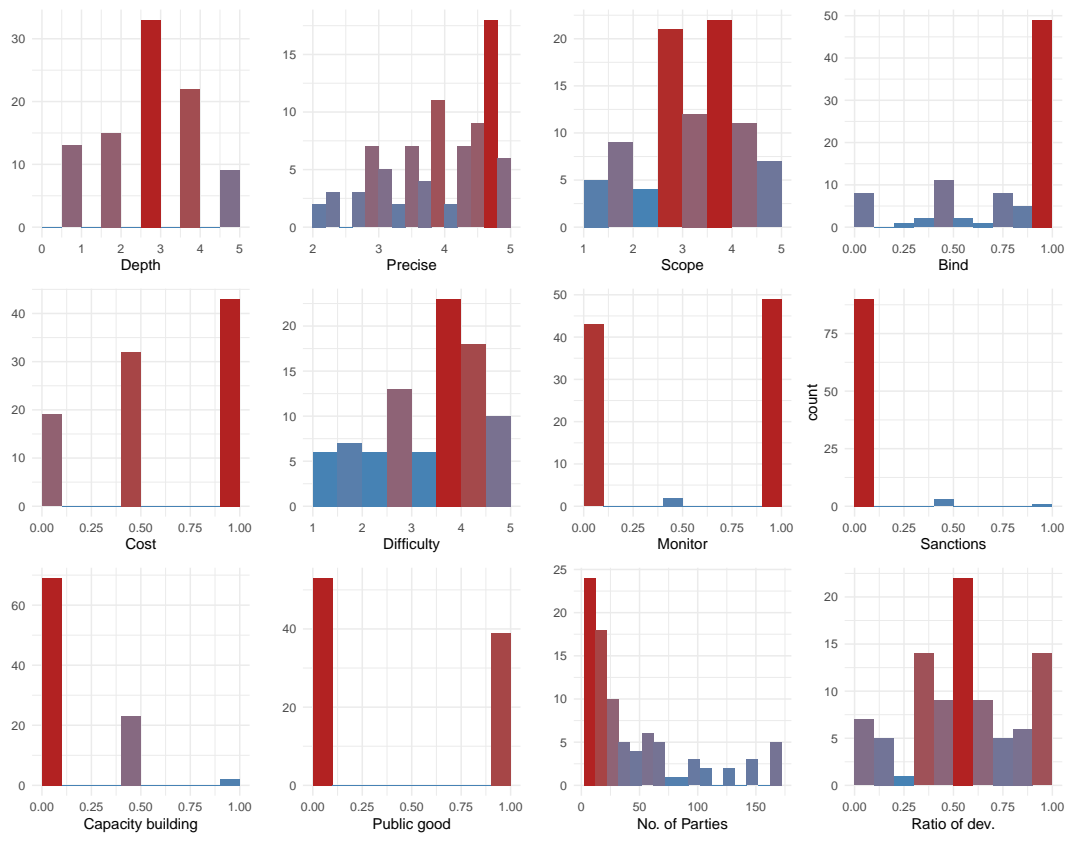


Figure 5: Histograms for control variables

## B Results and RC tables with all controls

	(1)	(2)	(3)
1.Depth	0 (.)	0 (.)	0 (.)
2.Depth	0.388* (0.162)	0.394* (0.167)	0.388* (0.148)
3.Depth	0.401* (0.161)	0.392* (0.168)	0.395* (0.154)
4.Depth	0.263 (0.193)	0.265 (0.197)	0.257 (0.189)
5.Depth	0.319 (0.198)	0.303 (0.207)	0.343 (0.190)
Scope	-0.0519 (0.0380)	-0.0631 (0.0378)	-0.0440 (0.0410)
Bind	-0.388* (0.144)	-0.411** (0.145)	-0.342* (0.133)
Precise	0.142 (0.0893)	0.158 (0.0898)	0.1000 (0.0742)
Cost	0.243 (0.140)	0.221 (0.135)	0.300* (0.134)
Difficulty	-0.115** (0.0401)	-0.112** (0.0372)	-0.126** (0.0410)
Monitor	-0.00915 (0.106)	-0.00169 (0.106)	-0.00467 (0.0941)
Sanction	0.326 (0.159)	0.351* (0.159)	0.330* (0.146)
Capacity Building	0.151 (0.0856)	0.175* (0.0820)	0.116 (0.0841)
Public	-0.0367 (0.0892)	-0.0541 (0.0906)	-0.00727 (0.0914)
Ratio	0.386 (0.235)	0.421 (0.242)	0.291 (0.217)
No. of Parties	-0.000151 (0.00119)	0.000340 (0.00123)	-0.000250 (0.00127)
Links	0.0167 (0.0106)		
Reinforce		0.0248* (0.0110)	
Trade			-0.0457 (0.111)
Constant	0.285 (0.495)	0.224 (0.495)	0.512 (0.414)
$R^2$	0.573	0.587	0.558
$N$	81	81	81

Standard errors in parentheses

\*  $p < 0.05$ , \*\*  $p < 0.01$ , \*\*\*  $p < 0.001$

Table XIII: OLS with clustered SEs: dependant variable is goal fulfillment. Table includes 3 different models, each includes one of the main explanatory variables: Number of links, Number of reinforcing links and a dummy for trade link, respectively.



	(1)	(2)	(3)
1.Depth2	0 (.)	0 (.)	0 (.)
2.Depth2	-0.00565 (0.612)	0.0184 (0.572)	0.00382 (0.589)
3.Depth2	0.113 (0.527)	0.0720 (0.546)	0.0738 (0.490)
4.Depth2	0.192 (0.488)	0.149 (0.504)	0.116 (0.480)
5.Depth2	0.0587 (0.659)	0.0418 (0.693)	0.0796 (0.605)
Scope	-0.0303 (0.166)	-0.0489 (0.157)	0.0252 (0.178)
Bind	0.288 (0.225)	0.319 (0.245)	0.564 (0.278)
Precise	0.00174 (0.154)	-0.0221 (0.163)	-0.121 (0.153)
Cost	-1.068** (0.372)	-1.011* (0.394)	-0.848* (0.355)
Difficulty	-0.0747 (0.0841)	-0.0966 (0.0846)	-0.119 (0.0715)
Monitor	-0.122 (0.217)	-0.0789 (0.211)	-0.0746 (0.201)
Sanction	-0.587 (0.412)	-0.560 (0.416)	-0.851* (0.383)
Capacity Building	0.296 (0.287)	0.306 (0.286)	0.200 (0.336)
Public	-0.258 (0.357)	-0.263 (0.370)	-0.181 (0.325)
Ratio	0.571 (0.379)	0.511 (0.365)	0.285 (0.417)
No. of Parties	-0.00191 (0.00270)	-0.00129 (0.00262)	-0.00552 (0.00460)
Links	0.0665 (0.0382)		
Reinforce		0.0591 (0.0541)	
Trade			0.399 (0.355)
Constant	3.117** (0.873)	3.362*** (0.819)	3.741*** (0.876)
$R^2$	0.347	0.327	0.303
$N$	74	74	74

Standard errors in parentheses

\*  $p < 0.05$ , \*\*  $p < 0.01$ , \*\*\*  $p < 0.001$

Table XIV: OLS with clustered SEs: dependant variable is behavior conformity. Table includes 3 different models, each includes one of the main explanatory variables: Number of links, Number of reinforcing links and a dummy for trade link, respectively.

	(1)	(2)	(3)
1.Depth	0 (.)	0 (.)	0 (.)
2.Depth	-0.234 (1.673)	-0.240 (1.855)	-0.0174 (1.624)
3.Depth	-0.293 (1.592)	-0.330 (1.767)	-0.0310 (1.385)
4.Depth	-0.192 (1.524)	-0.271 (1.647)	-0.163 (1.645)
5.Depth	-0.745 (2.051)	-0.720 (2.337)	-0.380 (1.811)
Scope	-0.0426 (0.547)	-0.0723 (0.546)	0.0688 (0.600)
Bind	0.767 (0.627)	0.816 (0.777)	1.442** (0.485)
Precise	0.122 (0.415)	0.0508 (0.453)	-0.141 (0.344)
Cost	-3.127* (1.450)	-2.912 (1.594)	-2.660 (1.526)
Difficulty	-0.263 (0.272)	-0.289 (0.281)	-0.359 (0.191)
Sanction	-1.723 (0.974)	-1.584 (0.951)	-2.351*** (0.672)
Capacity Building	0.621 (0.756)	0.602 (0.720)	0.431 (0.955)
Public	-0.665 (0.965)	-0.656 (0.963)	-0.506 (0.964)
Ratio	2.030 (1.089)	1.853 (1.035)	1.474 (1.258)
No. of Parties	-0.00419 (0.00844)	-0.00244 (0.00805)	-0.0158 (0.0168)
Links	0.165 (0.130)		
Reinforce		0.134 (0.188)	
Trade			1.540 (1.374)
cut1	-4.478 (2.441)	-4.964* (2.265)	-5.634** (2.043)
cut2	-4.235 (2.500)	-4.727* (2.344)	-5.400** (1.973)
cut3	-2.034 (2.361)	-2.563 (2.181)	-3.218 (1.857)
cut4	-1.103 (2.449)	-1.652 (2.290)	-2.276 (1.937)
cut5	0.739 (2.255)	0.174 (2.107)	-0.393 (2.128)
cut6	1.359 (2.205)	0.791 (2.048)	0.229 (2.255)
pseudo $R^2$	0.129	0.121	0.122
$N$	74	74	74

Standard errors in parentheses

\*  $p < 0.05$ , \*\*  $p < 0.01$ , \*\*\*  $p < 0.001$

Table XV: Ordered Logit: dependant variable is behavior conformity. Table includes 3 different models, each includes one of the main explanatory variables: Number of links, Number of reinforcing links and a dummy for trade link, respectively.

	(1) Goal	(2) Goal	(3) Conform	(4) Conform
1.Depth	0 (.)	0 (.)	0 (.)	0 (.)
2.Depth	0.281* (0.121)	0.270 (0.131)	0.00505 (0.587)	-0.00236 (0.592)
3.Depth	0.274* (0.124)	0.253 (0.133)	0.0895 (0.514)	0.110 (0.504)
4.Depth	0.132 (0.165)	0.134 (0.167)	0.146 (0.471)	0.110 (0.467)
5.Depth	0.178 (0.174)	0.149 (0.187)	0.106 (0.654)	0.178 (0.637)
Scope	-0.0451 (0.0418)	-0.0581 (0.0417)	-0.00565 (0.167)	0.0355 (0.157)
Bind	-0.384* (0.150)	-0.417* (0.153)	0.469 (0.266)	0.599* (0.279)
Precise	0.173 (0.0839)	0.189* (0.0836)	-0.120 (0.167)	-0.189 (0.167)
Cost	0.239 (0.176)	0.206 (0.166)	-0.862* (0.369)	-0.694 (0.344)
Difficulty	-0.111** (0.0363)	-0.107** (0.0337)	-0.113 (0.0768)	-0.125 (0.0762)
Monitor	0.00850 (0.104)	0.0116 (0.106)	-0.105 (0.215)	-0.103 (0.217)
Sanction	0.290 (0.171)	0.327 (0.171)	-0.653 (0.443)	-0.709 (0.448)
Capacity Building	0.128 (0.0873)	0.156 (0.0808)	0.190 (0.325)	0.113 (0.330)
Public	-0.0125 (0.0910)	-0.0277 (0.0931)	-0.184 (0.350)	-0.131 (0.330)
Ratio	0.376 (0.218)	0.403 (0.219)	0.322 (0.418)	0.157 (0.420)
No. of Parties	-0.000399 (0.00116)	0.000223 (0.00116)	-0.00308 (0.00333)	-0.00398 (0.00335)
Link_adj	0.0249 (0.0174)		0.0238 (0.0613)	
Reinforce_adj		0.0376 (0.0182)		-0.0426 (0.0578)
Constant	0.228 (0.449)	0.188 (0.443)	3.748*** (0.860)	4.034*** (0.846)
$R^2$	0.573	0.590	0.292	0.298
$N$	76	76	74	74

Standard errors in parentheses

\*  $p < 0.05$ , \*\*  $p < 0.01$ , \*\*\*  $p < 0.001$

Table XVI: OLS with clustered SEs: Using the adjusted number of links as explanatory variables. Dependent variable in column (1) and (2) is goal fulfillment. Dependent variable in column (3) and (4) is behavior Conformity. Table includes 4 different models with the adjusted number of links and adjusted number of reinforcing links as the main as explanatory variables. The first 2 columns show the results of using the explanatory variables on goal fulfillment and the 3<sup>rd</sup> and 4<sup>th</sup> show the results of using the explanatory variables on behavior conformity.

	(1)	(2)	(3)
1.Depth	0 (.)	0 (.)	0 (.)
2.Depth	0.265 (0.143)	0.403* (0.182)	0.265 (0.135)
3.Depth	0.323* (0.122)	0.442* (0.165)	0.322* (0.118)
4.Depth	0.222 (0.157)	0.356 (0.191)	0.224 (0.149)
5.Depth	0.212 (0.173)	0.347 (0.204)	0.224 (0.172)
Scope2	-0.0270 (0.0476)	-0.0502 (0.0467)	-0.0252 (0.0489)
Bind	-0.368* (0.161)	-0.383* (0.149)	-0.335* (0.154)
Precise	0.159 (0.0873)	0.131 (0.0842)	0.134 (0.0725)
Cost	0.260 (0.170)	0.251 (0.132)	0.311 (0.169)
Difficulty	-0.0919* (0.0343)	-0.101** (0.0351)	-0.0966* (0.0351)
Monitor	-0.0519 (0.126)	-0.0448 (0.123)	-0.0602 (0.116)
Sanction	0.422 (0.285)	0.472 (0.282)	0.442 (0.304)
Capacity Building	0.226 (0.123)	0.285* (0.124)	0.190 (0.124)
Public	0.00883 (0.0944)	-0.0119 (0.0905)	0.0221 (0.0968)
Ratio	0.334 (0.230)	0.332 (0.245)	0.275 (0.223)
No. of Parties	-0.000182 (0.00125)	0.0000856 (0.00133)	-0.000202 (0.00136)
year_1960	0 (.)	0 (.)	0 (.)
year_1970	0.248 (0.189)	0.205 (0.190)	0.292 (0.201)
year_1980	0.134 (0.180)	0.149 (0.186)	0.179 (0.191)
year_1990	0.142 (0.193)	0.150 (0.197)	0.185 (0.202)
Links	0.0104 (0.00899)		
Reinforce		0.0159 (0.00879)	
Trade			-0.0415 (0.102)
Constant	0.0184 (0.456)	0.117 (0.464)	0.113 (0.401)
$R^2$	0.578	0.579	0.572
$N$	76	81	76

Standard errors in parentheses

\*  $p < 0.05$ , \*\*  $p < 0.01$ , \*\*\*  $p < 0.001$

Table XVII: Dependent variable: Goal Fulfillment. Table includes 3 different models, each includes one of the main explanatory variables: Number of links, Number of reinforcing links and a dummy for trade link, respectively.

## C Same Issue interactions

Regime	Regimes addressing the same issue-area
Antarctic Regime	<ul style="list-style-type: none"> <li>• The United Nations Convention on the Law of the Sea (UNCLOS)</li> <li>• Conservation of Migratory Species (CMS)</li> <li>• The United Nations Environment Programme- Global Programme for Action (UNEP/GPA)</li> <li>• International Whaling Commission (IWC)</li> <li>• Straddling Fish Stocks Agreement</li> <li>• OPCR</li> <li>• London Convention</li> <li>• International Maritime Organization (IMO)</li> <li>• The International Convention for the Prevention of Pollution from Ships (MARPOL)</li> <li>• UNEP's Regional Seas Programme</li> <li>• The International Council for the Exploration of the Sea (ICES)</li> <li>• Convention on Biological Diversity (CBD)</li> </ul>
Baltic Sea Regime	<ul style="list-style-type: none"> <li>• The United Nations Convention on the Law of the Sea (UNCLOS)</li> <li>• HELCOM</li> <li>• The International Council for the Exploration of the Sea (ICES)</li> <li>• London convention</li> <li>• The United Nations Environment Programme- Global Programme for Action (UNEP/GPA)</li> <li>• OPRC</li> <li>• International Maritime Organization (IMO)</li> <li>• Global Environment Facility (GEF)</li> <li>• The United Nations Environment Programme-Regional Seas Programme</li> </ul>

Barents Sea Fisheries Regime	<ul style="list-style-type: none"> <li>• The United Nations Convention on the Law of the Sea (UNCLOS)</li> <li>• Food and Agriculture Organization (FAO)</li> <li>• UNFA</li> <li>• The International Council for the Exploration of the Sea (ICES)</li> <li>• The United Nations Environment Programme- Global Programme for Action (UNEP/GPA)</li> <li>• International Maritime Organization (IMO)</li> <li>• Straddling Fish Stocks Agreement</li> <li>• The United Nations Environment Programme- Regional Seas Programme</li> <li>• Baltic Sea Fisheries</li> </ul>
Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)	<ul style="list-style-type: none"> <li>• Conservation of Migratory Species (CMS)</li> <li>• The Agreement on the Conservation of African-Eurasian Migratory Waterbirds (AEWA)</li> <li>• Seals</li> <li>• International Whaling Commission (IWC)</li> <li>• Berne convention</li> </ul>
The Inter-American Tropical Tuna Commission (IATTC) Regime	<ul style="list-style-type: none"> <li>• Food and Agriculture Organization (FAO)</li> <li>• North East Atlantic Fisheries Commission (NEAFC)</li> <li>• The Convention for the Protection of the Marine Environment of the North-East Atlantic (OSPAR)</li> <li>• North Atlantic Marine Mammal Commission (NAMMCO)</li> <li>• The United Nations Convention on the Law of the Sea (UNCLOS)</li> <li>• Cartagena Convention</li> <li>• UNFA</li> </ul>

The International Commission for the Conservation of Atlantic Tunas (IC-CAT) Regime	<ul style="list-style-type: none"> <li>• Food and Agriculture Organization (FAO)</li> <li>• North East Atlantic Fisheries Commission (NEAFC)</li> <li>• The Convention for the Protection of the Marine Environment of the North-East Atlantic (OSPAR)</li> <li>• North Atlantic Marine Mammal Commission (NAMMCO)</li> <li>• The United Nations Convention on the Law of the Sea (UNCLOS)</li> <li>• Cartagena Convention</li> <li>• UNFA</li> </ul>
International Regulation of Whaling	<ul style="list-style-type: none"> <li>• Conservation of Migratory Species (CMS)</li> <li>• Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)</li> <li>• The United Nations Convention on the Law of the Sea (UNCLOS)</li> <li>• North Atlantic Marine Mammal Commission (NAMMCO)</li> </ul>
London Convention Regime	<ul style="list-style-type: none"> <li>• Basel Convention</li> <li>• The Convention for the Protection of the Marine Environment of the North-East Atlantic (OSPAR)</li> </ul>
North Sea Regime	<ul style="list-style-type: none"> <li>• UNFA</li> <li>• Food and Agriculture Organization (FAO)</li> <li>• Straddling Fish Stocks Agreement</li> <li>• The United Nations Environment Programme- Regional Seas Programme</li> <li>• International Maritime Organization (IMO)</li> <li>• The International Convention for the Prevention of Pollution from Ships (MARPOL)</li> </ul>

Protection of the Rhine Against Pollution	<ul style="list-style-type: none"> <li>• The United Nations Environment Programme- Global Programme for Action (UNEP/GPA)</li> <li>• The United Nations Environment Programme- Regional Seas Programme</li> <li>• ECE Convention on transboundary rivers and international lakes</li> <li>• International Commission for the Protection of Lake Constance against Pollution</li> <li>• International Commission for the Protection of the Moselle against Pollution</li> </ul>
Regime for Protection of the Black Sea	<ul style="list-style-type: none"> <li>• The United Nations Environment Programme UNEP/GPA</li> <li>• Regime for Protection of DNIEPER</li> <li>• The United Nations Environment Programme- Regional Seas Programme</li> <li>• Black Sea Environment Programme</li> <li>• Black Sea Protection Convention</li> </ul>
South Pacific Fisheries Forum Agency Regime	<ul style="list-style-type: none"> <li>• UNFA</li> <li>• Food and Agriculture Organization (FAO)</li> <li>• The United Nations Environment Programme- Regional Seas Programme</li> </ul>
Stratospheric Ozone Regime	<ul style="list-style-type: none"> <li>• United Nations Framework Convention on Climate Change (UNFCCC) <b>or</b> Climate Change Regime</li> <li>• Long Range Transboundary Air Pollution (LRTAP)</li> </ul>
Climate Change Regime	<ul style="list-style-type: none"> <li>• Ozone</li> </ul>
Danube River Protection	<ul style="list-style-type: none"> <li>• ECE Convention on transboundary rivers and international lakes</li> </ul>
Hazardous Waste Regime	<ul style="list-style-type: none"> <li>• London Convention</li> </ul>



Oil Pollution Regime	<ul style="list-style-type: none"> <li>• OPRC</li> </ul>
Tropical Timber Trade Regime	<ul style="list-style-type: none"> <li>• Food and Agriculture Organization (FAO)</li> </ul>
Long Range Transboundary Air Pollution (LRTAP)	was not linked to any
Convention on Biological Diversity (CBD)	has no same issue area

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